Nanostructured Surfaces Through Chemical Nanotechnology: Opportunities and Applications

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ABSTRACT

Fundamental to the development of nanoscience and nanotechnology is the availability of high-purity materials exhibiting specific properties, tailored shape and microstructure. Achieving chemical homogeneity down to the nanometer scale (lattice engineering) is an overarching task, which renders the conventional material processing methods rather imprecise. Although it is difficult to envisage a straightforward recipe but the chemical methods based on molecular precursors represent one of the viable alternatives for the targeted synthesis of nanomaterials with different compositions, morphology and micro-structures. Transformation of precursor compounds possessing bonding features inherent to the solid-state lowers the need of diffusion and counterbalances the thermodynamic impediments.

Thin film deposition by CVD and sol-gel techniques has played a dominant role in the development of both protective and functional coatings, important for their technological implications. Commonly, multi-component coating materials are prepared from a mixture of precursors; however the efficiency of such processes is hampered by the mis-match of chemical reactivity such as thermal stability; vapour pressure etc. among the precursor species. As a consequence, phase separation and elemental segregation is commonly observed in materials processed by conventional techniques. We have designed several new precursor systems and demonstrated their suitability for the deposition of functional coatings on metallic and non-metallic substrates at low temperatures.

This presentation will focus how chemically processed nanostructured surfaces open up new vistas of material properties, which can be transformed into advanced material technologies. It will also address the several steps involved in the transformation of laboratory scale research into nanotechnology-based products.

Synthesis and Characterization of $NaYF_4$: Yb, Er Nanoparticles with Efficient Up-Conversion Fluorescence Based on New Type Solar Cells

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ABSTRACT

An up-converting material, which can be efficiently excited by near infrared light and emit strong visible light through a process termed 'up-conversion fluorescence', has shown great potential for use in silicon thin films solar cells. This kind of material when placed on the rear side of p-i-n type silicon thin films solar cells will increase the overall efficiency of the PV device by utilizing sub-band gap photons that would otherwise be transmitted through the device. Sodium yttrium fluoride ($NaYF_4$) up-converting nanoparticles doped with lanthanide ions have been synthesized. Different lanthanide ions (Yb^{3+}, Er^{3+}) were doped into the nanoparticles, which showed strong up-conversion fluorescence under excitation at 980nm. Above reason comes from that intensity of the hexagonal nanocrystals in this work is much higher than that of other cubic-phase $NaYF_4$ nanocrystals. In addition, the nanoparticles showed a spherical shape with an average size of about 50nm.

Study of ZnO:V Thin Films Prepared by dc Reactive Magnetron Sputtering at Different Pressures

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ABSTRACT

Vanadium doped ZnO films with the doping concentration of 0.8% were deposited onto glass substrates at different sputtering pressures by direct current (DC) reactive magnetron sputtering using a zinc target doped with vanadium. The effect of the sputtering pressures ($5*10^{-3}$–$3*10^{-2}$ mbar) on the structural properties of the deposited films have been studied by X-ray diffraction (XRD), scanning electron microscopy (SEM) and Energy Dispersive Spectrometry (EDS). The results of XRD show that all the films have a wurtzite structure and grow mainly with the c-axis orientation. The residual stresses which have been estimated by fitting the XRD results decrease with increasing sputtering pressure. The optical properties of the films were studied by measuring the transmittance. The optical constants (refractive index and extinction coefficient) and the film thickness were obtained by fitting the transmittance. All the results are discussed in relation with the sputtering pressure and the doping of the vanadium.

Suppressing Intermetallic Compound Growth in SnAgCu Solder Joints with Addition of Carbon Nanotubes

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ABSTRACT

In the present study, multi-walled carbon nanotubes (CNTs) were incorporated into SnAgCu solder matrix, to form composite solders. Isothermal aging study was performed on solder joints, to investigate the formation and growth of the intermetallic compound (IMC) layer at the solder/metallization interface. Results revealed that after soldering, the initial interfacial IMC thickness of the unreinforced solder joint was comparable to that of the composite solder joints. However, after aging, the interfacial IMC layer of the unreinforced solder joint was observed to grow more significantly than that of the composite solder joints. Furthermore, the composite solder joints exhibited lower

diffusion coefficient and this indicated that the presence of CNTs was effective in retarding the growth of the IMC layer.

Effective Photoluminescence Modification of ZnO Nanocombs by Plasma Immersion Ion Implantation

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ABSTRACT

Surface defects passivation of ZnO nanocombs was performed through a Ti plasma immersion ion implantation (PIII) with low bias voltages ranging from 0-10 kV. The room temperature near-band-edge emission was enhanced for modified ZnO nanostructures while the defect-related green band was completely quenched. Detailed temperature dependence PL revealed that the deep-level emissions were surface related and it was the most affected recombination processes by PIII, whereas the surface exciton related emission was slowly quenched as the ion energy increased. Time-resolved PL shows that the lifetime of the UV emission has been enhanced whereas the long lifetime of visible emission of the untreated ZnO nanocombs has been largely shortened. Our work demonstrates that metal ion PIII can be an effective way for surface modification/passivation of ZnO nanostructures to improve the optical properties.

Facile Preparation Method of Nanocrystal CdS Hollow Spheres with Miniemulsion Droplets as Templates

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ABSTRACT

CdS hollow spheres with well-controlled morphology and uniform size were successfully prepared using a miniemulsion technique, in which miniemulsion droplets of isooctane prepared with dodecylmercaptane as a co-stabilizer were employed as templates. The -SH groups of dodecylmercaptane generated S- ions under alkaline conditions, and further adsorbed Cd^{2+} ions around the droplets. These Cd^{2+} ions then reacted with S^{2-} ions, stemming from $Na_2S \cdot 9H_2O$, to directly form CdS hollow spheres owing to the evaporation of isooctane during the reaction and/or the subsequent drying process. No additional dissolution, calcination or additional surface modification of the templates was needed. The size of the hollow spheres could be tuned by altering the molar ratio of the anionic and non-ionic surfactants, while their shell thickness could be adjusted by changing the amount of co-stabilizer.

Cohesive Energy and Surface Energy of Fcc Metallic Nanocrystals

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ABSTRACT

The model for the surface energy of fcc metallic nanoparticles is developed based on the model for size-dependent cohesive energy and surface bond deficit consideration for the nanoparticles. Firstly, through the study the surface/volume ratio and surface *CN* (coordinate number) of the Wulff structure, the cohesive energy of interior atoms is determined. It is found that as same as the cohesive energy for the whole particles, the cohesive energy of interior atoms also decrease with the decreasing size. Considering the weakness of the cohesive energy and the increase of the surface bonds defect, size dependent surface energy of fcc metallic nanoparticles is determined. It is found that the surface energy have reduction firstly and turn back to increase when the size approach to critical size of particles. The reduction of surface energy is mainly due to the decrease of cohesive energy. The following increase of surface energy is due to the decrease of surface CN. Our prediction for the surface energy is agreed with the simulation results for metallic nanoparticles.

Preparing Graphitic Nanoribbons from Ultrathin Electrospun Poly(methyl methacrylate) Nanofibers by Electron Beam Irradiation

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ABSTRACT

Using ultrathin electrospun poly(methyl methacrylate) (PMMA) nanofibers as precursor, graphitic nanoribbons could be prepared by electron beam irradiation. With the help of the high resolution transmission electron microscopy, the real time processing of the carbonization and graphitization of the PMMA nanofibers could be clearly seen. By precisely controlling the irradiation, the graphitic nanoribbons could be fine-tuned. The mechanism of the transformation from PMMA to graphitic nanoribbons was analyzed detailedly. This new way to obtain graphitic nanoribbons from ultrathin electrospun PMMA nanofibers has promising potential applications in graphitic carbon nanostructure electronics and devices. Meanwhile, this carbonization and graphitization explained how PMMA could be inverted into negative electron resist from positive resist by high dose electron beam lithography, which provides a way to obtain patterned graphitic nanostructures directly from PMMA.

Effects of $AlCl_3$ on Preparation of Mesocarbon Microbeads

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ABSTRACT

The preparation of mesocarbon microbeads (MCMB) had been carried out by heat-treating a medium coal tar pitch at 420°C for 2 hours in the presence of aluminum chloride($AlCl_3$). A larger number of MCMB with small diameter were obtained. The

isolated MCMB were observed by scanning electron microscope. The average diameters of the MCMB were measured by laser particle size analyzer. The PI(pyridine insoluble) yields were determined from the weight of the extracted residue. The effects of $AlCl_3$ on preparation of MCMB had been studied. It was found that $AlCl_3$ promotes the formation of MCMB in coal tar pitch. The sphere size and PI yield increase with increasing in the amount of $AlCl_3$, the size distribution becomes wide gradually at the same time. The amount of $AlCl_3$ from 3 to 5wt% appears optimum to give small MCMB, diameter below 8μm, with good spherical shape and smooth surface at PI yield over 40wt%.

Synthesis and Characterization of Transition Metal Ion Doping on the Photocatalytic Activity of TiO_2 Nanoparticles

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ABSTRACT

Transition metal ion (V, Fe, or Cu) doped TiO_2 nanoparticles were synthesized from titanium tetraisopropoxide (TTIP) in absolute ethanol by the modified sol-gel method. The precursor of the transition metal to be doped was added to an alcoholic solution containing TTIP. This solution was loaded into a pouch type cellophane membrane and placed in a clear solution containing 1:1 (v/v) ratio of absolute ethanol and distilled water with 0.55–1.0% concentrated ammonia solution for 1 h. After the completion of the dialysis process (1 h), the suspension was centrifuged (7500 rpm, 10 min), washed with milli-Q water and then dried in an oven at 60°C for 24 h. The powder was finally calcined in a furnace at a temperature of 400°C for 3 h. The use of cellophane membrane offered the advantage of a well-controlled diffusion rate. UV-Vis absorption studies confirmed that the spectral responses of metal ion doped TiO_2 were shifted to the visible light region. Phase composition, crystallinity, crystal size and morphology of V, Fe, and Cu doped TiO_2 nanopaticles were examined by X-ray diffraction (XRD) and transmission electron microscopy (TEM). The crystalline size of V, Fe, Cu doped TiO_2 nanopaticles was found to be in the range of 10-20 nm. The Brunauer, Emmett and Teller (BET) adsorption-desorption of nitrogen gas for specific surface area determination at the temperature of liquid nitrogen was performed on V-, Fe-, and Cu-doped TiO_2

nanoparticles. The photocatalytic activities of the various doped samples were evaluated by studying the mineralization of sucrose, phenol, oxalic acid, formic acid, methanol, and malonic acid under UVA, solar spectrum, and visible light irradiation. Under UVA and solar spectrum illumination, bare TiO_2 outperformed all doped TiO_2 photocatalysts in mineralizing the various organic compounds. Under visible light illumination, it was found that Fe-doped TiO_2 nanoparticles could significantly mineralize only oxalic acid. This indicates that the enhanced performance of the Fe-doped TiO_2 nanoparticles might not be due to the red shift of the semiconductor. It is likely due to the formation of the easily photolyzed ferrioxalate complex. Various factors such as particle size, crystallinity, and amount of transition metal ion dopant in TiO_2 were evaluated for the enhancement of the photocatalytic activity.

Keywords: Nanoparticles, Photocatalytic Activity, Synthesis, TiO, Transition Metal Ion.

Characterization of Self-Organized InAs/GaAs Quantum Dots Under Strain-Induced and Temperature-Controlled Nucleation Mechanisms by Atomic Force Microscopy and Photoluminescence Spectroscopy

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ABSTRACT

Atomic force microscopy and photoluminescence spectroscopy (PL) has been used to study asymmetric bilayer InAs quantum dot (QD) structures grow by molecular-beam epitaxy on GaAs (001) substrates. The two InAs layers were separated by a 7-nm-thick GaAs spacer layer and were grown at different substrate temperature. We took advantage of the intrinsic nonuniformity of the molecular beams to grow the seed layer with an average InAs coverage of 2.0 ML. Then the seed layer thickness could be divided into three areas: below, around and above the critical thickness of the 2D-3D transition along the [110] direction of the substrate. Correspondingly, the nucleation mechanisms of the upper InAs layer (UIL) could be also divided into three areas: temperature-controlled, competition between temperature-controlled and strain-induced, and strain-induced (template-controlled) nucleation. Small quantum dots (QDs) with a large density around 5 $\times 10^{10}$ cm^{-2} are found in the temperature-controlled nucleation area. The QD size

distributions undergo a bimodal to a unimodal transition with decreasing QD densities in the strain-induced nucleation area, where the QD densities vary following that of the seed layer (templating effect). The optimum QD density with the UIL thickness fixed at 2.4 ML is shown to be around 1.5×10^{10} cm^{-2}, for which the QD size distribution is unimodal and PL emission peaks at the longest wavelength. The QDs in the in-between area exhibit a broad size distribution with small QDs and strain-induced large QDs coexisting.

ZnO Nanoneedle Arrays Directly Grown on Bulk Nickel Substrate for Li Ion Battery Electrodes with Improved Performance

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ABSTRACT

In this paper, a low-temperature (T=70°C) solution-phase approach has been developed for the fabrication of vertically-aligned ZnO nanoneedle arrays directly on bulk nickel substrate. The synthetic process involving no seeds, no catalysts, and no surfactants can be readily scaled up. The as-grown ZnO arrays are further used for the first time as anode materials for Li-ion batteries operated in the voltage window 0.05–2.5 V. In the preparation of battery electrode, there is no need to transfer the obtained ZnO arrays to a different surface or align them; in addition, no conducting carbon and other additives such as binder are employed. These offer significant advantages with respect to the cost and practicability. Galvanostatic cycling experiments show that our ZnO nanoneedle arrays exhibit considerably improved performance (especially the cycling stability) as compared to the powder of disordered nanoneedles. A first discharge capacity of 1219 mAh/g and a reversible discharge capacity of ~495 mAh/g after 10 cycles are observed (current rate: 200 mA/g). In contrast, ZnO film consisting of random nanoneedles has a smaller first discharge capacity (1090 mAh/g) and its reversible capacity fades rapidly even from the second cycle. The electrochemical performance of ZnO nanoneedle arrays can be further tuned by heat treatment of ZnO active materials at Ar atmosphere, which enhances the adhesion of ZnO to nickel substrate. Our results, combined with the fact that ZnO are cheap, easily prepared, and environmentally compatible, make the ZnO nanoneedle arrays a promising anode material for Li-ion batteries.

Synthesis, Optical Properties and Functional Applications of ZnO Nano-Materials: A Review

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ABSTRACT

This review article summarizes briefly some important achievements of our recent research on the synthesis, optical properties and novel applications of nano-strucured ZnO such as nanorods and honeycomb shaped 3-D (dimension) nano random-walls. A chemical reaction/vapor transporatation deposition technique was employed to fabricate those structures on $ZnO/SiO_2/Si$ substrate without any catalyst and additive in a simple tube furnace to aim the low-cost and high qualified samples. Random laser action with strong coherent feedback at the wavelength between 375 nm-395 nm has been firstly observed under 355 nm optical excitation with threshold pumping intensity 0.38 MW/cm^2 in ZnO 3-D random-wall nanostructure.

Structural and Wetting Properties of Metal Polymer Nanocomposites

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ABSTRACT

Polystyrene thin films of thickness 180-200 nm are modified by plasma immersion ion implantation and deposition (PIII&D) technique together with titanium filtered cathodic vacuum arc. The surface structure of modified films turns into a metal polymer nanocomposite where Ti nanoclusters of spatial size 10-20 nm are embedded in polystyrene matrices. Such structural formation is the interplay between ion sputtering and ion diffusion effect. The wetting properties of this nanocomposite, such as contact angle aging effect and hysteresis are investigated. The changes in various properties are believed to be due to structure of polymer nanocomposites as well as the basic principles of ion polymer interaction.

Combinatorial Investigations of Co-LiF and Co-Li_3N Nanocomposite as New Lithium Storage Material

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ABSTRACT

Nanocomposite Co-LiF and Co-Li_3N thin films were successfully fabricated by pulsed laser deposition (PLD). They were investigated as anode materials of lithium ion batteries. Both of Co-LiF and Co-Li_3N thin films showed large reversible capacities. The electrochemical products were characterized by high resolution transmission electron microscopy (HRTEM) and selected area electron diffraction (SAED) measurements. Co-LiF and Co-Li_3N thin films exhibited different electrochemical reaction mechanism in discharge and charge processes. The results both provide direct evidences that reversible decomposition and formation of LiF and Li_3N could be driven by nanosized transition Co metal.

Nanostructure Control of Carbon Aerogels and the Application in Lithium Ion Cells

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ABSTRACT

Carbon aerogels are derived via a sol-gel process with resorcinol and formodehyde and subsequent pyrolysis of the precursor (RF) aerogels. Due to their high surface area, electrically conducting network and chemical inertness, carbon aerogels can be considered ideal electrodes in rechargeable batteries. In this paper the optimization of the preparation and structure controlling of carbon aerogels are studied. The influence of preparation conditions on the structural properties of carbon aerogels are investigated by scanning electron microscopy, nitrogen adsorption and X-ray diffraction measurements. Carbon electrodes are prepared using carbon aerogels powders and binder, with the carbon aerogel electrode as the anode and with lithium metal foil as the cathode, cells are made. Electrochemical measurements of the lithium intercalation properties for carbon aerogels are performed under high-purity argon in a glove box. The model cells show that the capacity for the first cycle and the rechargeable capacity are all very high, but the ratio of the rechargeable capacity to the total capacity (first cycle) is about 0.3 to 0.4.

Keywords: structure control; rechargeable batteries; Carbon electrodes; lithium intercalation properties.

Response Linearity and Time Drift of Polysilicon Nanofilm Resistance for Piezoresistive Effect

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ABSTRACT

Investigations on the piezoresistive effect of poly-silicon nanofilms (PSNFs) have not been presented, since it is considered that their piezoresistive properties can become worse with film thickness decreasing. However, our experimental results indicated that the PSNFs (~100 nm in thickness, even thinner) had a high gauge factor (>30) and low temperature coefficients of resistance and gauge factor, suited for sensing applications. In order to study the effect of preparation parameters on the response linearity and time drift of the PSNF resistance, PSNFs with different doping concentration were deposited by LPCVD to fabricate sensing resistances. The film microstructure was characterized by SEM, TEM and XRD. The film resistivity and resistance change rates under different loading strains were measured. Based on the modified trap model, a conclusion was drawn that the response linearity and time drift of resistances were strongly depended on the carrier occupation level of trap states at grain boundaries. The conclusions are significant to improve the accuracy and reliability of piezoresistive sensors.

Keywords : Polysilicon nanofilm, piezoresistive effect, response linearity, time drift, trap model.

Fabrication of Various Thickness of Flame-Made Nano Zinc Oxide Thick Film and Its Response to Ethanol

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ABSTRACT

ZnO nanoparticles were synthesized by flame spray pyrolysis (FSP) using zinc naphthenate as a precursor dissolved in toluene/acetonitrile (80/20 vol%). The particle properties were analyzed by XRD, BET, and HR-TEM. The sensing films were produced by mixing the particles into an organic paste composed of terpineol and ethyl cellulose as the vehicle binder and were fabricated by doctor-blade technique with various thicknesses (5, 10, 15 µm). The morphology of the sensing films was analyzed by SEM analysis. The gas sensing characteristics to ethanol (25-250 ppm) were evaluated as a function of film thickness at 400°C in dry air. The relationship between thickness and ethanol sensing characteristics of ZnO thick film on Al_2O_3 substrate interdigitated with Au electrodes were investigated. The effects of film thickness, as well as the cracking phenomenon, though, many cracks were observed for thicker sensing films. Cracks increased with increasing film thickness because large grains or crack gaps caused the decreasing in the surface area, connectivity of films and deteriorating film properties of the electronic materials. The sensing characteristics with various thicknesses were compared, showing the tendency of the sensitivity to ethanol decreased with increasing a film thickness and a response time. The relationship between gas sensing properties and film thickness was discussed on the basis of diffusively and reactivity of the gases inside the oxide films. The sensing film of 5 μm thick showed the highest sensitivity and the fastest response time (within seconds).

Keywords: Flame spray pyrolysis; ZnO; Film thickness; Ethanol sensor.

Tunable Synthesis, Dispersion and Physical Characterization of Nanoparticle-Based Organic Resists for Inkjet Printing

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ABSTRACT

We demonstrate the preparation of photoresistbased colorant inks with nanoparticle pigments by chemical route and its influence of pigment particle size in nanometer on chromaticity and light transmittance of printed organic films on color filters. The synthesized photoresist-based ultraviolet curable inks with pigments in nanosize exhibit better physical characteristics of jetting, wetting, and curing, and can be used significantly to fabricate color filters with organic films by inkjet printing process. The light transmittance of the prepared organic films on color filters prominently increases with decreasing particle size of pigments, while the magnitude in range of color gamut of color filters increases within optimum nanoscale pigments in particle size. This verifies that size effect of nanoparticle pigment in colorant ink is remarkable on chromatic and optical characterization of printed organic films.

Self-Organized Pattern Formation by Ion Beam Erosion

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ABSTRACT

The dot and ripple surface topography emerging on Si, Ge and compound semiconductor surfaces during low-energy (≤2000 eV) noble gas ion beam erosion at oblique ion incidence is studied. The results show that there is a much more complex behavior of the surface topography with ion energy, ion fluence, angle of incidence, etc.

Monodisperse Nanocrystals of $LnVO_4$ (Ln = Ce, Nd): Controlled Synthesis and Upconverted Avalanche Luminescence

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ABSTRACT

$LnVO_4$ (Ln = Ce and Nd) nanocrystals (NCs) with square-plate, H-shaped, and rod-like morphologies have been synthesized in nanosized reverse micelle reactors, via a facile solvo/hydrothermal strategy. We have also identified a unique upconverted avalanche luminescence property pertaining to the NCs, and undertaken a systematic mechanistic study.

Fabrication and Characterization of n-ZnO Nanorod/p-$CuAlO_2$ Heterojunction

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ABSTRACT

n-ZnO nanorod/p-$CuAlO_2$ heterojunction diodes have been fabricated on p^+-Si (100) substrates. The p-$CuAlO_2$ thin films were deposited on Si substrates by DC-sputtering method and then n-ZnO nanorods were grown by vapor phase transport (VPT) system on the $CuAlO_2$ layer. The well aligned ZnO nanorods show single wurtzite hexagonal structure. Current-voltage characterization of the heterojunction exhibits rectifying diode behavior with a turn-on voltage of about 4.5 V. Electroluminescence emission, involving a weak near-band-edge emission of ZnO at 380 nm and a strong deep-level emission at 550 nm were observed at room temperature from the diode under forward bias.

Cooperative Energy Transfer in $Gd_2(MoO_4)_3$: Tb, Yb Nanophosphors

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ABSTRACT

In this paper, we report an efficient cooperative energy transfer in $Gd_2(MoO_4)_3$:Tb^{3+},Yb^{3+} nanophosphors. Powder samples of $Gd_2(MoO_4)_3$:Tb^{3+},Yb^{3+} were prepared by means of combustion synthesis. The products were analyzed by means of X-ray diffraction, scanning electron microscopy and fluorescence spectrometer. The dependence of Yb^{3+} concentration on the visible- and NIR-emission, decay lifetime and quantum efficiency from the $Gd_2(MoO_4)_3$:Tb^{3+},Yb^{3+} phosphors have been investigated. The optimal quantum efficiency has been found to be 185%. Our results show that in principle an efficiency luminescent converter that, in an ideal case, converts visible photons into two or more NIR photons.

A First-Principles Study on Edge Doping of Armchair Graphene Nanoribbon

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ABSTRACT

We present our *ab initio* calculations on the edgedoping effects of graphene nanoribbon (GNR) with hydrogen passivated armchair edges. Boron [Nitrogen] atoms are introduced to the GNR by substituting carbon atoms at the edges. Initial introduction of boron [nitrogen] atom decreases [increases] the Fermi level of the armchair GNR (AGNR), creating a *p*-type [*n*-type] semiconductor. Higher concentration of boron [nitrogen] atoms further decreases [increases] the Fermi level. Based on these observation, a *p-i-n* AGNR heterstructure is simulated and the transmission coefficient and current-voltage characteristic are also calculated.

New Microwave Concepts Based on Carbon Nano Tubes

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ABSTRACT

The paper discusses microwave-device concepts based on carbon nanotubes. First, the physical properties of the carbon nanotubes are briefly described. Then, field emission devices, quantum electronic devices, microwave passive and active devices all based on carbon nanotubes are in detail described and their performance evaluated.

Compositional Characterization of Nano-Materials and Thin Films with Secondary Ion Massspectrometry

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ABSTRACT

Characterizations of nanomaterials and nano-process are essential studies in order to establish fabrication processes of the nanomaterials and to optimize their conditions. The structural and compositional characterization is considered to be a first step for this kind of study. Secondary ion massspectrometry (SIMS) is one of the useful methods to analyze the composition, particularly trace elements. Advantages and disadvantages of SIMS analytical technique are discussed, comparing with other methods. Nano-particles patterning process is explained, using zinc oxide nano-particles. Its evaluation is carried out by means of a static SIMS, as example. Finally, the recent development of the novel Nano-SIMS is briefly mentioned, and then its application is reported, concerning with the grain boundary analysis of ceramics consisted with fine grains.

Interaction Between Fluorene-Based Polymers and Carbon Nanotubes/Carbon Nanotube Field-Effect Transistors

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ABSTRACT

We study the interaction between fluorene-based conjugating polymers and various chiralities of single-walled carbon nanotubes (SWNTs). The fluorene-based polymers are able to selectively wrap the SWNTs with certain chiral angles or diameters (1.02~1.06 nm)

depending on their chemical structures. This can be used to selectively extract or enrich certain species of nanotubes. For example, high purity of (7, 5) SWNTs (~79% of the semiconducting ensemble) can be obtained by fluorine-polymer assisted extraction from the narrowdiameter distributed SWNTs produced by the catalyst Co-MCM-41. In addition, we also study the interaction between fluorene-based polymers and SWNT networked field-effect transistors (SNFETs) by location- selective photo-excitation, where we find that the photocurrent generated in SNFETs is controlled by the energy-level alignment at the polymerelectrode interface and the SWNT-polymer interface is suggested to contribute to the dissociation of photo-generated excitons.

Surface Resistance of Carbon Nanotube/Inorganic Binder/Silver Composite Film

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ABSTRACT

This paper discussed the surface resistance of carbon nanotube (CNT)/inorganic binder/silver composites film. The used CNT were multiwalled CNT with diameter of 20 nm-40 nm and 5–15 μm in length. We used two inorganic binders: sodium metasilicate and tetraethyl orthosilicate (TEOS) and two silvers: nanosilver in powder and solutions. The CNT were separated and dispersed in inorganic binder with different blend ratios. Then, ethyl cellulose as thicker was added to adjust an appropriate viscosity for screen-printing. The different thickness of composite films were fabricated on glass fabric via screen-printing process. The impact factors on the surface resistance and morphology of conductive film were discussed. The surface resistance of conductive film declined as nano Ag powder or nano Ag solution ratio increased. The more nano Ag and CNT were, the stronger probability was the electron transmission and as a result to descend the surface resistance. The surface of conductive film appeared a concave-convex outlook which didn't impact on the measurement of surface resistance. CNT played the most important role for descending the surface resistance of conductive film.

Keywords: Surface resistance, carbon nanotube, inorganic binder, nanosilver, sodium metasilicate, tetraethyl orthosilicate.

Effect of Chemical Oxidation on the Gas Sensing Properties of Multi-Walled Carbon Nanotubes

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ABSTRACT

The effect of chemical oxidation on the gas sensing properties of multi-walled carbon nanotubes (MWNT) is presented in this paper. The MWNT was chemically oxidized in a mixture of concentrated sulfuric and nitric acids. The oxidation time was varied from 4 to 12 hours. X-ray photoelectron spectroscopy (XPS) was used to study effect on the chemical composition of the nanotube surface. The MWNT was deposited onto gas sensor substrate by drop coating method. The gas sensing properties of samples with different oxidation time for NO_2 and NH_3 were investigated at room temperature. Comparing with the as-obtained MWNT, the gas sensitivity of functionalized MWNT was greatly increased for both NO_2 and NH_3.

The Spectral Converter for Polysilicon Solar Cell

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ABSTRACT

Polysilicon solar cell is an economical energy source. There were a lot of studies on the improvement of the polysilicon solar cell by the electro-physics methods. Theoretically the maximal efficacy of solar energy transition on polysilicon is 24-25% while existing solar cell just 10-18%. So sola cell with the area of 1 M^2 will generate about 100-180 wt of power.

Efficiency and the practical power in the range are different, the main reasons are:
— The surface of silicon slice has high reflection coefficient.
— The surface will be damaged during the chemical process.
— The impurity of silicon affects the carriers removing during the formation of electricity from light.
— The maximal value of solar spectrum (λ = 470 nm) is different from the solar cell's max. (λ = 980-1040 nm).

On the basis of experimental data, we got the best working curve, in which the maximal

wavelength is 750 nm~850 nm. Photons in this zone hold have the power of 1.1~1.8 eV just the same as the power held by electron-hole formed on the surface of silicon. And the power of the electron-hole is 1.1+0.3 eV. A spectrum converter could switch the sun's rays to the wavelength corresponding to the power of electron-hole. A spectrum converter consists of thermoplastic or thermoses polymer layer (EVA, PBMA, silicone polymers) containing plentiful of phosphors. The surfaces of silicon slice and silicate glass can be contact closely when phosphor is used as the filler layers. The spectrum converter can not only improve solar cell voltage by 10-15%, but also expand the current by 8-12% as well. The efficiency of solar cell will increase by 18-12%.

In this paper, different structures of spectrum converters and their dependence on the components of phorphors are investigated.

Though polysilicon is not highly pure, it is cost-effective as compared with silicon. Thus, this study is worthful to be carried out.

Characterisation of Titanium Dioxide-Single Walled Carbon Nanotubes Composite Fibres Prepared by the Wet Spinning Technique

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ABSTRACT

Carbon nanotubes (CNTs) have been extensively interested due to their unique mechanical and electrical properties. Owning to their outstanding electronic, thermal, structural properties, chemical stability, low density, high mechanical strength, large surface area, high modulus and high conductivity, CNTs are desired for a broad range of applications in many fields such as energy storage, molecular electronics, nanoprobes, sensors, composite materials and templates. To enhance the performance of titanium dioxide (TiO_2) nanotubes for future applications, single-walled carbon nanotubes (SWNTs) were chosen for making the composite material with TiO_2. In this work, a simple, rapid and effective wet spinning methodology has been conducted and successfully

applied to fabricate the TiO_2 composites fibres. The TiO_2 nanorods were dispersed with SWNTs using biopolymer as a dispersant. By employing the wet spinning technique and choosing an appropriate coagulant, the stable suspension of TiO_2 and TiO_2 composite were directly injected into the coagulation bath to produce fibres. These fibres were characterized using atomic force microscopy (AFM), scanning electron microscopy (SEM), conductivity measurement, and Raman spectroscopy. Moreover, the AFM results indicated the samples characteristics according to SWNTs at various concentrations in TiO_2 suspension. This study also suggested that different concentration of SWNTs affected the RMS roughness value. The Raman spectra showed peaks which corresponded to their characteristic peaks of TiO_2 and SWNTs. The SEM results revealed that the bundles of SWNTs connecting with 2 points of the TiO_2 surface was clearly seen whereas some aggregations obtaining from either TiO_2 or a dispersant were found. The compounds were identified mainly by comparing their Raman spectra with those of bare TiO_2 and SWNTs. In addition, the combination between CNTs and TiO_2 has been studied to improve the properties of these composite fibres. The mechanical and electrical properties along with surface morphology and electrochemistry of the resulting fibres were also investigated. The presence of SWNTs clearly improved the electrical properties of the composite fibres compared to bare TiO_2. The application of the TiO_2/SWNTs composites will be further investigated.

Keywords: Single-walled carbon nanotubes, titanium dioxide, wet spinning, fibre, coagulant, composite.

CVD Synthesis and Hydrogen Storage Properties of Multi-Walled Carbon Nanotubes

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ABSTRACT

Multi-wall carbon nanotubes (MWNTs) had been synthesized by catalytic chemical vapor deposition of acetylene over Fe loaded mesoporous silica. The as-grown MWNTs were purified by a two-step purification procedure involving acid washing and oxidation in diluted air, and characterized using powder X-ray diffraction (XRD), transmission electron microscopy (TEM), scanning electron microscopy (SEM), thermo gravimetric analysis (TGA), and BET surface area measurements. Hydrogen adsorption measurements were carried out on as-prepared and purified MWNTs under moderate pressure (10 MPa) at 30°C using the manually-controlled apparatus for high-pressure adsorption with sufficient

accuracy, and the results had been discussed. Pressure drop of hydrogen was measured and the amount it adsorbed was calculated by using ideal gas law and it was presented in weight percent, wt%. The hydrogen storage capacity of MWNTs was found to increase remarkably after subjecting to purification treatment. The maximum hydrogen storage capacity of 1.9 wt% was obtained for purified MWNTs. The as-grown MWNTs had closed ends. The hydrogen molecules could be physically adsorbed on the external nanotube walls. However, sample which was subjected to purification treatment, which could open their ends effectively, increased hydrogen sorption capacity, as hydrogen could have entered nanotubes through their ends. Purification treatment resulted in an increase in the number of sites with high interaction potentials for hydrogen adsorption, and these sites could be considered to be the inside of tubes or the interstitial space between the tubes.

Improvement of Electrical Property in MWCNTs/PEDOT-PSS Nanocomposite Films via Microwave Treatment

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ABSTRACT

This work investigated an efficient, cost-effective, and mild method for modifying MWCNTs without adding modifier via microwave irradiation in a short time by focusing on the preparation and electrical properties of MWCNTs/PEDOT-PSS nanocomposite films. The MWCNTs samples were found to contain a significant proportion of higher graphitized structure compared to before microwave exposure. PEDOT-PSS nanocomposite films with pristine and microwave treated MWCNTs were fabricated using tape casting technique. The electrical conductivity of pristine and microwave treated MWCNTs/PEDOT-PSS nanocomposite films was enhanced with the increment of MWCNTs loading. It was also observed that the electrical conductivity of microwave treated MWCNTs composites was higher than one of pristine MWCNTs composites. Additionally, using PEDOT-PSS as a host material good dispersion of microwave treated MWCNTs could be achieved enhancing the conductivity with relatively low loadings (<5 wt%). Additions of MWCNTs at ~1 wt% were considered to be suitable for electrical conductivity, and cost considerations.

Experimental Study of a Novel Aligned Carbon Nanotubes Gas Sensor

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ABSTRACT

A novel aligned Carbon Nanotubes (CNTs) gas sensor based on gas discharge has been achieved. The sensor was composed of aluminum cathode electrode, insulated film and CNTs anode electrode. Due to adopting the method of anodic aluminum oxide (AAO) template to grow aligned CNTs, the electrode and CNTs were integrated, so the gas sensor simplified its structure and processing technics. As different gases have their unique breakdown voltage and discharge current, it is possible to identify one gas or certain mixture gases. Experimental results showed that the CNTs gas sensor proposed in this paper had the merits of small size, fast response, good sensitivity and selective, and it was very easy and convenience to be operated at normal temperature and atmosphere pressure, so it had the practical value.

Room-Temperature Growth and Characterization of Iron-Carbon Nanocomposite Fibers

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ABSTRACT

Graphite plates were Ar^+ ion-sputtered with a simultaneous Fe supply at room temperature. The sputtered surfaces were characterized by various kinds of carbon compostites, such as conical protrusions with and without single carbon nanocomposite fibers (CNCFs) on the top, depending on the Fe supply rates. The CNCFs thus grown were confirmed to be amorphous-like fibers without a hollow structure and possess no distinct boundary between the cone and the CNCF by transmission electron microscope.

As revealed by their compositional analysis, CNCFs surely composed of carbon and iron. Since the various kind of metals can be doped into the room-temperature grown carbon nanofibers, this ion-irradiation method is believed to be promising as a new approach to synthesize one-dimensional nanomaterials at low temperatures.

Luminescence from Inorganic Phosphor and Quantum Dot Composite Excited by Blue Light of In-Ga-N Chip

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ABSTRACT

Enhancing the efficiency of In-Ga-N light emitting diode (LED) is a stringent issue to technology research. In our previous work [1,2,3] it had been pointed out that when the heterojunction current of In-Ga-N LED is 350mA, its luminous flux will be 450-500lm and luminous efficiency will reach 80lm. In this paper a new construction of heterojunction is adopted on the chip using SiC substrate. Its luminous flux reaches 600lm while the luminous efficiency is 105-130lm/w and the color temperature is 6500K.

An interesting experimental result is described in this paper. When the exciting blue light with the wavelength of 480nm from In-Ga-N light radiation blazes $(YGdCe)_3Al_5O_{12}$ grains with the weight of 4mg and the diameter of 1.5mm on a screen, white light come into existence and its relative luminance is 7216. If the screen is added with CdS-CdSe quantum dots which are finely divided particles, of which the quantity is half of that of phosphor, the relative luminance is 9569, increasing by 32-48%. If big grains of $(YGdCe)_3(Al,B)_5O_{12}$ phosphor with the diameter of 3.5mm is adopted, the relative luminance reaches 7485 from 4635, which means that the luminance is increased by 62%. In the two experiments described above, emission spectral shaping has changed by 1-2nm. The luminous intensity of blue exciting light of quantum dots is a little lower, about 1000.

If phosphor grains contact with quantum dots directly, the photoluminescence intensity will increase. The explanation on it is still under progress but such a phenomena will be useful to the development of advanced LED with no doubt.

Molecular Self-Assembly for Molecular Electronics

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ABSTRACT

Creation of well-ordered functional nanostructure (nanocluster or molecule) arrays is one of the key issues in the development for future molecular- or nano-electronic devices, solid-state quantum computation, single-electron devices, and biosensors. One promising approach is the selective coupling of nanoclusters or molecules to the wellordered preferential adsorption sites on pre-patterned surface nanotemplates. Here we report the self-assembly of metal nanoclusters and molecules on a particular interesting surface nanotemplate of SiC nanomesh, which arises from self-organization of excess carbon atoms forming a novel honeycomb arrangement with unit cells with diameter of about 2 nm atop the 6H-SiC(0001) surface after annealing at 1100°C [1]. The nanomesh can be dynamically structured to control the periodicity and depth of the pores by annealing in vacuum. This nanomesh is demonstrated to be an effective template for the formation of well-ordered molecular arrays of copper(II) phthalocyanine (CuPc). The growth of C_{60} on the nanomesh follows a typical Stranski-Krastanov mode, and a complete C_{60} wetting monolayer can be epitaxially grown on this nanotemplate [2]. It is effective in isolating metal nanoclusters, resulting in the formation of monodispersed Co nanoclusters with a narrow size distribution [3-5]. The adsorption and desorption of Co nanoclusters and C_{60} do not change its atomic structure, making it a chemically and thermally stable nanotemplate for the formation of well-ordered nanostructures arrays as well as monodispersed metal nanoclusters. An alternative is the self-organization of binary or multicomponent molecular system into the well-ordered and coverage dependent supramolecular superstructures or the self-intermixed monolayer phases through a subtle interplay between intermolecular, intramolecular and interfacial (molecule-substrate) interactions. Here we demonstrate the formation of various well-ordered C_{60} superstructures with tunable periodicity and symmetry, including C_{60} dot arrays, C_{60}-rail arrays and C_{60}-pair arrays on α-sexithiophene (6T) bilayer on Ag(111), single-chain and double-chain C_{60} arrays on 6T monolayer on Ag(111), "Zigzag" C_{60} arrays on 6T monolayer on HOPG, C_{60} supergrating and square-nanomesh on p-sexiphenyl (6P) bilayer on Ag(111) (cf. Fig. 1) [6,7]. It is found that that the formation of the tunable C_{60} molecular arrays arises from the delicate balance between the homointermolecular (C_{60}-C_{60} and 6T-6T or 6P-6P, van-der-Waals forces), hetero-intermolecular (C_{60}-6T or C_{60}-6P, charge transfer) and molecule-substrate [C_{60}-Ag(111) and 6TAg(111), 6T-HOPG or 6P-Ag(111)] interfacial interactions under different experimental conditions, which can be simply adjusted by choosing appropriate C_{60} and 6T or 6P coverages and post annealing temperature. Our results suggest that controlling the intermixed phases of binary or multicomponent molecular systems

represents a simple and effective method for the construction of highly ordered functional molecular nanostructure arrays, and offers a versatile route towards the fabrication of novel molecular interconnects and devices. In particular, it could be a possible nanofabrication route towards a fullerene-based quantum computer.

References

[1] Chen W, Xu H, Liu L, Gao XY, Qi DC, Peng GW, Tan SC, Feng YP, Loh KP, Wee ATS, "Atomic structure of the 6H-SiC(0001) nanomesh", *Surf. Sci*. 596 (1-3) pp.176-186, Dec 2005.

[2] Chen W, Zhang HL, Xu H, Tok ES, Loh KP, Wee ATS, "C-60 on SiC nanomesh", *J. Phys. Chem*. B 110 (43) pp. 21873-21881, Nov 2006.

[3] Chen W, Xu H, Loh KP, Wee ATS, "Structure of Co deposited 6HSiC(0001)", Surf. Sci. 595 (1-3): pp. 107-114, Dec 2005.

[4] Chen W, Loh KP, Xu H, Wee ATS, "Growth of monodispersed cobalt nanoparticles on 6H-SiC(0001) honeycomb template", *Appl. Phys. Lett*. 84 (2) pp. 281-283, Jan 2004.

[5] Chen W, Loh KP, Xu H, Wee ATS, "Nanoparticle dispersion on reconstructed carbon nanomeshes", *Langmuir* 20 (25) pp.10779- 10784, Dec 2004.

[6] Zhang HL, Chen W, Chen L, Huang H, Wang XS, Yuhara J, Wee ATS, "C60 molecular wire arrays on a-sexithiophene nanostripes", *Small*, to appear.

[7] Chen L, Chen W, Huang H, Zhang HL, Yuhara J, Wee ATS, "Tunable C60 molecular chain arrays", *Adv. Mat*., to appear.

Integration of Individual Nanoscale Structures into Devices

Using Dynamic Nanostenciling

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ABSTRACT

We succeeded in integrating individual, pre-existing nanostructures into functional devices using ultrahigh vacuum dynamic nanostenciling. Nanostructures are first located via atomic force microscopy (AFM), while device elements are added step by step, with

an achieved positional accuracy of 20 nm. Electronic transport, potentiometry, and scanning Kelvin probe can be used for control at any fabrication stage.

Quantum Dot Sensitized Solar Cells

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ABSTRACT

Metal sulfide (CdS or PbS) quantum dots were synthesized in nanoporous TiO_2 films for applications in solar energy conversion devices. Several electrolytes were investigated for the functioning redox activity in sandwich type regenerative solar cells, based on the quantum dots sensitized TiO_2 film. A high IPCE was attained by optimizing the polysulfide electrolyte composition. The CdS QD shows a higher IPCE, compared to PbS, related to an increased light harvesting efficiency when the number and size of the QDs intensified. In contrast, QD size dependence on the IPCE was observed for the PbS, likely resulting from the conduction band edge potential shift (associated with quantum size effect) relative to the TiO_2 conduction band edge, or the kinetic competition between the hot electron injection and the electron relaxation in the PbS conduction band. We also propose that an I_3^-/I^- redox electrolyte, with NaSCN addition, can be employed to enhance the solar cell performance. SCN ions may attach to the QD surface forming a shell type structure to prevent the photocorrosion reaction, and act as an intermediate electronic state to induce the sequential step electron transfer reactions for the QD re-reduction.

Bioactivable Water-Soluble Inorganic Nanoparticles: From Protein Targeting to Nanostructured Self-Assemblies

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ABSTRACT

The ability for nanoparticles to label, target and penetrate the cell membranes is of great interest in studying single receptor tracking, vesicle trafficking, visualizing lipid or protein in-plan reorganization within the membrane, understanding the fusion process. In addition the adsorption of nanoparticles at fluid-fluid interface can be used for the fabrication of hierarchical self-assemblies. In these perspectives the ligand-stabilized semiconductor quantum dots (QDs), which are extensively developed as biolabels, appear very attractive. Therefore we investigate the interaction between functionalized water-soluble QDs and vesicles as a model fluid membrane by taking advantage of the optical properties and the versatility of the peptide chemical grafting of (CdSe/ZnS) QDs (A. Dif, E. Henry, F. Artzner, M. Baudy-Floc'h, M. Dahan, V. Marchi-Artzner, *submitted*). We presented here two different strategies to prepare water-soluble pegylated and bioactivable QDs. In addition magnetic pegylated water-soluble quantum dots were prepared by co-encapsulation of the CdSe/ZnS and magnetic iron oxide nanocristals into gallate amphiphile micelles (F. Boulmedais *et al*, langmuir *2006 22(23), 9797–9803*, V. Roullier, F. Boulmeais, F. Grasset, O. Cador, V. Marchi-Artzner, *submitted*)

Nanoelectronics: Effect of Temperature on Drain-Source Current in DNA-Single-Electron Transistor

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ABSTRACT

Quantum mechanical tunneling makes it possible that individual molecules can perform functions identical to those of the key components of existing microcircuits. Modern technology of silicon-integrated circuits can undoubtedly double the computing speed every 18 to 24 months according to Moor's prediction but current lithographic technologies used in microelectronics are approaching to their extreme limits to further shrink the size of integrated circuits. Bioelectronics is one of the areas of interest which overlaps with biotechnology and includes DNA-Electronics and cellular computing. Electronic circuit components using Single Molecules have been proposed back in 1974. DNA-Single Electron Transistor (DNA-SET) has already been proposed and realized. In this paper we further solve the theoretical implementation of DNA-Single Electron Transistor using tunneling properties of P-bonds (as tunneling junctions in coulomb blockade regime), in sugar-Phosphate back bone of single strand DNA(ssDNA) molecule and graphically present the effect of temperature on Drain-Source current 'I' at different Gate voltages 'Vg'. The simulation of DNA-SET model is done in 'C' language.

Controlling Molecular Assembly at Surfaces

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ABSTRACT

The adsorption and self-assembly of organic molecules at surfaces has recently been investigated extensively, both because of the fundamental interest and for prospective applications in nanoelectronics [1,2]. Molecule—molecule and molecule—substrate interactions can be tuned by appropriate choice of substrate material and symmetry. Upon molecular adsorption, surfaces typically do not behave as static templates, but often rearrange to accommodate different molecular species [3,4]. We describe recent experiments using Scanning Tunneling Microscopy, providing new insight into fundamental properties such as molecular diffusion [5,6] and self—assembly via surface templating [7,8], H-bonding driven by co-adsorption [9-11] and the transition from 2D Molecular Networks to 3D crystals [10, 12]. Our approach is to modify surfaces providing suitable surface cues, that may guide the assembly of adsorbates [13] and more complicated building blocks like living cells on biomaterials [14]. We jokingly call this approach 'Playing Tetris at the Nanoscale' [15].

References

[1] F. Rosei *et al.*, *Prog. Surf. Science 71,* 95 (2003).
[2] R. Otero, F. Rosei, F. Besenbacher, *Annu. Rev. Phys. Chem.* 57, 497–525 (2006).
[3] F. Rosei *et al.*, *Science 296,* 328 (2002).
[4] R. Otero, F. Rosei, *et al.*, *Nanoletters 4,* 75 (2004).
[5] M. Schunack, T.R. Linderoth, F. Rosei, *et al., Phys. Rev. Lett. 88,* 156102 (2002).
[6] J. Miwa, S. Weigelt, H. Gersen, F. Besenbacher, F. Rosei, T.R. Linderoth, *J. Am. Chem.* Soc.
128, 3164–3165 (2006).
[7] R. Otero, Y. Naitoh, F. Rosei *et al., Angew. Chem. 43,* 4092 (2004).
[8] F. Cicoira, J. A. Miwa, M. Melucci, G. Barbarella, F. Rosei, *Small*, 2, 1366–1371 (2006).
[9] K.G. Nath, O. Ivasenko, J. Miwa, H. Dang, J. Wuest, A. Nanci, D.F. Perepichka, F. Rosei, *J. Am. Chem. Soc. 128,* 4212 (2006).
[10] K.G. Nath, O. Ivasenko, J.M. MacLeod, J. Miwa, J. Wuest, A. Nanci, D.F. Perepichka, F. Rosei, *J. Phys. Chem.* C in press (2007).
[11] J.M. MacLeod, O. Ivasenko, D.F. Perepichka, F. Rosei, *Nanotechnology 18,* 424031 (2007).
[12] H. Dang, T. Maris, J.H. Yi, F. Rosei, A. Nanci, J.D. Wuest, *Langmuir* in press (2007).
[13] F. Cicoira, J.A. Miwa, D.F. Perepichka, F. Rosei, *J. Phys. Chem.* A in press (2007).

[14] J.-H. Yi, C. Bernard, F. Variola, S.F. Zalzal, J.D. Wuest, F. Rosei, A. Nanci, *Surf. Sci. 600,* 4613–4621 (2006).
[15] F. Cicoira, F. Rosei, *Surface Science 600,* 1 (2006).

Impact of Casimir Force in Molecular Electronic Switching Junctions

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ABSTRACT

Despite significant progress in synthesizing several new molecules and many promising single device demonstrations, wide range acceptance of molecular electronics as an alternative to CMOS technology has been stalled not only by controversial theories of a molecular device's operation, for example the switching mechanism, but also by our inability to reproducibly fabricate large arrays of devices. In this paper, we investigate the role of Casimir force as one of the potential source of a wide range of discrepancies in the reported electrical characteristics and high rate of device shorting in molecular electronic switching junctions fabricated by sandwiching a molecular monolayer between a pair of planar metal electrodes.

A Scaffold of Biological Molecules to Manufacture Monodisperse Silica Nanotubes [Invited]

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ABSTRACT

Nature is an unlimited source of inspiration for the development of materials presenting original mechanical or optical properties. The current structural knowledge of some of these biological assemblies is promising as an inspiration source to try to mimics their

supramolecular organizations. The development of simplified system presenting properties close to biological assemblies is of great interest. To this end, there is still a long way in order to understand not only the structures, but also their formation mechanisms.

Lanreotide molecules self-assemble in water into highly monodisperse supramolecular nanotubes, the diameter and wall thickness of which are 244Å and 18Å respectively. [1] Following biomineralization principles, we show that the self-assembled nanotubes can be used as a template to produce micron-long, bilayered silica nanotubes having a monodisperse diameter of 29 nm. The nanotubes organize spontaneously into centimeter-size, highly ordered bundles. Furthermore, the formation mechanism was elucidated using a range of techniques, including X ray diffraction, optical and electron microscopy [2].

References:

[1] *Biomimetic organization : octapeptide self assembly into nanotubes of viral capsid like dimension C.* Valéry, M. Paternostre, B.Robert, T. Gulik-Krzywicki, T. Narayanan, J.-C. Dedieu, G. Keller, M.-L. Torres, R. Cherif-Cheikh, P. Calvo & F. Artzner Proc. Natl. Acad. Sci. USA, 2003,100(18), 10258–10262.

[2] *Hierarchical architectures by synergy between dynamical template self-assembly and biomineralization,* E. Pouget, E. Dujardin, A. Cavalier, A. Moreac, C. Valéry, V. Marchi-Artzner, T. Weiss, A. Renault, M. Paternostre, F. Artzner Nature Materials, 2007, 6, 434–439.

Molecular Controlled Semiconductor Devices

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ABSTRACT

Two-dimensional arrangements of molecules can show remarkable cooperative electronic effects. Such effects can serve to couple molecular properties with semiconductor devices and to achieve direct electronic sensing of chemical and physical processes via electrostatic effects, i.e., without transfer of charge or matter between the locus of sensing and that of detection.

Electrical Switching Effect in AgTCNQ Charge Transfer Complex by Spin-coating with Ag Nanoparticles

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ABSTRACT

In this work, the AgTCNQ (TCNQ = 7, 7, 8, 8-tetracyanoquinodimethane) thin-film was prepared by spin-coating with mixture solution Ag nanoparticles and TCNQ, and characterized by infrared spectral and the electronic absorption spectral analysis, and then the AgTCNQ thin-film layer was sandwiched in a Al/AgTCNQ/Al crossbar structure array as organic bistable devices (OBD). The current-voltage characteristics show that the devices switches from the initial high impedance (OFF) state to low impedance (ON) state upon application of external electric field at room temperature. This reversible and reproducible memory switching phenomenon is caused by intermolecular charge transfer (CT) in the AgTCNQ thin-film. The positive threshold voltage from high impedance state to low impedance was about 4.1 V with the reverse phenomenon at a negative voltage of -4.5 V. The crossbar array of OBDs with AgTCNQ by spin-coating is promising for low cost applications of nonvolatile organic memory.

GeO_2/Organically Modified Silane Sol-Gel Hybrid Organic-Inorganic Films for Photonic Applications

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ABSTRACT

GeO_2/organically modified silane organic-inorganic hybrid films were prepared by a low temperature sol-gel spin coating process for optical photonic applications. Effects of the germanium content and heat treatment temperature on the optical and structural properties of the hybrid waveguide films were characterized by prism coupling technique, atomic force microscopy, UV-visible spectroscopy, and Fourier-transform infrared spectroscopy. The results indicate that a crack-free, dense, and high transparency in the visible range optical waveguide film with a thickness of more than 2 μm could be easily obtained by a single spin-coating process and a low heat treatment temperature. Furthermore, neodymium ions and azobenzene small molecular groups-doped GeO_2/organically modified silane hybrid films were also studied for up-conversion and optical switch applications. Luminescence and photoresponsive properties were observed from the doped hybrid films. These indicate that the as-prepared hybrid materials are promising candidates for integrated optics and photonic applications.

ZnO Nanorod Heterojunctions and LEDs

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ABSTRACT

Zinc oxide (ZnO) nanorods are of great interest due to their potential use in optoelectronic devices. Hydrothermal synthesis and electrodeposition are two very promising techniques for ZnO growth as they are simple and inexpensive and also involve low fabrication temperature, favoring the use of large area and/or flexible substrates. In this work, we investigated the influence of the seed layer on the morphology and optical properties of ZnO nanorods, as well as the influence of post-fabrication treatments, such as annealing under different conditions. To further demonstrate the potential use of ZnO nanorods in optoelectronic devices, light emitting diodes (LEDs) were also studied in this paper. We have focused on heterojunction devices with ZnO as an n-type layer, since heterojunction ZnO LEDs typically exhibit better performance compared to homojunctions. We have investigated devices using GaN and NiO as a p-type material, and in addition hybrid organic/inorganic devices were also prepared.

Photoluminescence and Raman Spectroscopy of Single Diamond Nanoparticle

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ABSTRACT

The paper reports the techniques that we have devised for immobilizing and allocating a single nanodiamond on the electron beam (E-beam) patterned smart substrate. The properly designed coordination markers on the semiconductor substrate and the high throughput of the confocal microscope provide us with a convenient tool to single out a nanodiamond with a size less than 100 nm and to study its optical properties on a single nanostructure basis. We have observed a broad PL emission centered at about 700 nm from a single nanodiamond which is due to the defects, vacancies in the nanodiamonds or the disordered carbon layer covered on the nanodiamond surface. We also observe red-shift in energy and asymmetrical broadening in linewidth of the sp^3 bonding Raman peak when the size of the single nanodiamond is decreased.

Dynamic Tuning of Slow Light Transmission in Manual Nanostructure Photonic Crystal Waveguide

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ABSTRACT

Dynamical and external tuning of the slow light transmission by thermo-optic effect in two-dimensional photonic crystal waveguide has been investigated. The changes of the temperature can modulate the cutoff or turn on of the guided mode in PBG. In additionally, the group velocity at identical wavelength of the guided mode can be tuned at the same time. It can be used to modulate the speed and turn on or off of the guided mode.

A Microstructure Fibre Doped with Nano-Material Particles

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ABSTRACT

The core property of optical devices is its high nonlinearity, which will play an important role in the future optical communications. The advent of nano-technology, have paved a way for researchers to invent a novel optical fibre by combining the technologies of optical fibre and nano-technologies. In this paper, we present a manufactural method of this novel optical fibre. In addition, we conduct the propagation constant simulation of this fibre using Femlab. An average effective refractive index $n_{eff} \approx 1.400$ is obtained. This result is a step-stone bridge for future research of nonlinear parameter on this novel optical fibre.

Optical Gain of Segregated GaInNAs/GaAs Quantum Wells at Emission Wavelength of 1.3 Micron

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ABSTRACT

The band structure and optical gain spectra of indium segregated $Ga_{0.628}In_{0.372}N_{0.015}As_{0.985}/GaAs$ single quantum well (QW) have been studied theoretically using 10-band k·p Hamiltonian. The optical gains of the TE and TM modes are calculated by employing the many-body optical gain model. The subbands and the optical gains of the GaInNAs/GaAs QW have been investigated for various segregation coefficients. It is found that the indium segregation tends to reduce the subband coupling. When the segregation coefficient R is smaller than 0.75, the gain maximum of the TE mode decreases as a function of R, however, it turns to increase when R is larger than 0.75. On the other hand, the gain maximum of the TM mode shows a monolithic increase with the increase of R. For R < 0.6, the effects of indium segregation on the optical gain of both the TE and TM modes are minor. These results may be useful when designing GaInNAs/GaAs QW based lasers.

Phosphor Polymer Layers to Facilitate Plant Growth

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ABSTRACT

Nowadays, accelerating plants photosynthesis is a stringenct issue to agriculture. Photosynthesis's chemical reaction is $6H_2O+6CO_2 \rightarrow C_6H_{12}O_6+6O_2\uparrow$, which needs 8 photons. The minimun energe of each photon is between 1.75 eV and 1.9 eV, and the maximun energe is between 2.8 eV and 2.9 eV. When the temperature falls, especially in autumn and winter, the photosynthesis will decline badlly.

We have been experimenting at Russia, China, South Korea, Mexico, and the other countrys in the last 10 years to accelerate the growth of plants in closed system like greenhouses to increase the plants' output. Special polymer layers(60-120 μm) which contains Lu_2O_2S Eu or $(Ba,Mg)_3Si_2O_8$ Eu abio-phosphor are coated on greenhouses. Lu_2O_2S Eu phosphor emits ultraiviolet rays with the wavelengh of 365-405 nm, which occupies about 8% of solar radiations. The other phosphor, which emits lights with the wavelengh of 470 nm, 530 nm and 650 nm, has 2 or 3 maximum values of emanation spectra. The outputs of crops, such as cumumber, watermelon, eggplant, strawberry, cherry and grape, growing in those greenhouse can increase by 30%-80%. Meanwhile, the maturity is 1.5-3 weeks shorter, and crops' vitamin content is much higher than the one from regular greenhouse.

The new generation of agriculture mulitlayer-film adopts phosphor, of which the diametre is 500 mm. It not only reduces the concentration of phosphor, but also enhances the intensity of light per unit area in the blue and orange areas. It is very important to Chinese Agriculture to facilitate plants growth to increase the output by exposing to radiations of phosphor.

Simulation of Electrically Pumped Nanophotonic Lasers Using Dynamical Semiconductor Medium FDTD Method

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ABSTRACT

We report successful simulation of several different types of current injection nanophotonic lasers showing the spatial-temporal evolution of the electromagnetic field using our dynamical semiconductor medium (DSM) FDTD model. The model's capability in dealing with complex electromagnetic structures and semiconductor carrier dynamics is illustrated.

Magnetic Properties and Photoluminescence of Undoped and Transition Metal Doped AlN Nanorods

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ABSTRACT

The undoped and transition metal (TM) -doped AlN (AlN:Cu and AlN:Fe) nanorods on silicon substrates were fabricated using a catalysis-free vapor phase method. All the nanorods exhibited high crystalline quality and preferred c-axis orientation. Room-temperature photoluminescence (PL) measurement revealed that undoped AlN nanorods exhibited strong oxygen-related impurity emission at ~3.25 eV. However, AlN:Fe nanorods had two strong ultraviolet emissions at 3.69 and 6.02 eV which could be attributed to Fe^{3+} -related and band-edge emission, respectively. Both the Cu and Fe-doped AlN nanorods are ferromagnetic. The spontaneous saturated magnetization of the AlN:Cu and AlN:Fe nanorods were determined to be 0.38 and 3.5 emu/cm^3 at room temperature, respectively. The Fe-doped AlN nanorods not only exhibited ferromagnetism but also significantly enhanced the band-edge emission as compared to the undoped AlN nanorods.

Magnetically Tunable Two-Dimensional Photonic Crystal by Self-Assembling in Magnetite Magnetic Fluid

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ABSTRACT

Under applied magnetic field, phase separation happens in the magnetic fluid and then periodic structures are formed. These periodic structures are actually photonic crystal and made of magnetic materials. The magnetic-field-sensitive property of the constitute materials provides the possibility of tunability for the band gap of the photonic crystal. The model of the two-dimensional photonic crystal is established according to the experimental experience about the structure formation in the magnetite magnetic fluid in the literature. The standard plane-wave expansion method is employed to calculate the band structures of the photonic crystal. Simulation results indicate that the forbidden bands only exist in the case of TE waves (electrical field is along the length of the columns) under relatively high magnetic fields and no forbidden bands happen for low magnetic fields. For the TM waves (magnetic field is along the length of the columns), no forbidden bands are resulted in the whole range of the magnetic fields. Moreover, the mid frequencies of the band gaps of the TE waves shift to lower values at higher magnetic fields. While the widths of the band gaps increase with the magnetic fields. The theoretical results presented in this work propose a different way and system for fabricating tunable two-dimensional photonic crystal. Nonetheless, further experiments are required to optimize the correlative parameters of the tunable photonic crystal and confirm these conclusions. And then the involved tunable photonic devices may be exploited.

Improvement of Blue GaN-Based Light-Emitting Diodes with Nanosphere Layers

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ABSTRACT

GaN-based light-emitting diodes (LEDs) with nanosphere layers were fabricated by spin-coating method. It was found that the LEDs with and without nanosphere layers had the same electrical characteristics. With 20 mA current injection, the luminance

intensities of the LEDs with nanosphere layers of 300 nm and 500 nm diameters exceeded that of the LED without nanosphere layers by 5.72% and 9.05%, respectively. The improvement of the luminance intensity is attributed to the periodic structure of nanospher layers increasing the light extraction of photons.

Transmission Properties and Application of a Two-Ring One-Bus Building Block

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ABSTRACT

We propose and demonstrate a simple one-bus two-ring configuration where the two rings are mutually coupled that has advantages over the one-ring structure. Unlike a one cavity system, it can exhibit near critically-coupled transmission with a broader range of loss. It can also significantly enhance the cavity finesse by simply making the second ring twice the size of the bus-coupled one, with the enhancement proportional to the intensity buildup in the second ring. A ring structure with high finesse has many potential applications, one of which, in bistability switching, is discussed.

The Numerical Simulation of the Multi-Channel SNLCFBG

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ABSTRACT

According to the principle that multi-channel dispersion and dispersion slope in the optic communication system can be compensated simultaneity by using sampled NLCFBG (SNLCFBG), In the paper, we investigate the reflect spectrum and time delay of

SNLCFBG by means of the numerical simulation, and analyze the equivalence relation between two kinds SNLCFBG formula, and consider the second formula representation is advantageous. The counting method of multi-channel numbers about SNLCFBG's is proposed using the sampled rate of the NLCFBG, and versatile formula of counting multi-channel number is pre-calculated to out-of-band multi-channel number on the main petal and the first side petal, and which can been deduced the multi-channel number on any side petal about the SNLCFBG. The value region of chirped parameter c1 and c2 of SNLCFBG are analyzed, and it is realized that the sampled rate of the NLCFBG decided the multi-channel numebers. The peak of reflected spectrum of the SNLCFBG has relation with modulation degree. Also, we investigate the relation between the sampled rate and multi-channel equilibrium.

Study on Oxygen and Nitrogen Adsorption in Carbon Nanotube

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ABSTRACT

Single walled carbon nanotubes (SWCNT) as well as oxygen and nitrogen adsorption are studied by density function and discrete variational (DFT-DVM) method, one of the first principle calculation methods. Several models with difference lengths and calibers are studied to discuss the length and section of SWCNT that affects the properties. Different types of adsorption models are optimized based on the energy minimization. There are some strong ionic and covalent interactions among carbon atoms, and between carbon and nitrogen or oxygen atoms. As the length of the SWCNT increases, the charges of the middle and top (or bottom) carbon layers decrease. The larger the length and section of SWCNT is, the stronger the adsorption between SWCNT and gas is. It is shown that oxygen adsorption in SWCNT increases carbon nanotube's electrical conductivity more obvious than nitrogen adsorption, which is consistent with the experiments.

The Study on Field Emission Properties of Different Carbon Nanotubes Deposited by Electrophoresis

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ABSTRACT

Two different carbon nanotubes (CNTs) were synthesized by thermal chemical vapor deposition (CVD) system through two different apparatuses. Uniform deposition of CNTs on glass substrate was observed through optimizing parameters in the process of electrophoresis by scanning electron microscopy (SEM). The field emission properties were tested in the diode-type construction with the cathode-anode gap of 170μm. The result showed CNTs synthesized by pyrolysis of iron(II) phthalocyanine ($FeC_{32}N_8H_{16}$) showed much better field emission properties such as lower turn-on field (defined at a current of 10μA/cm^2) of 2.35V/μm. On the other hand, even the field reached 5.29V/μm, only 8.7μA/cm^2 emission current density was obtained from the CNTs fabricated using acetylene (C_2H_2) as the carbon source. These differences result from the structure of CNTs such as radius and length.

Keywords: Carbon nanotubes, Field Emission, Electrophoresis Deposition.

Preparation of Carbon Nanotube Field Emission Device and Its Driving Circuits

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ABSTRACT

As a new type of flat panel display technology, field emission display (FED) has drawn great interest due to the advantages of high display-quality and low power consumption. In this thesis, diode-type 16×16 matrix CNT-FED device was designed and sealed based on screen-printing technology. The device showed a low onset electrical field of 0.75 V/μm and threshold field of 1.75 V/μm. With proper driving circuits, the dynamic display of the 16×16 matrix CNT-FED device was realized.

Carbon Nanotubes Synthesized by Ethanol Catalytic Chemical Vapor Deposition

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ABSTRACT

In this study, we report the synthesis of carbon nanotubes by ethanol catalytic chemical vapor deposition, which employs ferrocene as the catalyst precursors and ethanol as carbon source. We obtained massive deposits. The deposits were characterized by scanning electron microscopy, transmission electron microscopy, and visual laser Raman spectroscopy. We also discussed the effects of some synthesis conditions, e.g., pump system, substrates and synthesis temperature, on the synthesis of carbon nanotubes by ethanol catalytic chemical vapor deposition. Our results indicated that carbon nanotubes prefered to grow without using pump system and aligned carbon nanotubes arrays prefered to grow on quartz substrates. And we also found that the synthesis temperature could affect not only on the graphitization degree, but also on the aligned growth of carbon nanotubes and the diameter of carbon nanotubes.

Synthesis of Locally Aligned Carbon Nanotubes with Catalytic Combustion Technique

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ABSTRACT

We report the growth of locally aligned carbon nanotubes synthesized by catalytic combustion of liquid hydrocarbon on copper plate and silicon wafer. Scanning electron microscope images show that uniform and locally aligned carbon nanotubes were obtained perpendicular to the substrate, and these carbon nanotubes have different outer diameters ranging from 200 nm to 500 nm and uniform length over 10μm. The reaction time brought no significant influence to the diameter of carbon nanotubes, but the average length of the carbon nanotubes was obviously increased with prolonging the reaction time. It was also found that most of the carbon nanotubes have particles on their tips when the substrate was copper plates; however the carbon nanotubes synthesized on silicon wafer were opened without catalyst particles. The influence of various parameters such as the method of catalyst preparation, reaction time and the nature of the substrate the of the carbon nanotubes formation were studied. Following these results, a model of growth mechanism was suggested for the carbon nanotubes obtained by the method.

Single-Walled Carbon Nanotubes Synthesized by Floating Catalyst Chemical Vapor Deposition

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ABSTRACT

High-quality single-walled carbon nanotubes are a key aspect in the emerging field nanotechnology. Although many approaches have been developed, the research on the synthesis of SWNTs is still needed. In this study, we report the synthesis of high-quality SWNTs by floating catalyst chemical vapor deposition, which employs ferrocene as the catalyst precursors. We obtained massive deposits at low temperature region. The deposits were characterized by scanning electron microscopy, transmission electron microscopy, and visual laser Raman spectroscopy. The Raman spectrum obtained from raw deposits shows clear radial breathing mode at the range from 180 cm^{-1} to 300cm^{-1} and high-intensity graphite mode at 1577.7 cm^{-1} with a shoulder at 1550.5 cm^{-1}, and almost no detectable peak around at 1545 cm^{-1}, which is induced by defects, is observed. These results indicate that the deposits are high-quality SWNTs.

Application of Digital Image Processing Algorithms to the Recognition of Atomic Structure of SWCNTs

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ABSTRACT

It is important and intresting thing to recognize the graphite atomic structure of SWCNTs by processing original STM images, which is usefull to automatically calculate chiral vector and track surface structure disfigurement of SWCNTs during In-situ STM scanning of the analyzed object later. In this paper, we report some digital image processing algorithms application on the recognition of atomic structure of SWCNTs. At last, we also write the correlative software with c^{++} codes, which applying the digital image processing algorithms. And from the result of processing a classic STM image of SWCNTs, we can clearly see graphite hexagon structure.

Preparation and Characterization of Bamboo-Like Carbon Nanotubes

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ABSTRACT

A simple combustion approach for synthesizing bamboo-like carbon nanotubes was proposed. In the experimental, copper plate was employed as substrate, ethanol as carbon source and fuel, and iron chloride/nitrate as catalyst precursors, respectively. The as-grown black powder was characterized by means of scanning electron microscopy (SEM), transmission electron microscopy (TEM) and Raman spectroscopy. The results

show that carbon nanotubes in our products have a good bamboo-like structure, and the morphology and microstructure of bamboo-like carbon nanotubes are affected by synthesis conditions, such as concentration of catalyst precursor solution, synthesis time, and flame perturbations etc. According to observation and analysis of TEM images, we tentatively propose and discuss for the possible growth mechanism of bamboo-like carbon nanotubes.

Keywords: Bamboo-like carbon nanotubes, ethanol catalytic combustion technique, compartment layers, transmission electron microscopy.

Electrochemical Detection of Salbutamol Utilizing Vertically Aligned Carbon Nanotube Electrode

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ABSTRACT

Beta-adrenergic agonists or β-agonists are used as medicines in human for asthma treatment. These drugs have sometimes been illegally used as doping agents in animal feed additives and can also produce anabolic like 'prohibited drugs in sports'. Electrochemical sensing is a promising technique for β-agonists detection and quantification. Electrochemical detection of β-agonists by glassy carbon and boron doped diamond electrodes have been reported. CNT is a promising material for electrochemical electrodes due to its high reaction area and excellent electron transfer rate. However, electrochemical study of β-agonists by CNT electrodes have not been presented. In this work, carbon nanotube (CNT) is used as the working electrode in cyclic voltammetry (CV) study for analysis of a β-agonist, namely salbutamol. Vertically aligned CNTs are selectively synthesized on 1mm^2 window of gold coated SiO_2/Si electrode by thermal chemical vapor deposition (CVD) with gravity effect and water-assisted etching. For CV experiment, standard Ag/AgCl and platinum are used as reference and auxiliary electrodes, respectively. The electrochemical characteristics of salbutamol were studies in phosphate buffer (pH 6.0). CV measurement is carried out with different salbutamol concentrations ranging from 10^{-6} to 10^{-3} mol l^{-1}. From tested results, CV curves show irreversible oxidation peak at 0.7 V and the peak become more pronounced as the concentration increases. The amperometric response is high and detection limit was 1×10^{-6} mol l^{-1}3S/N). Thus, CNT electrode has been shown to be a potential candidate for the electrochemical detection of β-agonists.

Covalent Coupling of Quantum Dots to MWNTs Using a Self-Assembling Technique

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ABSTRACT

Multiwalled carbon nanotubes — quantum dots (MWNTs-QDs) composites were synthesized by a multi-steps wet chemical self-assembling technique. The structure of MWNTs-QDs was also studied in detail. Firstly, the MWNTs were pretreated with concentrated HNO_3, then the as-obtained oxidized MWNTs were refluxed in $SOCl_2$ and DMF solution to get MWNTs-COCl sample. The dried MWNTs-COCl were reacted with 2-Aminoethanethiol in DMF solution to obtain MWNT-$CONH_2CH_2SH$ sample. FT-IR spectroscopy was used to verify changes of chemical bonds at the open ends of MWNTs and to confirm the modification of MWNTs. At one time, quantum dots of ZnO alcogels were prepared via the sol-gel process, and were purred by filtrating through filters (0.22um pore size). Finally, the thiolated MWNTs were added into ZnO alcogels under ultrasonic condition and then magnetically stirring via a self-assembling technique. The pre-prepared ZnO and ZnO@MWNTscomposites had been characterized by X-ray diffraction (XRD), and transmission electron microscopy (TEM). It was found monodispersed ZnO nanoparticles anchored on the sidewalls of MWNTs, and the ZnO@MWNTs conjuction structure could be vividly observed from TEM image. TEM image also indicated that the decoration of MWNTs did not cause any damage to the tubular shape and the conjunction occurred at the ends and sidewalls of MWNTs. Moreover, to assess the optoelectronic properties, photoluminescence (PL) spectrum was also compared between monodispersed ZnO QDs and the ZnO@MWNTs composites. The relationship between PL spectrum and structure was discussed.

Synthesis of TiO_2/Mutiwalled Carbon Nanotube Composite

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ABSTRACT

Nano-structured TiO_2 has superior photo-catalysis, but its application suffers from an unsatisfactory quantum efficiency due to the recombination of electrons and holes induced by photo. In order to improve photocatalysis ability of TiO_2, composite materials of TiO_2 have received considerable attention. TiO_2/Multi-walled carbon nanotubes (MWCNTs) were prepared via wet chemistry route with hydrolysis of titanium salts. The purification and oxidation treatment of MWNTs in concentrated HNO_3 solution were conducted to opening the tips of nanotubes. Then the titanium salts were added into carbon nanotubes by capillarity. After being hydrolyzed, TiO_2/MWCNTs composite were prepared. The microstructure of as-prepare TiO_2/MWCNTs composite was studied by TEM. General TiO_2 nanoparticles were also prepared via the same wet chemistry route. As-obtained samples were calcined at different temperatures. After being characterized by X-ray diffraction (XRD), the phase transformation of nano-structured TiO_2 in composite was determined and compared with general TiO_2 nanoparticles. The photocatalytic activity of samples calcinated at different temperatures was studied by using the conversion of methyl orange in aqueous solutions as probe reaction. The influences of the structure on photocatalysis efficiency were discussed. By contrast with that of general TiO_2 nanoparticles, the special structure of TiO_2/MWCNTs composite could remarkably improve the efficiency of the photocatalytic reaction. The results indicate that the excited e^- in conduction band of TiO_2 may transfer into MWNTs and the possibility of the recombination of e-/h+ pairs decreases.

Synthesis of Carbon Nano-Materials by Catalytic Combustion Technique

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ABSTRACT

In this paper, the synthesis of carbon nanomaterials by catalytic combustion was reported, in which acetone and ethanol were employed as carbon sources, nickel nitrate, iron chloride as the catalytic precursor, and copper plate as the substrates, respectively. In the experiments, the substrates coated with given catalytic precursors were placed into flames to synthesize carbon nano-materials. The results of characterization indicated that the pruducts consist of carbon nanofibers and nanotubes.

Carbon Nanotubes Synthesized by Simple Thermal Chemical Vapor Deposition and their Electrical Properties

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ABSTRACT

A simple thermal chemical vapor deposition growth technique of multi-walled carbon nanotubes is present. Aligned carbon nanotube arrays on $Fe_2O_3/SiO_2/Si$ substrates, carbon nanotube film on Pt metal grid substrates, and straight carbon nanotubes on Mo-Fe/silica substrates have been synthesized at lower reaction temperature at atmospheric pressure by pyrolysis of ethyl alcohol as carbon source. The as-synthesized carbon nanotubes were characterized by both scanning electron microscopy and high-resolution transmission electron microscopy. The electrical property measurements of individual multi-walled carbon nanotube grown on $Fe_2O_3/SiO_2/Si$ silicon substrate and Pt metal grid substrate were performed by homemade 'nano-manipulator'. According to Current-Voltage curves obtained in our experiments, we could calculate the current density that the multi-walled carbon nanotubes could carry is about 10^7 A/cm^2, which is much larger than that of normal metals.

Electrosorption of Cupric ions from Solutions by Carbon Nanotubes and Nanofibres Film Electrodes Grown on Graphite Substrates

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ABSTRACT

Electrosorption of ions from aqueous solutions with Carbon Nanotubes and Nanofibres (CNTs-CNFs) film electrodes has been demonstrated. The cost-effective, large area CNTs-CNFs film was synthesised on graphite substrate by low pressure and low temperature thermal chemical vapor deposition (CVD). Successful removal of Cu^{2+} from water by electrosorption of CNTs-CNFs films was achieved. The electrosorption capacity of CNTs-CNFs film electrodes was approximately 30.6~136.2 μmol/g. The ion sorption followed a Langmuir isotherm, indicating monolayer adsorption. The degradation of CNTs-CNFs electrodes for the electrosorption of Cu^{2+} maybe due to the electrolytic reaction occurred on the surface of the electrodes.

Keywords: Carbon nanotubes and nanofibres; electrosorption; cupric chloride;langmuir isotherm; capacitive deionization.

Fabrication and Electrical Properties of Suspended Carbon Nanotube Field-Effect Transistors

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ABSTRACT

We fabricate suspended carbon nanotubes (CNTs) based field-effect transistors (FETs), and further investigate their electrical properties. We measure their field modulation effects by applying a back gate and found that some of these suspended carbon nanotube FETs showed special properties which is similar to a diode. These peculiar behaviors are suspected to a downbent shape which was formed during CNT growth, and the downbent shape of the CNTs in the device affect their electrical properties. A model including the downbent shape influence was used to explain the experiment results. With this model, the I-V curve and field modulation effect of those devices were well explained. We suggest that these suspended carbon nanotube FETs can be used as

electrical devices due to their diverse electrical properties, and we can also look forward to manipulate the downbent shape structure of the carbon nanotubes to fabricate devices with demanding properties.

Study on Composite Fibers from PVA and PVA-Functionalized MWNTs

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ABSTRACT

Multi-walled carbon nanotubes (MWNTs) were functionalized with polyvinyl alcohol (PVA) through esterification reactions, which was proved directly by FT-IR spectra and indirectly by TGA measurements. This ensured the dispersion of nanotubes in highly polar solvents to obtain high-quality solution and the intimate compatibility of the nanotubes and the PVA matrix to avoid any potential microscopic phase separation in the nanocomposites. Homogeneous solution of PVA-functionalized carbon nanotubes and PVA in dimethyl sulfoxide (DMSO) had been prepared in the conditions of stirring and sonication, then extruded into fibers by gel spinning and hot-drawing. The mechanical properties of the composite fibers as well as the neat PVA fibers were investigated. It was found that the mechanical properties of these composite fibers were significantly improved as compared to the neat PVA fibers. Scanning electron microscopy showed an apparent good wetting of the nanotubes in the PVA matrix. These results are supportive of good interfacial bonding between the functionalized carbon nanotubes and PVA.

Fabrication and Optimization of Field Emission Cathode of Carbon Nanotubes by Electrophoretic Deposition

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ABSTRACT

Cold cathodes of carbon nanotubes (CNTs) were deposited on the glass substrate by electrophoretic deposition (EPD) method. CNT films were thin and uniform which were characterized by scanning electron microscopy. In this work the process parameters such as bias voltage, deposition time, interelectrode distance and electrolyte were optimized to achieve the best cathodes. The uniformity of CNTs film and optimized emission properties of the cathode were achieved when the voltage was 25 V, the distance between two electrodes was 5 cm, and deposition time was maintained about 10 minutes. $Al(NO_3)_3$ is a good choice as the electrolyte, while CNTs deposited on the cathode agglomerated together if applying $Cu(NO_3)_2$, and only carbon nanogranules but few CNTs were found on the substrate for the case of $Ni(NO_3)_2$.

Conductivity of Screen-Printed Carbon Nanotube Composite Film and Its Sensitivity to Organic Gas

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ABSTRACT

A screen-printed nanocomposite film has been prepared which is composed of multi-wall carbon nanotubes and silicon dioxide binder. The conductivity of the film was studied at various organic ambiences, including acetone, ethanol, formaldehyde and methanol. It is found that the conductivity of the film decreases when the film is exposed to organic gases. The results indicate that the CNT nanocomposite film may find applications in low-cost gas sensor.

Keywords: Carbon Nanotubes, Gas Sensor, Screen Printing

The Synthesis of Carbon Nanotubes at Different Pressure by Arc Discharge and its Characterization

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ABSTRACT

Carbon nanotubes (CNTs) were synthesized at different pressure in He/C_2H_2 gas mixture by arc discharge. The morphologies of CNTs were characterized with field emission scanning electron microscope (FE-SEM), Field emission scanning and transmission electron microscope (STEM), X-ray diffraction (XRD) and Raman spectroscopy. Optical emission spectroscopy (OES) was used *in situ* to investigate the formation process of CNTs. FE-SEM observation reveals that the length of CNTs synthesized in He/C_2H_2 gas mixture is more than 50 μm and many carbon particles deposit on the wall of CNTs. STEM characterization illustrates that the CNTs wall synthesized at 0.100 MPa is obviously bigger than that synthesized at 0.035 MPa. OES results show that CH and C_2 species might act as the precursors of CNTs formation with H atom acting as etching species of amorphous carbon. The consumption rate of anode and product deposit rate on cathode increase with increasing pressure in the reactor and the former is smaller than the latter as C_2H_2 acts as carbon source for the formation of CNTs. Thus, it is possible to increase the deposit rate of CNTs at higher pressure in the arc reactor by enhancing the evaporation rate of anode from the anode and C_2H_2 and the deposit rate of CH and C_2 species.

Keywords: Carbon nanotube; Arc discharge; Transmission electron microscopy.

Study of Electrochemical Supercapacitors Utilizing Carbon Nanotubes Electrodes and PVA-Hybrid Polyacid Electrolytes

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ABSTRACT

Carbon nanotubes (CNTs) synthesized on copper and nickel alloy foil by low pressure chemical vapor deposition were employed as the electrodes of the electrochemical supercapacitors (ESs). A mixture of poly(vinyl alcohol), phosphomolybdic acid (PMA) and phosphotungstic acid (PTA) were used as the electrolyte. The surface morphology and structure of as-grown CNTs were observed by scanning electron microscope and Raman spectroscopy. The electrochemical properties of the ESs were investigated by cyclic voltammetry and galvanic charge-discharge measurements. The results showed that with the increase of PMA to 40%, the specific capacitance of the as-made ESs reaches the highest 10.7F/g.

Research on LLDPE-Inorganic Nanocomposites

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ABSTRACT

In this paper, we have investigated the influence of different types and contents nanoparticles on the mechanical properties, structure and dispersion morphology of the LLDPE/inorganic nanocomposites. The results indicate that two-step method has not only good compatibility between two phases but also mechanical properties and processing flowability.

Keywords: nanocomposites; LLDPE; preparation method; mechanical properties; dispersion morphology

Electrosorption of NaCl by Carbon Nanotubes and Carbon Nanofibres Composite Film Grown at Different Temperatures

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ABSTRACT

In this work, carbon nanotubes and carbon nanofibres (CNTs-CNFs) composite film was synthesized by low pressure thermal chemical vapor deposition. CNTs-CNFs film was characterized by scanning electron microscopy and Raman spectroscopy. The effect of different growth temperature on the morphology of CNTs-CNFs and electrosorption of NaCl solution by CNTs-CNFs film grown at 550°C, 600°C, 650°C have been investigated, respectively. The result showed that the desalination efficiency decreased with the increasing growth temperature. The optimal adsorption capacity was achieved by CNTs-CNFs film grown at 550°C.

Keywords: Carbon Nanotubes and Carbon Nanofibres, growth temperature, chemical vapor deposition, electrosorption

Research on Absorption Spectrum of Highly Pured and Soluble Carbon Nanotubes

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ABSTRACT

In this research, the modern analytical technologies such as UV-VIS spectrophotometry were applied to detect the spectrum, and ultraviolet spectra of the solutions are gained. The attenuating chracteristic of samples in different concentrations in ultraviolet band is studied based on the analysis of the spectrum. The effect of dispersant's surfactant activity on carbon nanotubes is studied as well. It is found that carbon nanotubes disperse very well combined with appropriate dispersant. Thus the obtained the extinction coefficient and transmittance coefficient of carbon nanotubes demonstrate many fine features and highly elevated intensity of the absorptions in their UV-VIS spectra.

Porphyrin-Functionalized Single-Walled Nanotubes Solution for DMMP Detection

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ABSTRACT

A novel material of porphyrin functionalized Single-walled Nanotubes was employed on optical property research, aimed to DMMP detection, a simulant to Sarin. The composites were synthesis by condensation Zn-Tetraphenylporphyrin and bonding on SWNTs with non-covalent methods. The results were well characterized with TEM, AFM, as well as UV-visible measurements, demonstrated the diameter of nanotubes we used was estimated to range ~0.9-1.5 nm, and the existence of nano-composites. It proved that with using porphyrin-functionalized single-walled carbon nanotubes in DMF solution, the materials were reversible and capable of detecting DMMP (Sigma, 97%) at 9 ppb levels by UV-visible measurements.

Keywords: Single-walled Nanotubes, porphyrinfunctionalized, DMMP detection, photophysical application.

Synthesis and Electrochemical Properties of Multi-Walled Carbon Nanotubes Via Flame

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ABSTRACT

Multi-walled carbon nanotubes (MWCNTs) were prepared using molybdenum dioxide as the catalyst on pure nickel substrate via a facile flame. Molybdenum dioxide nanoparticles formed from the decomposition product of ammonium molybdate which was then reduced in ethanol flame catalyzed the growth of MWCNTs in situ. The products were characterized by means of scanning electron microscopy, transmission electron microscopy and X-ray diffraction for morphology, microstructure and phase purity, and by BET measurement and BJH method for its surface area and pore-size distribution. The observed MWCNTs have diameters of 10-40 nm and the length about 3-4 micrometers with some defective graphite sheets. The MWCNTs were treated with ammonia to remove the catalysts and attain a high surface area with porous structure. The specific surface area of the treated MWCNTs is about 176 m^2g^{-1} and the average pore diameter is 16.6 nm. Using the MWCNTs as polarized electrodes, an electrochemical double-layer capacitor with a specific capacitance of ca. 50 F g^{-1} was obtained.

Keywords: Nanomaterials; Carbon nanotubes; Combustion synthesis; Electrochemical super capacitors; Specific capacitance

Straight Carbon Nanotubes Growth by Thermal Chemical Vapor Deposition Using Printing Process

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ABSTRACT

In this paper, we present a very simple printed method for depositing iron catalyst over silicon substrates that can be efficiently utilized in the production of carbon nanotubes (CNTs) by thermal chemical vapor deposition (CVD). A lot of multi-walled carbon nanotubes (MWNTs) have been successfully grown from iron catalyst over a large pattern area by thermal CVD using methane. Iron catalyst films were composed of many iron islands. By adjusting the temperatures, one can control the diameter and the morphology of the MWNTs. Utilizing screen printing technology not only providing easy pattern catalyst film, but also a large area substrate to mass production CNTs. The morphology and structure of CNTs have been characterized by SEM and Raman spectroscopy.

Composite of Carbon Nanotubes and Sn

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ABSTRACT

Composite of carbon nanotubes (CNTs) and Sn was investigated by solving the CNTs into molten Sn. The problem of poor wettability between CNTs and Sn was resolved by coating the CNTs surface with metals (Sn, Cu and Ag) by electroless plating. Such metals are supposed to serve as medium for interacting with melted Sn matrix and achieve high strength interfacial adhesion. The experimental results show that the Ag coated CNTs are wetted in a certain degree by liquid Sn and embedded well in the Sn matrix. While in the case of Sn and Cu coated CNTs, fewer CNTs are embedded in the Sn matrix because of desorption or oxidation in liquid Sn.

A Method to Improve Big Area Field Emission Competence of Carbon Nanotube

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ABSTRACT

Carbon nanotube (CNT) possesses favorable field emission characteristic. Studies indicate that carbon nanotube present along perpendicular orientation have better field emission competence than other orientation. In this paper, a method to make carbon nanotube present along perpendicular orientation on big area was depicted. Through testing relative parameters, we study improving field emission competence, as well as estimating field strength factor. This method is meaningful to deposit big screen field emission display (FED).

Keyword: CNT, FED, perpendicular orientation.

Raman and Morphological Characteristics of Carbon Nanotubes Depending on Substrate Temperatures by Chemical Vapor Deposition

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ABSTRACT

Carbon nanotubes (CNTs) films were synthesized at low pressure using nickel as catalyst by thermal chemical vapor deposition with hydrogen-acetylene mixture. The Raman characteristics and morphological features of CNTs at different substrate temperatures were investigated. The variation of CNTs morphological feature mainly depends on the substrate temperatures. In the low temperature range (450–550°C), the film consists of graphite particles and CNTs mixture with some amorphous phase. With increase the temperature (550–650°C), the tube content increases, and the tube diameter decreases. At high temperature range (700–800°C), the film consists of CNTs and nanoparticles mixture. Raman spectroscopy results show that the intensity ratio I_D/I_G of the G-and D-band has a maximum at the medium temperature of 600°C, and the width of G band becomes narrow with the substrate temperature. The growth behaviors of CNTs at different temperatures are discussed based on the experimental results.

The Research of Radar Absorbing Structures made of Glass/Carbon Fibers/Epoxy Composites Filled with Carbon Nanotubes

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ABSTRACT

The radar absorbing structures (RAS) is one kind of functional composites, which can not only load bearing but absorb electromagnetic wave energy by inducing dielectric loss and minimize reflected waves. Therefore, the development of the RAS haves become essential for reducing RCS of the object. The composites possess excellent specific stiffness and strength. The electromagnetic wave properties of the RAS can be tailored by controlling the content of the lossy materials.

In the present study, RAS composed of glass fibers, carbon fibers and epoxy resin filled with carbon nanotubes (CNT), were designed and prepared over the frequency range of 8.2-12.4 GHz. The permittivities of the composite were measured by using a network analyzer, HP8510B. The contents of the composites were observed to be different from each composite. As a result of the experiment, it was found that the composites can be suitable to be used as RAS. By the calculation of the reflection of electromagnetic waves energy based on the genetic algorithm in the RAS, it was discovered that the composites can be applied to design an optional RAS composites filled with CNT.

Keywords: RAS, carbon nanotubes, permittivity, genetic algorithm.

Study on Carbon Nanotubes Supported with Magnetic Fe_3O_4 Nanoparticles

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ABSTRACT

In this work, the CNTs supported with magnetic ferroferric oxide (Fe_3O_4) nanoparticles were successfully prepared by thermal decomposition method. The samples were characterized using SEM, XRD, TGA, DTG and DSC. The results showed that, the CNTs were loaded with Fe_3O_4 nanoparticles under own reduction of CNTs at high temperature condition. The content of Fe_3O_4 nanoparticles in supported materials on the CNTs depended on the calcination temperature. At a low calcination temperature, the main composition of the supported iron was the stable iron oxide (Fe_3O_4) with respect to Fe_3O_4. Meanwhile, the crystallite size of the formed Fe_3O_4 particles was small. With increasing the calcination temperature, the content of Fe_3O_4 nanoparticles in supported iron on the CNTs increased and the crystallite diameter of Fe_3O_4 nanoparticles increased. At a calcination temperature of 600°C, very pure Fe_3O_4 nanoparticles formed and their crystallite diameter was 38.4 nm. The Addition of polyvinyl alcohol (PVA) which acted as an adhesive agent, remarkably improved the interaction between Fe_3O_4 nanoparticles and CNTs.

Covalent Sidewall Functionalization of Single-Walled Carbon Nanotubes via Reduction of Benzophenone by Potassium Metal

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ABSTRACT

Covalent sidewall functionalization of single-walled carbon nanotubes (SWNTs) via addition of diphenylcarbinol (DPC) anions and diphenylcarbinol radicals was reported. The reaction of a potassium atom with a benzophenone molecule results in transferring one electron from the potassium to the benzophenone, forming a radical which adds readily to nanotubes to form functionalized SWNTs (DPC-SWNTs). DPC anions were generated from two-electrons reduction of a benzophenones by two potassium metal. These anions were used to functionalize SWNTs in a different way. First, anions added to the sidewalls of nanotubes to form intermediates DPC^{n}-$SWNT^{n-}$. Finally, oxidation of the intermediates DPC^{n}-$SWNT^{n-}$ gives the neutral derivatives DPC-SWNTs. Raman spectroscopy shows that, compared with pristine SWNTs, the disorder mode (1323.1 cm^{-1}) of functionalized SWNTs is greatly enhanced, which is indicative of increased number of sp^3 hybridized carbon atoms in the functionalized SWNTs, due to chemically induced disruption of the aromatic system of p-electrons in the hexagonal framework of nanotube walls. UV-Visible spectroscopy shows that functionalized SWNTs lose the van Hove singularities typical for pristine SWNTs, suggesting a significant alteration of the electronic structure of nanotubes through covalent sidewall functionalization. Raman and UV-Visible spectroscopy confirm unambiguously that covalent functionalization has taken place. ATR-FTIR and XPS were utilized to characterize DPC groups grafted onto the sidewalls of carbon nanotubes. ATR-FTIR spectroscopy shows that phenyl and carbinol groups have been grafted onto the nanotubes. X-ray photoelectron spectroscopy (XPS) shows the atomic rate of O/C and number of C-O bands increases after functionalization. Thermo gravimetric analysis (TGA) shows that the degree of functionalization is about 14% and 10% for anion addition and radical addition, respectively. A long chain hydrocarbon marker (n-$C_{18}H_{35}$) was grafted onto the functional groups by esterification reaction for high-resolution TEM (HRTEM) visualization. The functional groups (phenyl and carbinol) offer a variety of possible reactions for further derivatization. This process,

utilizing reduction of an aromatic molecular by alkali metal, will open a way for covalent sidewall functionalization of SWNTs.

Morphology and Chemical Composition of Catalysts for Growth of Carbon Nanotubes in Flame

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ABSTRACT

In this study, catalyst particles were prepared on cordierite substrates via dipping methods. Methane diffusion flame was set up for synthesis of Carbon nanotubes. With variety of dipping solutions, catalysts with different compositions and morphology have been prepared successfully. It is concluded that the catalytic efficiency of different oxide has the order Nickel/cobalt oxide > nickel oxide > cobalt oxide≥nickel/iron oxide and iron oxide. And it is interesting that with addition Fe in nickel oxide catalyst particles, the carbon products have various structure, such as V shape and Y shape nanotubes, bamboo-liked carbon nanotubes and carbon onion. Based on the growth mechanism of carbon nanotubes, the effects of chemical composition and physical dimension on carbon nanotubes are also discussed in detail.

Enhancement of Characteristics of Gas Sensor Based on Single-Walled Carbon Nanotube Bundles

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ABSTRACT

An enhancement in sensitivity and recovery of single-walled carbon nanotube (SWNT)-based gas sensor is presented in this paper. The SWNT powder was dispersed in a H_2SO_4:HNO_3 solution, then stirred magnetically at room ambience. Transmission

electron microscopy (TEM), scanning electron microscopy (SEM) and BET measurements were used to evaluate the effect of acid treatment on the adsorption sites of SWNT. The enhancement in adsorption site was employed in gas sensing application, resulted in an improvement in characteristics of sensor. Upon exposure to 50 ppm of ammonia gas in nitrogen, the resistance of the sensors could increase from 10.8% (for the original sample) up to 68% (for the 8-h-stirred sample) in comparison with their initial values after 30 min. The recovery of the SWNT-based sensor was also significantly accelerated because of the acid treatment.

The Synergistic Effect of Carbon Nanotubes and Clay on the Toughness of Epoxy Nanocomposites

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ABSTRACT

The diglycidyl ether of bisphenol A (DGEBA) epoxy resin containing different shape nanofillers, such as multi-wall carbon nanotubes (MWCNTs), clay and clay-MWCNTs composites, were prepared separately, and Diaminodiphenyl sulfone (DDS) hardener was used as curing agent. The nanocomposites were processed by shear mixing and speed mixture at different clay concentrations (2 and 5wt%) and varied MWCNTs concentrations (from 0.1 to 0.5wt%). Investigation by X-ray diffraction (XRD) revealed that an exfoliated nanocomposite structure was formed in which the clay layers were randomly dispersed in the matrix. Morphologies of the fracture surfaces of nanocomposites were characterized by field emission scanning electron microscopy (SEM). The fracture toughness test results show that clay-MWCNT exhibits a synergistic effect on toughening epoxy resin.

Keywords: Carbon nanotubes, clay, nanocomposites, fracture toughness, hybrid, synergistic effect.

Response Modeling and Sensitivity of the Carbon Nanotubes/Graphite/Epoxy Composite Sensor

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ABSTRACT

A set of multi-wall carbon nanotubes (MWCNTs)/graphite/epoxy (EP) composites were used to form piezoresistive strain sensors for structural health monitoring applications. The static resistance of epoxy composite with different concentrations of MWCNTs and graphite was tailored. And a steel equivalent moment beam was used for modeling and testing the response of the sensors. The effect of the concentrations of MWCNTs, also the synergistic effect of MWCNTs and graphite on the sensitivity of the sensor was studied. The results show that the carbon nanotubes/graphite/epoxy resin sensor has a fairly linear symmetric strain response under static strain.

Keywords: Multi-wall carbon nanotubes(MWCNTs), graphite, epoxy composites, strain sensor.

Removal of Encapsulated Nickel Catalyst from Carbon Nanotubes by Redox Reaction

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ABSTRACT

Carbon nanotubes have attracted tremendous research interest for the last decade due to their superior physical and chemical properties and promising applications. Most work reported carbon nanotubes are usually cured with acid such as H_2SO_4 and HNO_3 first before use because of its poor solubility. During this process, the catalyst encapsulated in the nanotube can be eliminated and acid group COOH can be linked on the surface to generate more chemical reaction. In this report, a different treatment process to remove the Nickel catalyst is studied in detail. The results were estimated by Raman spectroscopy, Scanning Electron Microscope, and Water Contact Angle test.

Accurate Calculation of f_T of CNTFET by Considering Quantum and Parasitic Capacitances

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ABSTRACT

In this paper, we present an effort to develop a comprehensive capability for simulation of cylindrical gate (gate all around) carbon nanotube transistors with zigzag (n.0) CNT as the gate channel for estimation of the high frequency response parameter. This parameter is significant in circuit design with this kind of transistors which are predicted to replace conventional MOSFETs in CMOS technology. We employed non-equilibrium Green's function (NEGF) formalism to simulate the CNTFETs by self-consistently solving the Poisson and Schrödinger equations. The NEGF transport equation is solved in an atomistic mode space approach, which only treats the first subbands in the tube's circumferential direction while retaining an atomistic grid along the carrier transport direction. Using self-consistent algorithm, the random walk theory is also considered. Simulation examples show that these approaches describe quantum transport effects in nanotube transistors which are in good agreement with reported experimental results. The transconductance of CNTFET is computed by means of I_d estimation with the mentioned NEGF method. This parameter is used to obtain f_T, the cut-off frequency of the transistor. To achieve more accurate results, quantum and parasitic capacitances are considered. These values are used to ameliorate the calculated gate capacitance. The quantum capacitance of the transistor is extracted from band structure calculation of CNT. The parasitic capacitances between gate-source and gate-drain are derived using finite element method with adoptive meshing. The effects of quantum and parasitic capacitances on f_T are discussed.

The Electrical Property of MWNT-Mullite Composites

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ABSTRACT

In this paper the CNTs were added into the mullite ceramics to change the electric conducting property of mullite. We present the electrical property of the new ceramics matrix composite with the varying volume content of reinforcing nanotubes up to 15%. Multi-walled Carbon nanotubes-mullite composites (MWNTs/mullite = 0~15 vol.%) were

prepared by hot-pressing the corresponding raw material powders of MWNT, alumina and silica. The introduction of MWNT to the mullite matrix is effective to improve the electrical conducting properties. The electric conductivity of the composites was increased remarkably by adding a very small amount of MWNT in relation to the unique specialties of the carbon nanotubes: the mullite matrix is a kind of insulator with the electrical resistivity of $10^{12}\Omega$cm, however, the composite with not more than 15% MWNT gained the increment of over 10^{10} times of electric conductivity; the introduction of 1 vol. % MWNT improved the conductivity to 0.007S/m, compared to the pure mullite matrix, the electrical conducting property has been significantly changed. In particular, the conductivity of the 10 vol. % MWNT-mullite composites got the highest value of 0.04 S/m.

Aligned Single-Walled Carbon Nanotubes (SWNTs) Based Field-Effect Transistor Biosensors

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ABSTRACT

Due to their unique electrical, geometrical, mechanical and biocompatible properties, single-walled carbon nanotubes (SWNTs) are attractive materials for the construction of nanoscaled field-effect transistor (FET) biosensors [1], which has exciting potential application in high throughput proteomic studies, disease diagnosis and nanobiotechnology. In this paper, we present a new micro-fluidic assembly method to align SWNTs onto pattered gold electrodes surface. By controlling the experimental condition, we can connect the electrodes with one bundle of SWNTs. The fabricated FET has good performance in electronic properties.

Ehanced Field Emission of Printed Carbon Nanotube by Coating Oxidation Barium Nanoparticles for High Current Application

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ABSTRACT

With nano-diameters, superb chemical and mechanical stability, carbon nanotubes (CNTs) are regarded as an excellent electron source for the vacuum-microelectronics devices such as field emission display (FED), X-ray tube and travelling wave tube (TWT). For FED application, the emission current density of 1mA/cm^2 is enough. While for X-ray tube or TWT applications, the work current density is much higher than FED application, which is too difficult to realize for the moment. This paper provide a new method that covering CNTs cathode with a thin layer of oxidation barium (BaO) to improve the current density of CNTs emitters.

The CNTs cathodes, prepared by screen printing was soaked in barium nitrate ($Ba(NO_3)_2$) solution (0.5 wt%) for 12h, and then sintered at 580°C with nitrogen protection for 1h to make $Ba(NO_3)_2$ decompounded into BaO. Fig. 1 and Fig. 2 show the SEM images of CNTs cathode with or without a thin layer of BaO in its surface. The field emission properties of with- or without-BaO CNTs were investigated by standard I-V measurement. The testing result shows the similar current density before it is less than 15mA/cm^2. When the current density is higher than 15mA/cm^2, an evident rapid increase of current density of the CNTs coated BaO was observed.

We believe when the CNTs emitter work at high current density, it will release vast joule heat because the imperfect structure of CNTs. If the tube surface temperature is high enough, the CNT will decomposed the BaO to Ba. BaO and Ba are important thermionic emitting materials. The cooperation of field emitter and thermionic emitter make the current density increased at high current density condition. It is one of promising ways to achieve very high current density.

Carbon Nanotubes (CNTs) as Conductive Filler for Polymer Composite

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ABSTRACT

Carbon Nanotubes (CNTs) with its exceptional electrical properties has become one of the most potential materials to be used as conductive filler in polymer composites. However, to obtain maximum transfer of electrical properties of CNTs to the composites, well dispersed and electrically connected CNTs in polymer matrix has to be achieved. Vertically aligned carbon nanotubes with network structures were synthesized by a two steps Plasma Enhanced Chemical Vapor Deposition (PECVD) process. Free standing method was used to incorporate the CNTs network with polystyrene to create CNTs network-polymer composites. A benchmark sample consists of typical aligned CNTs has also been synthesized and which electrical transport properties are compared to that of the CNTs network-polymer composite. Electrical properties of the composites samples were measured by two probes technique using Keithly 197 and Fluke meters, under vacuum ($\sim 7\times10^{-6}$mbar). Standard techniques were used to measure I-V characteristic at 20°C.and minus 100°C.The results show that the CNTs network-polymer composite exhibits electron tunneling conductivity, which is lower in resistance than the electrons hopping conductivity of the benchmark CNTs-polymer composite. This findings show that the CNTs network offers a promising application as filler material for creating super conductive composite.

Review of Effect of Different Substituting Elements on the Properties and Nanostructures of FINEMET Alloy

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ABSTRACT

The research on the properties and structures of FINEMET alloy with different addictive elements has attracted a lot of interest worldwide due to the increased demand of high quality soft magnetic materials. The effect of the different substituting alloying elements on the properties and nanostructures of FINEMET alloy has been reviewed in this article. The influence of different heat treatment methods and varied additions of alloy elements on soft magnetic properties of FINEMET alloy has also been discussed in the article. In order to further reduce the cost and improve the performance, properly designing of composition and heat treatment are required.

Keywords: Finement alloy, Nanostructures, Soft magnetic properties.

Friction and Wear Characteristics of Nano-solid Lubrication Coating of Laser Cladding

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ABSTRACT

The friction and wear characteristics of nickel-based self-solid lubricant coating produced by a Nd:YAG Laser was studied in this paper. The change tendency of some elements and surface topography of the coating was analyzed by SEM and EDS. It was found that a large amount of white particles and submicron pores are distributed in the Ni-based alloy solid solution matrix. For the laser-clad Ni60-10%BN-5%CaF_2 coating at the output power of 380 W, the microstructure in the upper and interface regions is dendrites and small amount massive compound, which is fine and homogeneous., The general trend of elements B and N is concordant examined by energy spectrometer. The output power of YAG laser can influence the structure of the Ni-based hexagonal BN solid lubricant laser cladding coating. EDS analysis indicate that hexagonal BN lubricant has been fused into the coating in the laser cladding procedure. Elements of Cr, Ni and Fe which comes form self-fluxing powders Ni60 change obviously. Cladding coating and the substrate is good metallurgical combine. The friction and wear characteristics of the coating which contain solid-phase lubricant (h-BN) and non-lubricant were tested. The results show that the friction coefficients of Ni60-10%BN-5%CaF_2 and Ni60 coatings are stable about 0.5 and 0.63, respectively, when friction pair rotational speed is 2m/s and loading is 20N under room temperature. The corresponding friction coefficients have no obvious change during the friction pair rotational speed or loading changes. While the friction coefficient of the laser-clad Ni60-10%BN-5%CaF_2 is decreased sharply to between 0.35 and 0.45 during friction pair rotational speed is 2m/s and loading is 40N under 400°C, which indicates that hexagonal BN lubricant in the laser cladding coating plays a role of anti-friction under heavy loading.

Synthesis and Characterization of Dandelion-Shaped SiCN Rods

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ABSTRACT

Assited by Co as catalyst, an interesting structure, dandelion-shaped SiCN rods, was synthesized using microwave plasma chemical vapor deposition method with gas mixtures of CH_4, H_2 and N_2 as precursors and Si chips inserted in the sample holder at symmetrical positions around the specimen as additional Si sources. Scanning electron microscopy shows each rod has not only a column about 0.4~0.8 mm in diameter and about 10~20 mm in length, but also a ~2 mm sized ball-like tip, from which nanowiskers of 0.3 mm long with 20~30 nm in diameter were formed. The samples are atomic-level hybrids composed of Si, C and N atoms. Two strong peaks (3.25 and 2.84 eV) were observed from photoluminescence spectroscopy at room temperature, indicating the dandelion-shaped SiCN rods have potential application in optoelectronic devices.

Mass Synthesis of Large, Single-Crystal Gold Nanoplates Using a Pyridinium-Based Ionic Liquid

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ABSTRACT

Single-crystal gold nanoplates, with triangular, hexagonal, or truncated triangular shapes, have been successfully synthesized in high yield via microwave heating of $HAuCl_4 \cdot 4H_2O$ in an ionic liquid (N-butyl-pyridinium tetrafluoroborate, [BuPy][BF_4]) without any extra capping agents and reducing agents. The gold nanoplates are single crystals bound primarily by (111) lattice planes, as revealed by both selected area electron diffraction and powder X-ray diffraction. These large gold nanoplates have intense absorption in the near infrared region. The reaction temperature plays important role in the formation of final products. This facile approach may be extended to the synthesis of other metal nanomaterials of different size.

Keywords: Gold nanoplates, ionic liquid, synthesis.

Synthesis of Nano-Sized ZnO Structure in Ionic Liquid

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ABSTRACT

ZnO nanorods were successfully synthesized by thermal decomposition of Zn $(OH)_2$ in the ionic liquid 1-butyl-3-ethylimidazolium tetrafluoroborate. Their structure and morphology were characterized by means of infrared spectroscopy (IR), X-ray powder diffraction (XRD), and transmission electron microscopy (TEM). The TEM results indicate that the diameter of the ZnO nanorods was 10 nm, and the length was 200 nm. The XRD pattern reveals that the ZnO nanorods belong to the hexagonal crystal system. The results show that ionic liquid can not only act as a reaction medium but also modify ZnO nanorods in the reaction. In this paper the growth mechanics of ZnO nano-structure was also preliminary studied.

Keywords: ZnO, ionic liquid, nanostructure, thermal decomposition.

Multi-Directionally Grown Ribbon-Like Carbon Fibers

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ABSTRACT

Here, a simple and low cost catalytic combustion method was employed for preparation of ribbon-like carbon fibers. A lot of multi-directionally grown ribbon-like carbon fibers were obtained. In our experiment, methanol was used as the carbon source and the nickel nitrate as the catalyst precursor. The copper plate was used as the substrate. M. M. Wilson *et al*. also adopted flame method, but their setup is complex. From the view of realizable application, our method is more adaptive. This study has significances for fundamental investigation and has a promising of industrial application.

Keywords: Carbonfibers, ribbon-shaped structure, multidirectional structure, catalytic combustion.

Analysis on the Annealing Properties of ITO Thin Film

Prepared by Vacuous Evaporation Method

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ABSTRACT

Hyaloid ITO conducting thin film was prepared by vacuous evaporation plating process. A Sheet resistance of 400Ω/square was obtained by four point resitivity test system. And penetration coefficient was 80% which was measured by grating spectrograph. The film thickness was 103 nm which was measured by SEM. XRD and atomic force microscope were used to analyze the phase, fine texture and roughness. The thin film was annealed. The result showed that crystallization tended to be more complete, texture tended to be more compact and the crystal grain growth was found. The sheet resistance firstly decreased and then increased but the penetration coefficient increased with the increasing of the annealing time.

Study on Fluorescence of Eu(III)-Acetylacetonate Complex

Affected by Block Copolymer of PVA-b-PEG

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ABSTRACT

Our attention is focused on the formation of a new type of PVA-b- PEG copolymer and its improvement on fluorescence of rare earth complexes. In the present study, PVA-b-PEG block copolymers were prepared by means of chemical oxidation copolymerization of polyethylene glycol and poly (vinyl alcohol), and were characterized by IR and ^{1}HNMR. The results showed that PVA were grafted with PEG which were embellished by toluene 2,4-diisocyanate (TDI) and formed stable PVA-b-PEG block copolymers. In ethanol solutions, the fluorescence enhancement function of the copolymers to Eu(III)-acetylacetonate(Eu-AA) complex was studied. Fluorescence spectroscopy showed that Eu^{3+} compounded not only with acetylacetonate but also with PEG

abounded in PVA-b-PEG, and the presence of PEG-200 in the Eu^{3+} prevented the quenching of the emission of the Eu3+ ion, decreased the spectral width and increased the emission intensity of Eu^{3+}. PVA-b-PEG copolymers enlarged the extension of covalent bond and were fluorescence enhancement system.

Horizontal Growth of In_2O_3 Nanowires at Low Temperatures

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ABSTRACT

The positioning and directed growth of semiconductor nanowires (NWs) is currently of considerable interest for "bottom-up" approaches to the engineering of intricate structures from nanoscale building blocks. We report on the horizontal growth of In_2O_3 NWs, which is important for in-situ fabrication of the In_2O_3 NWs-based devices. The In_2O_3 NWs, in the diameter of about 10 nm, are suspended bridges directly grown from the patterned indium film by a one-step annealing method at a very low temperature of about 400°C. This low temperature allows glass to be applied as substrates for in-situ fabrication of the In_2O_3 NWs devices. The patterned *In* film, which is used as the source material and covered with a 10nm-thick *Au* film, is realized by a conventional photolithography, while *Au* film acts as the catalyst for the growth. We also investigate the growth mechanism of the In_2O_3 NWs. It is revealed that a certain content of oxygen in the *In* film facilitates the growth of the In_2O_3 NWs.

Subminiature Gas Sensor Based on the Photonic Crystals

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ABSTRACT

In this paper, we design a symmetric Mach-Zehnder interferometer (MZI) gas sensor based on two-dimensional Photonic crystals (Phc), which is filled with the gases of

different refractive index in the holes of the silicon plate. Self-Collimation (SC) effect analyzed by equi-frequency contour (EFC) is used to route the propagation of light straightly; the bending and splitting of lights are realized by the line-defect structures. Finite Difference Time Domain (FDTD) simulations show that the outputs of the MZI vary with the gas in the test arm and a π phase shift of the two output light beams is achieved as the gas refractive index n=1.24. By analyzing the corresponding relationship between the output results and the refractive index of gases in the test arm, it can act as a gas sensor. Finally, we conclude the mechanisms of the outputs and analyze the phase shift and the Effective Index (n_{eff}) in the SC direction which is calculated by the radio of vector-k. As the wavelength λ=632.8 nm (the wavelength of CO_2 laser), the size of the MZI is as small as 6745 nm × 6745 nm. Thus, we realize the micromation of the sensor, which may play an important role in high-density integration design.

Research on Photocatalytic Activity of Nano-TiO_2 Coating on Foam Al by Composite Electroplating

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ABSTRACT

Nano-TiO_2 coating was deposited by composite electroplating on foam aluminum for the first time. Surface morphology of the films were characterized with Scanning Electron Microscope (SEM).The photocatalytic activity of the samples was tested on the degradation of methylene blue solution under the irradiation of UV lamp. The best technological parameters of composite electroplating were gained by the experiments. The results showed that when annealed for two hours, the sizes of the TiO_2 particles were even and scattered well in the coatings. The samples have good photocatalytic activity. The degradation rate of methylene blue solution reached 47% after 6 hours irradiation of UV lamp.

Keywords: Composite electroplating, TiO_2 coating, Foam aluminum, Annealing, Photocatalytic.

Study Electro-Discoloring Properties of Nano Crystal W03 Thin Films

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ABSTRACT

Nanocrystalline W03 thin films prepared by RF reactive sputtering in this paper. Based on the analysis of the Berg hysteresis model, We analyze the process parameter influence on the hysteresis effect, inclusing pumping speed, temperature of substrate and target, input power, target to substrate distance and area of target. A new active feedback control method is present in this paper to eliminate hysteresis effect and depositing nanocrystalline W03 thin films. Through measurement of its electro-discoloring properties, we get a good tungsten oxide films. This films have high visible light transmission rate at the 550 nm while not colored, the maximum value reach 95%. When Colored, changes can reach 65%. Through XPS and XRD analzed, nanocrystalline W03 have very high ratio surface area and those defect provide ion more diffusion channel, so nano-crystaln has a good electro-discoloring property. The better size of Nano-crystal about 40 nm.

Keywords: Electro-discoloring, nanocrystalline, WO films.

Preparation of PZT Ferroelectric Thin Films by Electrochemical Reduction

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ABSTRACT

In this paper, we report the growth of lead zirconate titanate (PZT) ferroelectric thin films, formed by means of the electrochemical reduction. In our experiment, the electrolyte was prepared by lead nitrate ($Pb(NO_3)_2$), zirconium oxide chloride ($ZrOCl_2{\cdot}8H_2O$) and titanium chloride ($TiCl_3$) solution. A graphite plate with 1cm of width was employed as the anode, and a stainless steel plate was employed as both cathode and substrate. The controlled current that was supplied by a DC power supply passed through the electrolyte to deoxidize PZT precursor films on the surface of the stainless steel at room temperature. The results indicate that the atomic ratio of compositions in the film can be controlled by controlling the molar concentration of electrolytic solution, current density and reaction time. The perovskite PZT thin films can be obtained when the precursor films are heated to a certain temperature for sintering.

Raman Spectroscopic Characterization for Carbon Nanofibers

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ABSTRACT

Catalytic grown carbon nanofibers, obtained from ethanol diffusion flame catalytic combustion method over copper plate, have been characterized by the visible Raman spectroscopy for the degree of graphitization. Two groups of experiments were performed for the Raman spectroscopic characterization. The first group of experiment was that three kinds of chloride were used as the catalyst precursors for the synthesis of carbon nanofibers. The second group of experiment was that ferric chloride of different concentration was employed as the catalyst precursor and other experimental conditions were the same the first group of experiment. Scanning electron microscopy has shown that the resultant carbon nanofibers are different in morphology via the two group of experiments. The results from the Raman spectroscopic characterization have fuether confirmed this point. The results indicate that the catalyst precursor has not only effects on the degree of graphitization of carbon nanofibers but also carbon nanofibers can be tailored by control of the concentration of catalyst precursor solution. According to the data obtained from the Raman spectroscopic characterization, the relative intensities and the amount of amorphous carbon were estimated. When the information from these characterizations are combined with that of the associated morphologies of the carbon nanofibers, it is possible to synthesize perfect carbon nanofibers.

Keywords: Carbon nanofibers, Catalytic combution, Raman spectroscopic characterization.

Controlled Morphology and Luminescence of Traditional Phosphors Coated by ZnO Nanostructures

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ABSTRACT

A coating layer of ZnO on the surface of CRT conventional phosphors was produced by chemical vapor deposition (CVD). Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) study reveal that the morphology of coating layer can be controllably produced by changing the substrate temperature. When substrate temperature is near 600°C, an array of c-axis aligned nanorods was present. The room temperature photoluminescence (PL) measurement suggested that for the coated phosphors a strong UV emission of ZnO was introduced while the visible emission of original phosphors was still remained. The UV-visible coupling effect can be expected to improve the cathodoluminescence (CL) for these coated phosphors. The CL test for modified phosphors demonstrated that for ZnO;Zn phosphors this coupling effect did work and luminescent performance did improve in the lower voltages. The results show a potential application of coated phosphors screen for low-voltage display devices such as field emission devices (FEDs).

Higher Drive Current for SiGe Nanowires

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ABSTRACT

Nanowire is mainly used in biological sensor because it has the high surface-to-volume ratio. In this study, we have successfully fabricated the Poly-Si and SiGe nanowire with Ge = 7% and 11% respectively by side-wall spacer technique. In order to normalize the drive current of nanowires, we consider the nanowire as a resistance. The conductance is chose for comparison between the nanowires. The higher conductance achieved of SiGe nanowire with/without nanowire implantation and the SiGe nanowire with higher Ge concentration had higher conductance. However, the disadvantage of lower contact resistance is found in SiGe pad. The 3-amino-propy-ltriethoxy-silane (APTES) was used to modify the surface, which can detect the charge with different pH. Comparing the conductance change; the SiGe nanowire with higher Ge concentration improved the sensitivity. But the over-higher Ge concentration (40%) did not increase the sensitivity; the reason maybe the higher defect appears at the surface as higher Ge concentration.

B-Doped TiO_2 Nanotubes and Its Photocatalytic Activity

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ABSTRACT

Two-step hydrothermal method was developed to prepare B-doped TiO_2 nanotubes (BTNTs). BTNTs was characterized by TEM, XRD, XPS, FT-IR, UV-Vis spectroscopy, its photocatalytic activity was evaluated by the degradation of methyl orange (MO) aqueous solution both under UV light and visible light irritation. The results from TEM indicated that BTNTs with diameter of 10–20 nm and length of several μm was successfully prepared by two-step hydrothermal reaction. The XRD revealed that the BTNTs had crystalline structure of anatase. Especially, the photocatalytic tests indicated that the BTNTs showed higher photocatalytic activity, the degradation of MO were 99.8% and 90.6% under UV light irritation for 90 min and sunlight (55klux) irritation for 100 min, respectively. FT-IR and XPS results showed that doped boron was present as the form of B^{3+} in BTNTS forming a possible chemical environment like Ti-O-B. Boron atoms can substitute oxygen atoms in the TiO_2 lattice, which causes the band gap narrowing and extend its light absorption into the visible region. Moreover, large specific surface area and one-dimensional structure of BTNTs may be contributed to the greater absorption to organic pollutants and lower combination of electron hole pairs. The synergetic effect of B-doped and one-dimensional tubular structure leads to a higher photoactivity of BTNTs. Additionally, the BTNTs could be easily separated from the reaction solution by sedimentation. These results show that BTNTs will provide possibility to future industrial applications in environmental pollutants cleaning up.

Influence of the Shape and Size of Catalyst on the Morphology of Carbon Sub-Microfibers

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ABSTRACT

The investigation of the relation of catalyst particles with resultant carbon deposits has been carried out. In this paper, the influences of catalyst particles on the morphology of carbon fibers are studied. Carbon fibers have been synthesized by the decomposition of methanol/ethanol over copper substrate via catalytic combustion technique and chemical vapor deposition method. The structural characteristics of the carbon product were assessed from the scanning electron microscopy. In situ scanning electron microscopy showed that the size and the shape of the catalyst particles can influence the morphology of the resultant carbon fibers.

Keywords: carbon fibers, ribbon-shaped structure, multidirectional structure, catalytic combustion.

On the Formation of Nano- Phase in Amorphous Fe-Si-B-M Alloy and its Soft Magnesium Performance

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ABSTRACT

The crystallization of amorphous Fe-Si-B-M alloy and its soft magnesium performance are reported in this paper. The Fe-Si-B-M wire was produced by the melt spinning technique. The amorphous structure of the wire was obtained when the speed of running wheel reached 22m/s. The heat-treatment of the amorphous Fe-Si-B-M wire was done in the range of heat-treatment temperature 460–580°C. The test results showed that the precipitation of the new phase appeared with no larger than 20nm in the microstructure of the alloy. μi of the alloy was 11×10^{4} and Bs was 1.5T. The test results indicated that the soft magnetic properties of the alloy were better than that without heat-treatment.

Keywords: Rapid solidification, Fe-Si-B-M alloy, heat-treatment.

Manufacture of $BaTiO_3$ Based Ceramic Nano-Powder and its Property

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ABSTRACT

$BaTiO_3$ based ceramics were applied widely to make electronical units. But conventional processing of $BaTiO_3$ ceramic particles relies on $TiCl_4$. In this paper, new raw materials was used to synthesize $BaTiO_3$ based ceramic nanopowder with the particle size of 20–90nm. BET equipment was used to measure the specific surface area of $BaTiO_3$ based ceramic. The pecific surface area is 15 m^2/g. Sedimentometry was applied to measure particle size and distribution. The dielectric constant of $BaTiO_3$ based ceramics is more than 5000.

Keywords: $BaTiO_3$, powder preparation, composite, dielectric constant.

Differences Between the nc-Si:H Thin Films Deposited by RF-Sputtering and PECVD

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ABSTRACT

Nanocrystalline silicon thin films were deposited by radio frequency (RF) sputtering and by PECVD separately with the processing parameters varied. A combination of X-ray diffraction (XRD), ellipsometry and Raman measurements were used to characterize the films. The optical band gaps (E_g^{opt}) were derived from Tauc plots, and the result showed that the films prepared by RF-sputtering has a wider band-gap compared with the film deposited by PECVD, and suitable for the solar cell window layer. A investigation of the differences in Raman shift and the crystallization ratio (Xc) between the two kinds of films were also carried out. The XRD results shown that the film deposited by the radio frequency (RF) sputtering has a preferred orientation in (201) and this preferred diffraction orientation corresponds to tetragon microstructure, which has a wider band-gap compared with the silicon films deposited by PECVD.

The Band Gap Model and the I-V Characteristic of the nc-Si:H Thin Films Deposited by RF-Sputtering

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ABSTRACT

Nanocrystalline silicon thin films were deposited by radio frequency (RF) sputtering on p-type silicon substrates at low temperature (150°C). In the working gas (H_2+Ar), the H_2 dilution percentage was changed from 31% to 73%. The duration time of film deposition was changed at the same time. The optical band gaps(E_g^{opt}) were derived from Tauc plots, and the result showed that the films prepared by RF-sputtering has a wider band-gap. Basing on our experimental results and the heterojunction quantum dot (HQD) theory, a new modified band gap model of the nc-Si:H film is suggested. The I-V characteristics about the quantum dots in the nc-Si:H film is discussed theoretically and experimentally.

Structure and Properties of Epoxidized Nature Rubber/Organoclay Nanocomposites

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ABSTRACT

In recent years rubber/layered silicate nanocomposites have attracted great interest. Epoxidized natural rubber (ENR) combines the properties of natural rubber and polar rubber. Up to now, only few studies were devoted to ENR-based nanocomposites prepared by mixing intercalation method. In this paper, Organomodified clays of 10A, 15A and 20A were compounded with ENR (50% epoxidation), respectively. The nanometer scales of organoclays in rubber matrix were determined by X-ray diffraction testing, the exfoliated/intercalated structures of organoclay 15A in ENR were confirmed by transmission elector microscopy. The increases in tensile moduli and strengths of ENR/15A and ENR/20A nanocomposites vulcanizaters were caused by the better interactions between rubber macromolecule chains and organoclay layers. The curing characteristic and viscoelastic properties of uncured composites were determined by RPA2000. DMA test showed that the Tgs nanocomposites shifted a little to that of ENR vulcanizates. Nanocomposites of ENR/10A, ENR/15A and ENR/20A were obtained by mixing intercalation method. The addition of nanoclay 15A and 20A improved the mechanical properties of ENR, while the properties of ENR/10A was enhanced indistinctively.

Annealing Effect on X-ray Detection Properties of Nano-Sized Polycrystalline Lead Oxide Film

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ABSTRACT

Polycrystalline lead oxide (PbO) film is excellent candidate material for direct conversion X-ray detector. However, it has been reported that a thickly and bulky film reduce significantly the charge collection efficiency as well as the electron-hole pair creation due to lower mass density of film. In this paper, firstly, the nano sized lead-oxide particles, which can use in a novel high efficiency flat panel X-ray detector, were synthesized by a

simple solution-combustion method. Energy dispersive X-ray spectrometer (EDXS) & field emission scanning electron microscopy (FE-SEM) was used to analyze the component ratio and the morphology of the PbO particles as a function of annealing temperature. Secondly, the PbO films of 150μm- thickness were deposited on glass substrates using a particle-in-binder (PIB) method at room temperature. The influences of post-deposition annealing on the X-ray detection characteristics of the PbO films were investigated in detail. The key parameters – the dark current, the X-ray sensitivity, signal to noise ratio (SNR), and signal decay – were measured. It was found that the annealing conditions strongly affect the electrical properties of the PbO films. The X-ray sensitivity of films annealed in oxygen gas increases dramatically with increasing annealing temperatures up to 500°C.

Tin Oxide Nanostructures for Hydrogen Gas Sensing Applications

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ABSTRACT

A high-yield synthesis of SnO_2 nanoparticles via a facile, economical and easily scalable solid-state molten salt synthesis method has been demonstrated. The inorganic additive, molar ratios of chemicals and annealing temperature were found to control the size and porosity of the SnO_2 nanoparticles. The synthesized SnO_2 nanostructures were uniform, well-dispersed and exhibit high crystallinity. Hydrogen sensors made up of the SnO_2 nanoparticles were found to possess high sensitivity and stability.

Effect of Co Substitution on Microstructure and Absorption Application of FeSiB Flakes

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ABSTRACT

The effect of Co substitution on microstructure and absorption application of FeSiB flakes is investigated in the frequency range of 0.5-18GHz. $Co_xFe_{78-x}Si_9B_{13}$ (x=0, 5, 10 and 15) nanocrystalline flakes with nanocrystal/amorphous two-phase were prepared by ball milling. Co substitution decreases the grain size and affects microwave behavior both compositionally and structurally according to the mechanism of nanostructure. The $Fe_{78}Si_9B_{13}$ flakes realized broad band absorption and the absorption band can be moved toward lower frequency by Co substitution.

Performance Study of Abrasive Wear and Erosive Wear of WC-12Co Coatings Sprayed by HVOF

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ABSTRACT

WC-Co cermets have been used traditionally as wear-resistant materials. Recent work has shown that nanostructured cermets offer improved properties over their conventional counterparts. This work examines the performance of such conventional and nanostructured materials in the form of coatings deposited by high velocity oxy-fuel(HVOF) thermal spraying. WC-12Co coatings were deposited under identical conditions using nanostructured, multimodal and conventional WC-12Co powder feedstocks. The phase constituents of the feedstock powders and the coatings were analyzed by XRD. Abrasive and erosive wear resistances of coatings were carried out on wet sand rubber wheel abrasion tester and suction & jet blasting machine respectively. The characterizations of spraying feedstock powders, microstructure and surface micrographs of the prophase and anaphase attrition & erosive surfaces were analyzed by SEM. The results indicated that: microstructures of nanostructured and multimodal WC-12Co coatings prepared by HVOF are dense with little porosity, and their microhardness values are obviously higher than conventional WC-12Co coating, though Nano WC decomposed much more server than conventional WC did during spraying. As well, it was found that nanostructured and multimodal WC-12Co coatings exhibited better abrasive and erosive wear resistance in comparison with conventional one.

Electrochemical Studies of V_2O_5-CNTs Nanocomposite

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ABSTRACT

Carbon nanotubes (CNTs) doped vanadium pentoxide (V_2O_5) porous aerogels are a good kind of material as the cathode material in lithium batteries due to their layered structure, high energy density, good reversibility, high capacity for lithium ion insertion. V_2O_5-CNTs nanocomposites were synthesized by a sol-gel method, using the solvent exchange and ambient pressure drying technique. Electrochemical measurements of the nanocomposite were tested. The lithium ion capacity and cycle ability of the composites were investigated by galvanostatic discharge-charge cycling. The results showed that the nanocomposite had the higher capacity, about 384.0mAh/g in the first discharge process and 256.3mAh/g in the second discharge cycle. The charge-transfer reaction at the electrode/electrolyte interface and the kinetic mechanism were too studied by using electrochemical impedance spectroscopy.

Synthesis and Electrical Characteristic of P-Type ZnO Film on Indium-Tin-Oxide Glass Substrate by Ultrasonic Spray Pyrolysis

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ABSTRACT

This paper has present a transparent diode device fabricated by p and n type ZnO films using ultrasonic spray pyrolysis (USP) method. The ammonia is added to the solution to provide the N-source and the P type ZnO can be obtained. I-V curve for the transparent diode can be measured and the turn-on voltage of the diode device is 2.3 V.

Research on Nanocomposite Based on Chitosan Intercalated in Montmorillonite

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ABSTRACT

Chitosan/montmorillonite nanocomposite was prepared by solution of Na^+-montmorillonite and chitosan. Intercalation of chitosan into Na^+-montmorillonite provides nanocomposites with both interesting structural and functional properties. Dissolving of chitosan into the acid on the molecular chain could cause chitosan molecule solution, where $-NH^{3+}$ was inserted in the interlayers of montmorillonite. Intense mutual function increased the spacing between the montmorillonite interlayers and destroyed the crystal structure of montmorillonite to form inserted even part peeling nanometer compound.

A rotational viscosimeter was used to track the viscosity change to analyze the course of intercalation reaction. By the biggest flocculation point, the course can be divided into two stages, flocculating stage and inserting stage.

Techniques employed in the characterization of the nanocomposites, XRD, FTIR spectroscopy, SEM, and thermal analysis, confirmed the high affinity between montmorillonite layers and chitosan macro-molecules.

Thermodynamic analysis indicated that the intercalation reaction could carry out spontaneously. Thermo gravimetric analysis, tensile tests and scanning electron microscopy showed, compared with the original chitosan, the mechanics property of chitosan/montmorillonite nanocomposite was enhanced distinctly. Especially the wet strength and percentage elongation at dry break was raised by 1.62 and 1.68 times separately. With the addition of montmorillonite, thermal decomposing rate of the composite in the solution decreased remarkably, about 50%. The maximum temperature

of the thermal decomposition was enhanced 27°C. The composite could be fit for acid solution; degree of swelling was reduced from 190% on chitosan to 83% on the composite.

Keywords: chitosan, montmorillonite, nanocomposite, intercalation reaction.

Interface Study of $CuInSe_2$/ZnO and $CuInSe_2$/ZnO Devices using ICP-Assisted Magnetron Sputtering ZnO Buffer Layer

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ABSTRACT

A connection between the back contact and the front contact in a solar cell will short-circuit the cell by forming an highly conductive ohmic shunt path [1]. Without the intrinsic zinc oxide (i-ZnO) layer, a scratch or a hole would form a shunt path between the molybdenum back contact and the aluminum doped zinc oxide front contact. Intrinsic ZnO layer can reduce the effect of this kind of shunts and the amount of protection depends on the resistivity and the morphology of the ZnO film. In our work, ZnO film was prepared for CIS solar cell application [2-4] on CIS layer by inductively coupled plasma (ICP) assisted DC magnetron sputtering at room temperature. The sputtering was done in an Ar and O_2 gas mixture and a ceramic ZnO target was used. The microstructures of the film were investigated by X-ray diffractometer (XRD) and scanning electron microscope (SEM). Film with resistivity of $7x10^8 \Omega\cdot cm$ and transmittance of about 80% in the visible range was prepared under the conditions of 4 mTorr working pressure, 300 W RF power, 30 W DC power.

Dynamic Process of Conductive Networks Formation for Carbon Black Filled Poly(vinylidene fluo-ride)/Poly(methyl methacrylate) Composites

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ABSTRACT

This work attempts to determine how the conductive filler and matrices affect the conductive networks formation in nanoparticles filled polymer blends. Using Poly(vinylidene fluoride) (PVDF) and Poly(methyl methacrylate) (PMMA) as matrices, carbon black (CB) as a conductive nanofiller, the dynamic process of conductive networks formation in the above composite system is investigated by real-time tracing the time dependence of electrical resistivity during the isothermal treatment. It is observed that the dynamic percolation curves for CB filled PVDF/PMMA composites shift to a shorter percolation time with increasing both the annealing temperature and the CB concentration. The shape of the dynamic percolation curves remains self-similarity to each other, and the Arrhenius plots of the percolation time (t_p) against the inverse of the annealing temperature do not change with changing both the CB concentration and the annealing temperature. The activation energy of PVDF50/PMMA50/CB system is close to that of PVDF/CB system, but is lower than that of PMMA/CB system. SEM micrographs verified that conductive networks formation can be attributed to CB particles agglomeration in matrices. The PVDF40/PMMA60/CB composite shows the shortest percolation time caused by a competition among the interaction be-tween CB and matrices, the viscosity of the composite and the volume effect. Furthermore, the percolation time for CB filled miscible PVDF/PMMA composites during the annealing treatment is predicted by a thermodynamic percolation model with modified parameters and it expresses experimental results well.

Laser Processing and Spectroscopic Characterization of Porous Silicon

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ABSTRACT

Porous silicon was prepared by using an argon-ion laser in a laser-induced etching process at different etching time. Scanning electron microscopy was used to monitor

changes in surface morphology produced during the etching process. Porous silicon samples were subjected to spectroscopic investigations. The first-order Raman line asymmetry was found to decrease with increase of the etching time, while the peak position downshifted for a given power density. The photoluminescence spectra (PL) exhibit a blue shift in peak position with etching time. Both Raman and PL data were explained using appropriate quantum confinement models involving three-dimensional confinement and Gaussian size distributions of nanocrystallites constituting porous silicon samples. There is reasonable agreement between the results obtained from Raman and PL spectroscopic investigations of the PS samples.

Fabrication and Characterization of p-type ZnO Nano-Thin Films Prepared by *in Situ* Oxidation of Sputtered Zn_3N_2

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ABSTRACT

The precursor Zn_3N_2 films were deposited on quartz glass substrates by reactive DC magnetron sputtering and oxidized *in situ* at various temperatures by introducing pure oxygen gas directly into the deposition chamber. X-ray diffraction (XRD), scanning electron microscopy (SEM), UV-VIS transmittance, Hall-effect measurements and photoluminescence (PL) were carried out to investigate the structural, optical and electrical properties of the samples. The results showed that the properties of ZnO:N films strongly depended on the oxidation temperature and duration. By optimizing the oxidization conditions, high-quality p-type ZnO:N films with c-axis preferential orientation were obtained. Hall effect measurement results showed that the ZnO:N films oxidized at 500°C had a resistivity of 0.7Ω·cm, a hole concentration of 6.2×10^{18} cm^{-3} and a mobility of 4.95 $cm^2/V\cdot s$ while the films still showed high transmittance in the visible region and strong excitonic UV emission at 387 nm.

Keywords: P-type ZnO, nano-thin film, DC magnetron sputtering.

Crystal Growth of ZnO Films on Glass Substrate by MOCVD with Two Buffer Layers of SiO_2 and ZnO

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ABSTRACT

In this paper, SiO_2 film was grown on the substrate of Corning glass, a thin layer of ZnO(~ 15 nm) was grown on SiO_2 film subsequently. High quality ZnO film was grown on the two buffer layers after that. The two ZnO films were all grown by metal-organic chemical vapor deposition under different temperature. We could find only the X-ray diffraction pattern of (0 0 2) ZnO film indicating strong c-oriented growth.

Keywords: ZnO; SiO2; Thin film; MOCVD

Soft Magnetic Properties and High Frequency Characteristics of Fe-O Nanocrystalline Alloy Films

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ABSTRACT

The effect of oxygen-doping and thickness has been studied on soft magnetic properties and high-frequency characteristics of as-deposited Fe-O alloy thin films produced at room temperature by a helicon-plasma-enhanced RF magnetron sputter-deposition. A reduction in magnetic coercivity due to grain refinement was achieved using very low dose of oxygen which did not lead to the formation of crystalline Fe oxides with the low saturation magnetization. The real part (μ') of permeability has a high value of 1100 and is maintained up to 1 GHz below 150 nm for the relative O_2 flow ratio of R_{O2} = 2.4%.

Preparation and Characteristics of $Ni_xFe_{3-x}O_4$-Encapsulated Hollow Glass Spheres by Ferrite Plating

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ABSTRACT

Hollow glass spheres were encapsulated with a layer of $Ni_xFe_{3-x}O_4$ film in the open air by ferrite plating; the films were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM) and energy dispersion spectroscopy (EDS). The films with thickness at about 0.5 mm had amorphous structure. The proportion of nickel to iron in the films was affected by the proportion of reactants and the synthetic conditions. Hysteresis loops determined by vibrating sample magnetometer (VSM) indicated that the films had ferromagnetic behavior after anneal.

Design, Preparation and Characterization of the Opto Electronic Materials Co-Doped with Metal Nano-Particles and Dyes Based on the Supramolecular Structure

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ABSTRACT

A novel method for designing of functional material was developed to achieve optical storage material absorbing in short wavelength band. The composite film co-doped with metal nanoparticles and dyes was prepared by colloid chemistry method. The characterization of the films was made by using Transmission Electron Microscope (TEM), Ultraviolet-Visible Spectra (UV-Vis), Fourier Transform Infrared Spectra (FT-IR),

and thermal gravimetric analysis (TGA). Compared with the undoped film, a 6-nanometer absorption blue-shift of methyl orange (MO) in the film doped with silver nanoparticles was observed. The mechanism of absorption shift was analyzed by a proposed supramolecular structure model. TGA showed that the composite film based on supramolecular structure could present excellent thermal properties suitable for the requirements for optical storage. The results suggested that this new type of material was capable of matching GaN semiconductor laser, having wavelength of 400-450 nm, in optical storage technology.

Efficiency Enhancement for ZnO Tetrapod Dye-Sensitized Solar Cells by TiO_2 Coating and Ammonium Treatment

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ABSTRACT

Dye sensitized solar cells (DSSCs) have aroused much interest in recent years. However, the efficiency still needs improvement. In order to enhance the performance of the cells, it is important to increase the active surface area for dye adsorption so as to increase the light absorbance. In this work, zinc oxide (ZnO) tetrapods, which have four legs extending from a common core, were used to fabricate the photoanode due to its large surface area. Also, it is important to reduce the recombination rate and increase the carrier transport rate so that a higher efficiency can be achieved. Therefore, the effect on the performance of cells after coating a titanium oxide (TiO_2) film and ammonium treatment on the ZnO nanostructures were investigated, too. The former helped suppress the recombination rate while the latter helped improve the carrier concentration and charge transport. Moreover, X-ray photoelectron spectroscopy (XPS) and photoluminescence (PL) spectroscopy were performed on the as-grown and ammonia annealed samples. Under optimal conditions, AM 1.5 power conversion efficiency of 1.02% was achieved.

The Effect of H Content in Si Precursor on the Performance

of Microcrystalline Crystallized by Pulsed YAG2ω Laser on Soft Substrate

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ABSTRACT

YAG laser crystallization of Si-based thin film deposited on plastic substrate has been studied. The Si-based thin films as crystallization precursor are with varied hydrogen (H) content. The effect of the H content on the crystallinity of the resulted poly-Si film has been investigated. The experimental results of the poly-Si crystallized by double-frequency YAG laser shows that the initial dehydrogenation process could be left out if mc-Si was adopted as the crystallization precursor. The YAG laser annealing condition on plastic substrate and the crystallization results have been discussed in the paper.

Key words: Poly silicon, 2 ω YAG laser crystallization, H content, plastic substrate.

Preparation and Characterization of WO_3 Nano-Powder with Microemulsion Method

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ABSTRACT

WO_3 nano-powder was synthesized by micro-reactor method in CTAB/n-butyl alcohol/n-octane/H_2O microemulsion system and sodium tungstate and hydrochloric acid as reactants. Structure and properties of WO_3 nano-powder were characterized by X-ray diffractometer, transmissive electron microscopy and UV-vis. It is shown that the particle sizes, topography of the particles and phase structures of WO_3 nano-powder are changed with moisture content in the microemulsion system, calcination temperatures and different reactants, the sizes of WO_3 nano-powder increase with moisture content in the microemulsion system and calcination temperatures. The sizes of WO_3 particles obtained from ammonium tungstate as reactant are samaller than that sodium tungstate as reactant.

Keywords: W/O microemulsion, micro-reactor, CTAB, tungsten trioxide nanoparticles.

Porous Silicon Prepared by Hydrothermal Etching and its Surface Transformation Induced by Plasma Immersion Ion Implantation

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ABSTRACT

A hydrofluoric-acid-free hydrothermal etching technique is used for the preparation of porous silicon. Hydroxide bismuth ($Bi(OH)_3$) powder and a piece of 1cm×3 cm p-type (100) silicon were put into a kettle with 40 ml deioned water. The kettle was heated to 180°C, and kept at that temperature for 48 hrs, and then cooled down naturally. The surface morphologies were observed using a scanning electron microscope (SEM) and an atom force microscope (AFM). It was found that with the increase of hydroxide bismuth dosage the average hole size became larger, and the distribution of the hole sizes became much broader. By plasma immersion ion implantation (PIII) technique, high dose nitrogen ions were implanted into the porous silicon samples. Photoluminescence (PL) spectrum at room temperature showed an obvious blue-shift after N-ions implanting. The mechanism of such blue-shift has been studied in this work.

Key words: Hydrofluoric-acid-free; Hydrothermal-etching; Nano-porous silicon; PIII; PL

Study Morphology Transition in Block Copolymer Thin Film Traced by AFM Utilizing Single-Wall Carbon Nanotube

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ABSTRACT

A relatively efficient and simple relocation technique for atomic force microscopy (AFM), which takes advantage of single-wall carbon nanotube, is used for investigating repeatedly the imaging of some specific spaces on the whole substrate with a high relocation accuracy of tens of nanometers. As an example of the application of this technique, AFM ex-situ study of the morphology transition induced by solvent treatment in a block copolymer thin film has been carried out. By using single-wall carbon nanotube independent of microdomain patterns, even if the morphology of the block copolymer has been changed completely after a certain treatment, the previous imaged spot can be found easily. It is believed that this kind of relocation method can be widely used in material science and molecular biology field besides polymer.

Cavitation Erosion Resistance Performance Study of Nanostructured WC-12Co Coatings Sprayed by HVOF

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ABSTRACT

The Nanostructured WC-12Co coatings were prepared by high velocity oxy-fuel(HVOF) spraying with five kinds of spraying parameter and their properties, such as hardness and cavitation erosion resistance were investigated. The phases of feedstock powders and the as-sprayed coatings were determined by XRD. The characterizations of spraying powder, microstructure and surface morphology of the prophase and anaphase cavitation erosion surfaces were done by SEM. The results indicated that the barrel length was the key factor that controlled the decomposition of nanostructured WC during spraying, Nano-WC decomposed much more severely when using a long barrel than using a short one. While nanostructured WC partly decomposed, which resulted in volume loss of cavitation erosion of partly decomposed coatings are less than undecomposed coatings in pure water, and are similar to ZG06Cr16Ni5Mo that used for cavitation erosion.

Synthesis of Acicular α-Al_2O_3 Powder by Precipitation Method

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ABSTRACT

Nanometer-size acicular α-Al_2O_3 powder is an important raw material wildly used in ceramic materials, semiconductor materials *et al*. The morphology control of α-Al_2O_3 particle is a problem. In this paper, the ammonium aluminum carbonate hydroxide (AACH) precursor with acicular particles was synthesized by precipitation method. We controlled the morphology of AACH by adjusting the pH value and charging rate during the chemical reaction. When baking at 1200°C for 1 h, the AACH phase transformed to α-Al_2O_3 phase and the α-Al_2O_3 particles inherit the acicular morphology from the precursor. The prepared α-Al_2O_3 powder has good dispersibility and the particles have about 2 μm length and 200 nm diameter.

Keywords: Alumina, Synthesis, Precipitation.

Preparation and Properties of the Sensing Nano-Film Immobilizing Plant-Esterase-$TPPS_1$

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ABSTRACT

A novel sensing nano-film for detecting dimethyl methyl phosphonate (DMMP), which is based on inhibition of plant-esterase by monosulfonate tetraphenyl porphyrin ($TPPS_1$), was prepared, and characterized by atomic force microscope (AFM) in this study. Several influence factors, such as sodium alginate concentration, activation time, and adsorption time, were investigated. The morphology and DMMP sensing property of the film prepared under optimized conditions were analyzed. The results showed that the activity of immobilized plant-esterase was higher when sodium alginate concentration wass 0.43 M, activation time was 80 min, and adsorption time was 170 min. The nano-structure of the film was characterized by AFM. This nano-scale had a good effect on sensitve and lowered the detection limit. The interaction of $TPPS_1$ with immobilized plantplantesterase yielded a characteristic peak at 422 nm. Addition of the inhibitor DMMP to the immobilized plant-esterase-$TPPS_1$ film resulted in a decrease in absorbance intensity at 422 nm due to the displacement of the porphyrin from the active site. The loss in intensity at 422 nm was linearly dependent on DMMP concentration at levels below 9×10^{-7} mol L^{-1}. DMMP concentrations as low as 4.5×10^{-10} mol L^{-1} had been detected.

Keywords: Immobilizing plant esterase-$TPPS_{1;}$ DMMP sensing property.

New Insight into the Role of Nitrogen Doping ZnO

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ABSTRACT

Using first-principles pseudopotentials method based on density functional theory, we have performed a detailed study of ZnO doped nitrogen. The formation energies and electronic structure are calculated for various defect configurations (N_o, N_i, N_{Zn}) in charge states. It is found that nitrogen substituting oxygen (No) has the lowest formation energy under Zn-rich condition, which is in good agreement with other calculated results and experimental data. The complex defects configurations are also considered, the configuration of nitrogen substitute zinc and oxygen along the c axis has lower formation energy at +1 charge states. Furthermore, the electronic structures are compared to identify the changes of ZnO doped by nitrogen in various charge states. We suggest that the Zn-rich condition of ZnO should be controlled to obtain p type ZnO. The study yields new insight into the role of nitrogen doping ZnO, which would be useful for the application of ZnO material in the field of optical device.

Benzene Adsorption Properties of Silica Aerogel-Fiber Composites

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ABSTRACT

Silica aerogel-fiber composites were prepared via a heat pressing process. Nonwoven fibers were distributed inside the silica aerogels as a composite to act as a supporting skeleton which increased the mechanical strength. The morphology, pore structure, benzene adsorption capacities of the silica aerogels and the composites were characterized. The results show that the silica aerogel-fiber composites have more excellent benzene adsorption capacities compared with the traditional absorbent materials. The saturated benzene-adsorption percentage of the composites has a direct relation with the silica aerogels weight per unit area and the saturated benzene-adsorption percentage of silica aerogels. The experimental results are in good agreement with those calculated by a special formula. The composite process has no influence on the porous structure of the silica aerogels.

Keywords: Silica aerogel; nonwoven fibers; composites; benzene adsorption properties

Preparation of a Novel Core-Shell Structure $CoFe_2O_4/TiO_2$ Magnetic Nano-Photocatalyst

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ABSTRACT

The core-shell $CoFe_2O_4/TiO_2$ magnetic nano-photocatalyst were prepared by hydrolysis of titanium tetrachloride precursor in the presence of the $CoFe_2O_4/TiO_2$ magnetic photocatalysts. The core-shell structure the $CoFe_2O_4/TiO_2$ magnetic photocatalysts were dried blew 100°C and calcined at 350°C for 2h. The prepared photocatalysts were easy to be separated from polluted water by using an external magnetic field and shown high catalytic activity for the degradation of methyl orange in water under UV and visible-light. The morphology and the crystalline structure of the $CoFe_2O_4/TiO_2$ magnetic photocatalysts were characterized by transmission electron microscopy (TEM) and X-ray diffraction (XRD). The size of $CoFe_2O_4$ particles was about 20 nm and a TiO_2 coating was enwrapped on the $CoFe_2O_4$. The diameter of $CoFe_2O_4/TiO_2$ particles is in the range of 30-40 nm. So the shell of TiO_2 enwraps closely around the core and the thickness is in the range of 10-20 nm.

Keywords: Core-shell, $CoFe_2O_4/TiO_2$, Magnetic photocatalyst.

Characterizations of SnO_2 Thin Films Deposited on Glass Substrates

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ABSTRACT

The SnO_2 films prepared by a two-step thermal oxidization method is shown below: first, tin films, which aced by evaporation, were oxidized at oxygen atmosphere below the melt-pointing of metal tin, and then, the films were continued oxidization at high temperature. The effects of oxidation temperature on the structural properties, optical properties of the samples were investigated by scanning electron microscopy (SEM), X-ray diffraction (XRD), and UV-VIS transmittance spectra. It was found that the grain size and the surface morphology correlate with the oxidation temperature. The surface of SnO_2 thin films was compact and uniform by SEM measurements. XRD analyses revealed that various diffraction peaks of SnO_2 were observed even with the temperature of 400°C. When Tin films were oxidized at a temperature of 550°C, various diffraction peaks were indexed as (1 1 0), (1 0 1), (2 0 0), and (2 1 1). Moreover, the (2 0 0) peak from the SnO_2 is hardly detected, if the oxidation temperature is less than 550°C. UV-VIS transmittance spectra showed the optical transmission of SnO_2 thin films in the visible wavelength region improved with increasing oxidation temperature. And the energy gap increases as the oxidation temperature increases too. The technique developed in this work also has many advantages than other methods for fabricating SnO_2 films, such as easiness in large area fabrication, low-cost, high reliability in control processing.

Preparation of Palladium Nanoparticles and their Applications in Dehalogenation of Aryl Halides

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ABSTRACT

Pd nanoparticles with narrow size distribution were prepared by using $Pd(OAc)_2$ in poly(ethylene glycol) in the absence of reducing agent, which lead to a highly active catalyst for the dehalogenation of aryl halides.

Synthesis and Optical Properties of β-BaB_2O_4 Nanorods from Hydrothermal Method

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ABSTRACT

The nanorods of barium borate (β-BaB_2O_4) were first prepared by simple hydrothermal method with the assistance of CTAB and investigated optical properties. The growth mechanism of β-BaB_2O_4 nanorods could be attributed to a CTAB template-confined. The barium borate nanorods with diameters of 20~30 nm and lengths of 200~500 nm were obtained, their optical properties were primary studied. The optimum experimental parameters and possible soft-template growth mechanism for the formation of barium borate nanorods was discussed. Powder X-ray diffraction (XRD), infrared spectroscopy (IR) and transmission electron microscope (TEM) tests were applied to investigate the composition, morphology and crystalline of the nanorods barium borate. Optical properties of barium borate nanorods were examined by FL and UV-VIS. The main peaks in the excitation and emission spectra can be viewed as the typical emission of barium borate. The ultraviolet-visible (UV-VIS) absorption spectrum revealed that barium borate was effectively excited by the ultraviolet light, which caused the large electronegativity difference in B-O band.

Keywords: Hydrothermal method; barium borate; nanorods; optical properties.

Synthesis of Nano-Sized WC/MgO Powders by Reactive High-Energy Ball Milling

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ABSTRACT

A mixture of powders of pure WO_3, Mg and graphite with an atomic ratio of 1:1:3 was ball milled at room temperature using a high-energy ball mill method in the present work. After ball milling for 4.7 h, a mechanical solid state reduction is successfully achieved between the Mg and WO_3 particles to form a product of MgO and a mechanical solid state reaction also takes place between the W particles and graphite powders to obtain WC. The extension of the ball milling leads to the refinement of the products. After ball milling 50 h, the nanocrystalline MgO/WC grains with a size of 25 nm were obtained. The experimental results and kinetics analysis indicate that the formation of MgO is a mechanically induced self-sustained reaction by high-energy ball milling, and very short milling time is needed to complete the reaction.

Keywords: High-energy ball milling; Nanocomposites; Kinetics; Self-propagating reactive.

Mechanical Reinforcement of Silica Aerogel Insulation with Ceramic Fibers

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ABSTRACT

Silica aerogels doped with ceramic fibers were prepared successfully via sol-gel process with polyethoxydisiloxanes (E-40) as the silicon source. Surface modification was used to realize ambient pressure drying. The morphology, pore structure, mechanical properties and thermal conductivity of the silica aerogels doped with ceramic fibers were investigated. The results show that the ceramic fibers were evenly distributed inside the silica aerogels to increase the mechanical property. The mechanical strength of the silica aerogels increases from 1.6×10^4 pa to 9.6×10^4 pa with the doping of 10% ceramic fibers, while the thermal conductivity is 0.029w/m·K at room temperature in air. The hydrophobic properties of the doped aerogels are improved a lot by surface modification.

Keywords: silica aerogel, ceramic fibers, mechanical property, thermal conductivity, hydrophobic.

Preparation and Properties of Bilayer Colored Nanofilm Coated Glass Using On-Line Processing

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ABSTRACT

A bi-layer nanofilm for colored solar-control coated glass was prepared using electrochemical deposition and chemical vapor deposition (CVD) on the float glass production line. The spectral performance, surface morphology and microstructure of the composite film were analyzed by spectrophotometry, scanning electron microscopy (SEM), energy-dispersive spectrometry (EDS), transmission electron microscopy (TEM), atomic force microscopy (AFM) and secondary-ion mass spectrometry (SIMS). The experimental results show that the processing parameters, such as the concentration of SiH_4 and the electric current, strongly influence the visual transmission. The top surface layer of amorphous silicon is smooth, the size of the nodules is about 100 nm, the surface roughness is 9.66 nm and the thickness of the layer is 70~78 nm. An oxidization gradient along the thickness of the silicon layer was observed. The diffusion depth of Cu and Bi in the bottom layer is around 1 μm.

Keywords: A. thin film, B. vapor deposition, C. electron microscopy, D. microstructure.

Synthesis and Bioactivity of Highly Ordered TiO_2 Nanotube Arrays

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ABSTRACT

The highly-ordered TiO_2 nanotube arrays were fabricated by potentiostatic anodization of Ti foil in a fluorinated dimethyl sulfoxide (DMSO). TiO_2 nanotube arrays with 12μm in length, 170 nm in diameter and about 70 in aspect ration are formed using a 40V anodization potential for 24 h. The as-prepared nanotubes are amorphous but crystallize with heat treatment temperature. Anatase phase appears at a temperature about 300°C, and anatase phase transforms to rutile phase at about 600°C. The diameter of nanotubes constricts, the wall thickness increase slightly after heat-treatment, and the nanotube arrays structure are stable up to 600°C. A thick apatite layer about 13μm covers the whole surface of TiO_2 nanotube arrays after heat treatment at 500°C and soaking in SBF for 14 days, indicating excellent *in vitro* bioactivity of TiO_2 nanotube arrays due mainly to its high specific surface area and its anatase phase.

Study on the Formation of Hydroxyapatite on Chondroitin Sulfate

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ABSTRACT

A biomimetic process was developed to prepare nano hydroxyapatite with 0.5mass% chondroitin sulfate as template. The crystalline phase, microstructure, chemical composition and morphology of the hydroxyapatite crystals obtained in the experiment were characterized by means of X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR), transmission electron microscopy (TEM), Atomic Force Microscope (AFM) and Elemental analysis respectively. The interaction between the functional groups of ChS and HA was investigated by electrical conductivity, UV-Vis spectrum and FTIR. The results show that the nucleation and growth of HA crystals occurred through the chemical interactions between the HA crystals and preorganized functional groups of the ChS macromolecular. The ChS plays a templating role to provide active sites for the nucleation and growth of HA crystallites. And the crystallinity of samples increased with the aging time.

Synthesis of In_2O_3 Nanowires, Nanobouquets and Nanopins

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ABSTRACT

Semiconducting oxide In_2O_3 nanostructures were prepared by reduction of In_2O_3 powder at 650°C through vapour-phase transport process. In_2O_3 nanowires, nanobouquets and nanopins were obtained. The obtained In_2O_3 nanostructures were characterized by the X-ray diffraction measurement, scanning electron microscopy, and transmission electron microscopy.

Growth of Red-Cell-Like Bi_2WO_6 Hierarchical Architectures and their Use as Recyclable Visible-Light Photocatalysts

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ABSTRACT

Bismuth Tungstate (Bi_2WO_6) that was prepared by solid-state reaction at high temperature in previous work showed catalytic activity in the degradation of organic compound under visible light irradiation. During the past three years, some reports on the fabrication of Bi_2WO_6 nano-/microstructures in solution and their use as visible-light photocatalysts have emerged. Despite much progress in this exciting field, no report has discussed the repeating usage of this material to degrade organic compounds, partially due to the lack of well-defined Bi_2WO_6 structures. In this article, red-cell-like Bi_2WO_6

hierarchical architectures consisting of a number of square nanoplates of average ~30 nm in side length have been firstly synthesized by a hydrothermal method at 180°C for 12 h. These as-prepared microstructures have biconcave configurations with typical sizes of 1.8–2.5μm, uniform and monodisperse. TEM examination indicates that the single-crystal subunit nanoplates with (001) as their two-dimensional (2D) surfaces assemble orderly using both their edges and faces. The good photocatalytic activity in the degradation of rhodamine B under visible light irradiation (λ>400 nm) is also discussed. Furthermore, we show that these architectures can serve as effective and convenient recyclable photocatalysts, which is crucial to industrial applications. Only a slight decrease in the photodecomposition rate is observed after 5 cycles of the photocatalysis experiment. All these results demonstrate that the red-cell-like Bi_2WO_6 hierarchical architectures are promising visible-light-driven photocatalysts and have many potential applications in environmental protection.

New Technique for Developing of Nano-Magnetic Lubricating Oil Using Non-Equilibruim Plasma at Normal Pressure

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ABSTRACT

The magnetic lubricating oil of nitride was developed in a gas-liquid reactor by the plasma activated and ionized reactants at atmospheric pressure. The reaction time was shortened to 2 hours by controlling discharge parameter of plasma and optimizing the thermal decomposition temperature of $Fe(CO)_5$. The magnetic lubricating oil is composed of nanoparticles with about 10 nm gain size, and has good fluidity with saturate magnetization of 800G (non-concentrated). The experiment researches show that plasma can supply the needed activation energy for the band broking of the gas-liquid reactant molecules which are recombined and forming magnetic lubricating oil, and that plasma activation at normal pressure is an effective method for synthesis of magnetic fluid.

Keywords: Plaxma, activation, magnetic lubricating oil.

Preparation and Characterization of SiO_2 Nano-Rods by CVD Method

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ABSTRACT

A simple method is presented for the preparation of silica nano-rods. The silica nano-rods with a diameter of about 200 nm with smooth surface were synthesized by chemical vapor deposition method at 1300°C. The as-synthesized samples were characterized by means of scanning electron microscopy, energy dispersive x-ray, and transmission electron microscopy. The results show that synthesized silica nano-rods have a uniform size, well-defined shape, and smooth surface. However, the morphologies and microstructures of silica nano-rods are affected by synthesis conditions, such as the synthesis temperature and the vapor concentration of the SiO_x. On the basis of these experimental results, a possible growth mechanism of silica nano-rods in this process is proposed.

Keywords: Silica nano-rods; CVD; synthesis conditions; scanning and transmission electron microcopy.

Synthesis and Electro-Optic Property of Intercalation Polyimide and Polyimide/Silica

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ABSTRACT

An intercalation nonlinear-optical (NLO) polyimide was synthesized by the ring-opening polyaddition of 4,4'-(Hexafluoroisopropylidene) diphthalic Anhydride (6FDA) and [(6-nitrobenzothiazol-2-yl)diazenyl]phenyl-1,3-diamine. Then, sol-gel technique was adopted, utilizing 3-aminopropyltriethoxysi- lane (APTES) and tetraethoxysilane (TEOS). The polyimide/silica hybrid material was obtained. The polyimide and hybrid were characterized by the methods of FT-IR spectra, differential scanning calorimeter (DSC), thermogravimetric analysis (TGA), scanning electron microscopy (SEM), transmission electron microscope (TEM), x-ray diffraction (XRD) to get their structure, morphology, thermal performance etc. The results showed that interpenetrating hybrid polymer networks was formed, there were finely dispersed, and existed bond conjunction between organic-inorganic phases. The glass transition temperature (T_g) and the decomposition temperature (T_d) at 5% mass loss were 247, 364°C and 363, 462°C, respectively. These results showed that the hybrid material had excellent thermal stability than the pure polyimide. The polyimide and hybrid solution could be spin coated on the indium-tin-oxide (ITO) glass to form optical quality thin films. The electro-optic coefficients of nonlinear optical polyimide and hybrid were measured at the wavelength of 832 nm. The electro-optic coefficients (γ33) were 19 and 16pm/V and the values remained well (retained > 92% for more than 100 h). The results suggest that the materials have potential applications for high performance optical device.

Keywords: Polyimide; hybrid material; electro-optic property.

Study of Uricase Immobilized on ZnO Nanotetrapods for Uric Acid Detection by Quartz Crystal Microbalance

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ABSTRACT

Uricase immobilized on ZnO nanotetrapods for uric acid detection was studied by quartz crystal microbalance (QCM). The ZnO nanotetrapods were synthesized by evaporating high purity zinc pellets (99.999%) at 900°C in air and then distributed onto the electrode surfaces of QCM at room temperature. Uricase directly immobilized on ZnO nanotetrapods in air. And the sensor was used for uric acid detection. The frequency response showed a linear (r = 0.99872) dependence on the uric acid concentration ranging from 5.0×10^{-6} to 1.0×10^{-3} $molL^{-1}$ with a detection limit of 2.0×10^{-6} $molL^{-1}$. All the results indicated one-dimensional ZnO structure is a good material for biosensor application.

In Situ Synthesis of Nanoparticles within Polyelectrolytes Multilayer Films to Fabricate the Nanostructured Hematite Hollow Microspheres Used for Oxygen-Evolving Photoanode

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ABSTRACT

Ferric compounds were preformed assembled on the long chain of poly (styrenesulfonate) (PSS) forming PSS-Fe complexes. Alternating layers of PSS-Fe complexes and poly (diallyldimethylammonium chloride) (PDDA) were assembled on the melamine formaldehyde (MF) microspheres by layer-by-layer technique. Hematite nanoparticles were in situ synthesized within polyelectrolyte multilayer films (PEMFs), and nanostructured hollow hematite microspheres were formed after the removal of MF template through further heating treatment. Excitated by ultraviolet radiation, the nanostructured hematite hollow microspheres used for oxygen-evolving photoanode can generate photoelectrons to induce photocurrent, which indicate its photoelectriochemical oxidation activity.

Keywords: In situ synthesis; Polyelectrolyte multilayer films; Layer-by-layer; Hollow microspheres; Hematite nanoparticles; Photoelectriochemical.

Bienzymatic Glucose Biosensor Based on Co-Immobilization of Glucose Oxidase and Horseradish Peroxidase on Gold Nanoparticles-Mesoporous Silica Matrix

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ABSTRACT

A newly bienzymatic glucose biosensor was prepared for selective and sensitive detection of glucose. This biosensor was built by simultaneous immobilization of glucose oxidase (GOx) and horseradish peroxidase (HRP) into the gold nanoparticles-mesoporous silica composite (GNPs-MPS) matrix, and then casting the composite on glassy carbon electrode (GCE) using Nafion as a cross-linker. Cyclic voltammetry (CV) and amperometry were employed to investigate the catalytic behavior of the biosensor to the oxidation of glucose. As a result, the biosensor exhibited an excellent bioelectrocatalytic response to glucose, as well as good long-term stability and reproducibility.

Keywords: Bienzymatic biosensor; Glucose oxidase; Horseradish peroxidase; Mesoporous silica; Gold nanopariticles.

Preparation and Properties of Nano-Composite Mesostructured Thin Films Containing Rhodamine B

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ABSTRACT

Nano-composite mesostructured thin films containing rhodamine B have been prepared. A precursor sol containing tetraethoxysilane, ethanol, surfactant cetyltrimethylammonium bromide (CTAB), water, rhodamine B and acid catalyst was prepared by sol-gel, the control being suitable response condition. Depositing the precursor sol on a substrate wherein evaporation of solvent and water causes the formation of mesostructured films on the substrate surface by evaporation- induced self- assembly process. The mesoporous film was characterized by XRD and TEM. The absorption and fluorescence spectra of the films have been observed. The UV-visible absorption spectra of the films incorporated with rhodamine B show that the main absorption band of rhodamine B-doped films can be attributed to the rhodamine B monomers, and only a very weak absorption band of the dimer can be observed. The single emission band in fluorescence spectra of rhodamine B-doped films can be attributed to transitions from the lowest-lying level of the first excited electronic state to the electronic ground state of rhodamine B monomers. The red shifts in the peak of the luminescence spectra with increasing rhodamine B-content in the films which may be interpreted as reflecting a decrease in the dipole moment of the exited molecule.

Keywords: Nano-composite mesostructured film, rhodamine B, fluorescence spectra, absorption spectra, sol-gel method.

Preparation of Nanoporous Silica Films with Varying Porosity by Manipulating the Amount of Surfactant

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ABSTRACT

A surfactant Cetyltrimethyl ammonium bromide (CTAB) is used as an organic template as the structure directing agent, under acidic conditions to generate the porous structure upon removal by heat treatment. A precursor sol containing tetraethoxysilane (TEOS), surfactant and hydrochloric acid catalyst was prepared by sol-gel process. Depositing the precursor sol on a substrate wherein evaporation of solvent and water causes the formation of nanoporous or mesoporous silica films on the substrate surface. The interaction between polymer after hydrolysis of tetraethoxysilane and surfactant was used to form molecules self-assembly in the solution by rapid solvent evaporation during dip coating. Influence of surfactant concentration on the structures and porosity of the nanoporous silica films was examined and analysed. By manipulating the amount of surfactant, nanostructure and porosity, pore size and pore shape as well as the morphology of the films could be controlled. Small angle X-ray diffraction, Field emission scanning electron microscope(TEM), Atomic force microscopy(AFM) exhibit hexagonal, cubic and new phase composed of primitive cubic and 3-d hexagonal(3-dH) as well as nano-porous larger than mesoporous organizations of the films. The porosities of 51.8%-65.6% were obtained via spectroscopic ellipsometry, which measures the refractive index of the film and the dielectric constant is calculated via porosity.

Keywords: Nanoporous, mesostructured, silica films, surfactant, varying porosity, sol-gel method.

Preparation of Nanometer Silicon Carbide Powders by Sol-Gel Processing

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ABSTRACT

Nanometer silicon carbide powders are synthesized by sol-gel and carbothermal reduction processing with TEOS (tetraethoxysilane, $(C_2H_5)_4SiO_4$)) and saccharose ($C_{12}H_{22}O_{11}$) as starting materials. Silica sol is prepared by hydrolyzed TEOS with deionized water, ethanol (CH_3CH_2OH) as cosolvent and hydrochloric acid as catalyst. It further dehydrated to make colorless and transparent gel and dried to obtain drying gel at 40°C. Carbothermal reduction of the prepared silica/saccharose composites is carried out in argon atmosphere of 500 Pa in a high vacuum furnace at temperatures ranging from 1200°C to 1500 °C to form powders. The surface morphology and crystal structure of nanometer SiC powders have been investigated using X-ray diffraction (XRD), atomic force microscopy (AFM) and Raman spectrum. Experimental results show that the samples have better crystalline state and its typical diameters reach nanometer magnitude.

Keywords: Silicon carbide powders, Sol-gel, Carbothermal reduction.

Self-Assembly of ZnO Nanorod Bundles into Flowerlike Architectures by a Hydrothermal Route

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ABSTRACT

The self-assembly of ZnO nanorod bundles into interesting flowerlike architectures are achieved via a simple hydrothermal route, which are different from many literatures reports. The composed ZnO nanorods, as self-assembly building blocks, are single crystals with the [0001] growth crystallographic direction; and most of them have diameters of ~ 500 nm, lengths of up to ~ 6.0 μm. The investigation results indicate that the ammonia content plays an important role in the formation of the flowerlike architectures in the presence of ethylenediamine. With the increase of the content of ammonia, self-assembly of ZnO nanorods into different flowerlike architectures are synthesized. A possible growth mechanism of the flowerlike ZnO architectures was proposed.

Nanofiber-Liked Polyaniline Thin Film Gas Sensor for Xylene Detection

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ABSTRACT

A nanofiber-liked polyaniline was prepared by *in-situ* oxidative polymerization and used for volatile organic compounds detection. The polyanilines were characterized by scanning electron microscopy and X-ray diffraction. Scanning electron microscopy showed a nanofibrous structure with 40~70 nm in diameter. In addition, the electrical properties of thin films were also discussed. The sensing behaviors to xylene were investigated in several hundreds ppm range. The sensor showed several tens of percent in sensitivity; however, the sensor did not show good response and recovery time.

Keywords: Polyaniline, Volatile organic compounds, Xylene, Gas sensor.

Determination of Rifampicin Location in Cholesterol-Lipid Liposomes by ^{2}H and ^{31}P Solid-State NMR

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ABSTRACT

Liposome encapsulated rifampicin (RIF), a first line anti-tuberculosis agent, was prepared using the chloroform film method. Cryo-transmission electron microscopy of the liposome showed a mixture of unilamellar and multilamellar vesicles with a size of 200-300 nm. The results correlated with those obtained from dynamic light scattering. Deuterated 1-palmitoyl-2-oleoyl-*sn*-glycero-3-phosphocholine (d-POPC) was used to prepare liposomes for solid-state nuclear magnetic resonance (SS-NMR). Cholesterol (CH), which orientates between the phospholipid molecules and affects the fluidity of the bilayer membrane, increased the physical stability of the liposome to longer than 4 weeks with increased CH content. Furthermore, SS-NMR results indicated that RIF was located between the methylene chains of the phospholipid bilayer, in association with CH molecules.

Study on Preparation and Antibacterial Property of Cu/TiO_2 Composite Nanoparticles

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ABSTRACT

Cu/TiO_2 composite nanoparticles were prepared by photoreduction deposition methods. The properties of the nanoparticles were widely characterized by X-ray diffraction (XRD), transmission electron microscopy (TEM) equipped with energy dispersive X-ray spectroscopy (EDS). Moreover, the antibacterial performances were performed by zone of inhibition (ZOI) tests against the bacteria species. The results suggested that the pH value had great influence on the properties of Cu/TiO_2 composite nanoparticles. Cu element tends to exist as Cu_2O when the pH is high, but Cu element does as pure Cu phase when pH value is low. With the increase of UV irradiation time, Cu phases are subsequently oxidized to Cu_2O, and the amount of Cu_2O in composite nanoparticles increased. The antibacterial activities of composite nanoparticles against *Staphylococcus*

aureus are well and enhanced with the increase of the Cu_2O amount. The synergistic effect was found between Cu and TiO_2.

Keywords: Cu/TiO_2 composite nanoparticles, photoreduction, antibacterial performance

Synthesis, Characterization and LPG Sensing Properties of Fe Doped Nano-Sized Tin Oxide

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ABSTRACT

This paper reports the synthesis, characterization and LPG sensing properties of Fe doped nano-sized tin oxide. The Fe doped nano-sized SnO_2 powder was synthesized by using a chemical co-precipitation method using stannic chloride ($SnCl_4$, $5H_2O$), iron chloride ($FeCl_3$) and ammonium hydroxide (NH_4OH), as starting materials and water as a carrier. The resulting nano-sized powder was characterized by X-ray diffraction (XRD) measurements, transmission electron microscopy (TEM) and thermogravimetric analysis (TGA). The LPG sensing properties of the synthesized Fe doped nano-sized SnO_2 powder were investigated at different operating temperatures and LPG concentrations. It was observed that doping of Fe significantly enhances the sensitivity of the nano-sized SnO_2 to the LPG. The sensitivity of Fe doped nano-sized SnO_2 to 75 ppm of LPG is maximum at an operating temperature 350°C and it was found to be ~504.30%. The response and recovery times were found to be nearly 3 sec and 5 sec, respectively. Finally, the plausible mechanism for the enhancement in the LPG sensing properties was discussed.

Preparation of Nano-Structured InGaAs Thin Film by Molecular Beam Epitaxy

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ABSTRACT

The nano-structured InGaAs films have been prepared by molecular beam epitaxy at different substrate temperature. The substrate temperature was varied from 400°C to 20°C. The samples were characterized by X-ray diffraction and absorption spectra. The results show that the grain size of InGaAs films and the bandgap width increase with increasing substrate temperature. The as-deposited nano-structured InGaAs films have been passivated using hydrogen plasma. The influence of hydrogenation on these InGaAs films has been studied by Fourier transform infrared absorption spectroscopy. These data show the presence of various hydrogen bondings in InGaAs samples prepared at 200°C and 20°C. And the effect of the post hydrogen passivation increases the dark resistivity and photo sensitivity. These results demonstrate the post hydrogen passivation reduces the defects in the films and improves properties of nano-structured InGaAs film.

Process Investigation of a-GaAs and a-GaAs:H Thin Films Prepared by Radio Frequency Magnetron Sputtering

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ABSTRACT

Amorphous GaAs(a-GaAs) and hydrogenated amorphous GaAs (a-GaAs:H) films have been deposited by radio frequency (RF) magnetron sputtering technique in different gas ambient. The dependence of the growth rate, grain size and optical properties on the deposition parameters has been studied. The results show that the growth rate gives a maximum value of 4.66 Å/s with the increase of working pressure up to 0.55 Pa, and increases with the increase of RF power. The grain size and optical band gap dependents on RF power. In addition, H addition shifts the optical absorption edge to higher energy. The thermal annealing experiment has been carried out. It can be found that a-GaAs:H starts to recrystallize at 350 °C accompanied by evolution of hydrogen.

Optical and Electrical Properties of a-InGaAs:H Films Prepared by Double-Target Magnetron Co-Sputtering

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ABSTRACT

Film growth is carried out in the growth ambient with H_2/Ar ratios ranging from 0 to 0.4 at a constant working pressure of 1 Pa by magnetron co-sputtering with the targets of InAs and GaAs. The composition, and structure characterization have been measured by electron diffraction spectrum (EDS) and X-ray diffraction (XRD). The optical properties and electrical properties of amorphous InGaAs:H α-InGaAs:H) films have been studied by spectrophotometer and microampere meter. The optical band gap of a-InGaAs:H thin film shifts to higher energies with increasing H_2/Ar ratios from 0.1 to 0.4. At the same time, dark conductivity and photo-sensitivity properties are related to H_2/Ar ratios. These results indicate that hydrogen has passivation effect on α-InGaAs:H thin films significantly. In addition, the temperature characteristic of the sample was investigated.

Nano SiO_2 on Electrical and Tribology Properties of GF/epoxy Composites

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ABSTRACT

With using ultrasonic wave and coupling agent, the nano- SiO_2 powder was modified and dispersed in epoxy resin respectively and epoxy nanocomposites were prepared. Then the tribological, electrical and mechanical properties of epoxy nanocomposite materials were studied. The tribological characteristics of the material were analyzed through friction and wearing test. The electrical insulation characteristics were studied through volume resistivity and permittivity test. The results demonstrate that the bending strength and modulus are increased 56% with the addition of nano SiO2 for the GF/Ep composites, but within 7wt%, the bending strength and modulus changes not obviously with the increase of the content of SiO_2. The bulk resistivity is increased and permittivity is also decreased from 4.8 to 4.2 for the SiO_2-GF/Ep composites when the content is within 5wt% and the best is 3wt%. With the further increased of the content of SiO_2, bulk resistivity is decreased and permittivity is also increased a little. However, the friction coefficient and wear rate (mass loss) are both increased and the friction behavior also become unsteady for the GF/Ep composites added of SiO_2, but the effects is not obvious, especially at low friction rate.

Keywords: Epoxy resin, Composites, Nano-SiO_2, Insulation, Volume Resistivity, Friction.

Simple Synthesis of SnO_2 Hollow Nanospheres and Application in Lithium-Ion Battery Anodes

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ABSTRACT

SnO_2 hollow nanospheres were prepared by the simple heat treatment of sawdust impregnated by $SnCl_4$ water solution in alkaline conditions. The crystallographic structure of the sample was determined by X-ray powder diffraction (XRD). The structure and morphology of these hollow SnO_2 nanostructures were investigated by transmission electron microscopy (TEM) and high-resolution transmission electron microscopy (HRTEM). The formation mechanism of SnO_2 hollow sphere was studied by an un-situ TEM preliminarily; it indicates that microspheres containing Sn-ion were formed in the impregnating process. The electrochemical Li-insertion of hollow SnO_2 anodes were measured by the galvanostatic charge-discharge technique. Preliminary testing indicates that the initial charge capacity of 607.7 mAh g^{-1} is higher than that of carbon-based materials (theoretically 372.0 mAh g^{-1}).

The Structure and Properties of SnS Thin Films Prepared by Ultrasonic Spray Pyrolysis

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ABSTRACT

In this paper, SnS thin films were prepared by the method of ultrasonic spray pyrolysis deposition. The crystal structure and surface morphology were characterized by X-ray diffraction (XRD) and scanning electronic microscope (SEM). The photoelectric properties were investigated by I-V measurement and optical transmittance spectrum. The XRD results show that the crystal structure of the samples is polycrystalline orthorhombic phase with preferred orientations on (040). High temperature (315°C ~ face°C) is propitious to deposit SnS thin films. Low temperature (lower than 265°C will cause the formation of SnS_2 or Sn_2S_3 phase. Sn/S ratios also work on the structure of SnS thin films. Low Sn/S ratio (0.5) will cause the formation of amorphous thin films even at high deposition temperature. The best condition is about 315°C and Sn/S ratio at 1.25. The thin film is uniform and compact that deposited on this condition, with energy gap at 1.39 eV and photoconduction at $7.37\times10^{-3}\ \Omega^{-1}\cdot cm^{-1}$.

The Significant Properties of a New Composite System

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ABSTRACT

Carbon nanotube-mullite (Al_2O_3/SiO_2=3/2) composites (CNTs /mullite = 1~5 vol.%) were prepared by hot-pressing the corresponding composite powders, in which the multi-walled carbon nanotubes mostly are quite homogeneously dispersed between the mullite grains. The electrical conductivity and mechanical properties of the composites have been studied and discussed in relation to the microstructure of the carbon nanotubes and the nature of the matrix. Specifically, σ increases strongly with increasing CNTs amount so that the composites gradually changed from insulator into conductor, and these nano composites exhibit impressively large absorbent of microwave, a rarely reported phenomenon in CNT composites; the fracture toughness of the 5 vol.% MWNT-mullite composites, compared with the monolithic mullite, was enhanced by 80%. We illustrate the CNT-mullite composites a potential multifunctional composite system owing to the introduction of the carbon nanotubes.

Photocurrent Response of the Nanometer Silicon Crystallite System

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ABSTRACT

We report on the investigations of the photocurrent generated by high density of nanometer grains embedded in hydrogenated amorphous silicon (a-Si:H) host of the hydrogenated nanocrystalline silicon (nc-Si:H) thin film. A phenomenon of high photocurrent is observed in the photon energy range between the c-Si band-gap and a-Si band-gap. By the comparison investigation, a increase of the nanometer grains density has been found to result in a narrow continuous energy band in the a-Si:H band-gap, from which the transitions can effectively generate the free electron-hole pairs, resulting in the observed high photocurrent. The high density of nanometer Si crystals is a good way to improve the photocurrent response through the improvement in the conductivity and optical cross section, due to high density of nano meter gains and voids between the grain boundaries.

Antireflective Sub-Wavelength Gratings Fabricated by UV-NIL

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ABSTRACT

Sub-wavelength gratings (SWGs) have been widely used in many fields since the structure has the function of antireflection and increase the light transmittance. Many researchers are fabricating SWGs on the glass substrate hoping that it can be used in solar cells, display or light emit diodes (LEDs). Nanoimprint is an emerging lithographic technology that promises high resolution, high throughput, and low cost patterning of nanostructures. In this paper, an antireflective SWGs on a quartz substrate with transparent resist by UV-nanoimprint lithography (NIL) is fabricated. The transmittance at the wavelengths from 1000 nm to 2000 nm were measured and compared with the same substrate without SWGs pattern. The results show that the SWGs pattern increases the transmittance by about 1.5%.

Keywords: Sub-wavelength gratings (SWGs), UV-Nanoimprint lithography (UV-NIL), photorisist, stamp.

Synthesis of Octahedral Lead Oxide Nanocrystals By Electrochemical Reduction

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ABSTRACT

The shapes of metal oxide nanocrystal are usually defined by polyhedra that are enclosed by {111} and {100} facets. Many metal and mental oxide nanocrystals have been prepared by different synthesizing methods. For example, A. Singhal *et al*. have produced cube-shaped CoO and Co_3O_4 by combustion flame-chemical vapor condensation technique. Tian *et al*. have synthesized tetrahexahedral platinum

nanocrystals with high-index facets and high electro-oxidation activity by a new electrochemical method. However, there are no reports on synthesizing lead oxide nanocrystals by electrochemical reduction method to the best of our knowledge.

In this paper, we report the growth of octahedral lead oxide nanocrystals by means of the electrochemical reduction method. In our experiment, the electrolyte was prepared by lead nitrate ($Pb(NO_3)_2$). Stainless steel plate was employed as both cathode and substrate. The controlled current that was supplied by a DC power supply passed through the electrolyte. Octahedral lead oxide nanocrystals were synthesized at the room temperature. The SEM of octahedral lead oxide nanocrystals are shown as follows.

Keywords: Electrochemical reduction; lead oxide; octahedral.

Anion-Releasing Polyalkcne Composite with Opal-Immobilized Cp_2ZrCl_2

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ABSTRACT

This thesis focuses on the research in ethylene oligomerization and in situ copolymerization in the confined geometry, i.e. homogenous catalysts immobilized onto molecular sieves, in comparison with ethylene polymerization behavior using homogenous catalysts. We primarily explored the similarities and differences between the two catalytic systems. Experimental results showed that there are potential commercial applications for catalysts immobilized onto molecular sieves.

Iron-based LTM catalysts are firstly immobilized onto mesoporous molecular sieves (MCM-41 and SBA-15) and exhibited higher oligomerization activities than their homogenous counterparts above 70°C. In addition to its high temperature performance the molecular sieve-immobilized catalyst possessed relatively high selectivities for low molar-mass α-olefins compared to the homogeneous catalyst.

Iron-based LTM catalyst $C_{25}H_{17}Cl_2N_3$. $FeCl_2$ and metallocene catalyst $Et(Ind)_2ZrCl_2$ are firstly immobilized onto mesoporous molecular sieves (spherical MCM-41) and LLDPE is formed within the confined geometry of the pores of molecular sieve by *in situ* copolymerization. The dual-functional catalytic system showed easily controlled smoother kinetics process and the polymeric morphology of LLDPE was greatly improved. Compared with the homogenous catalyst systems, LLDPE prepared this way has

obvious advantages such as higher molecular weights, lower melting temperatures, and higher branching degrees.

Opal is a kind of non-crystalloid or colloid active silicon dioxide which contains water. The most significant characteristics of opal lie in its anion-releasing effect, which plays positive roles in purifying air, resisting bacteria, improving air quality, adjusting the physiological functions, and strengthening the body immunity and so on.

As the carrier, opal was immobilized into metallocene complex which can conveniently produce polyethylene (PE) composite. The resulting PE composite is expected to find applications in many fields relating to environment and human life, such as health care, environmental protection and so on..

Keywords: Opal, Anion-releasing, Polyethylene composite, polyalkcne, immobilized catalyst, oligomerization, *in situ* copolymerization.

Artificial Morphology Control of ZnO Nanostructures and Thin Films in Aqueous Solution Route

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ABSTRACT

In the recent years, nanostructured and thin filmed materials have attracted important attention for the various synthesis and applications. ZnO, which has a wide band gap (3.37eV) and a large exciton binding energy of 60 meV, is one of the most promising material for device application in piezoelectric device, chemical and gas sensors, UV lasing application, and light emitting diode.

In this work, we report on low temperature growth and systematical characterization of ZnO nanostructures and thin films on Si substrates by controlling the ZnO seed formation in a single aqueous solution route. Zinc acetate dehydrate [$Zn(CH_3COO)_2{\cdot}2H_2O$, 0.01 M] dissolved into de-ionized (DI) water (100 ml) was used as a seed solution. Cleaned Si substrates were dipped in the seed solution for 30 min at room temperature. The seed coating on the Si substrates by a dipping process was repeated from 3 to 12 times to achieve uniformly and densely coated seed layers on the Si substrates. Then, a thermal treatment of the seed-coated Si substrates was carried out in oxygen ambient for 30 min

at 500°C to improve the crystallinity of the seed layer. After the thermal treatment of ZnO seeds, ZnO nanostructures and thin films were formed by the continuous supply of zinc ions and hydroxyl radicals into the aqueous solution consisting of zinc nitrate hexahydrate [$Zn(NO_3)_2 \cdot 6H_2O$, 0.025 M], hexamethylenetetramine(0.025 M) and DI water (250 ml). The main growth of ZnO nanorods and thin films was carried out at 95°C. In the workshop site, artificial morphology control of ZnO nanorods and thin films by a seed preparation function will be presented.

Artificial Morphology Control of ZnO Nanostructures and Thin Films in Aqueous Solution Route

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ABSTRACT

In the recent years, nanostructured and thin filmed materials have attracted important attention for the various synthesis and applications. ZnO, which has a wide band gap (3.37eV) and a large exciton binding energy of 60 meV, is one of the most promising material for device application in piezoelectric device, chemical and gas sensors, UV lasing application, and light emitting diode.

In this work, we report on low temperature growth and systematical characterization of ZnO nanostructures and thin films on Si substrates by controlling the ZnO seed formation in a single aqueous solution route. Zinc acetate dehydrate [$Zn(CH_3COO)_2 \cdot 2H_2O$, 0.01 M] dissolved into de-ionized (DI) water (100 ml) was used as a seed solution. Cleaned Si substrates were dipped in the seed solution for 30 min at room temperature. The seed coating on the Si substrates by a dipping process was repeated from 3 to 12 times to achieve uniformly and densely coated seed layers on the Si substrates. Then, a thermal treatment of the seed-coated Si substrates was carried out in oxygen ambient for 30 min at 500°C to improve the crystallinity of the seed layer. After the thermal treatment of ZnO seeds, ZnO nanostructures and thin films were formed by the continuous supply of zinc ions and hydroxyl radicals into the aqueous solution consisting of zinc nitrate hexahydrate [$Zn(NO_3)_2 \cdot 6H_2O$, 0.025 M], hexamethylenetetramine(0.025 M) and DI water (250 ml). The main growth of ZnO nanorods and thin films was carried out at 95°C. In the workshop site, artificial morphology control of ZnO nanorods and thin films by a seed preparation function will be presented.

A Novel Vinyl Ether Resin of Poly(4-vinylphenol) Derivative for Lithographic Resist

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ABSTRACT

Most of the commercial UV-curable resins currently used are based on free radical polymerization, mainly of which are very reactive acrylate monomers. Although acrylates display good resistance against atmospheric conditions, they also have several disadvantages such as health hazards and inhibition of polymerization by atmospheric oxygen [1]. On the contrary, vinyl ethers (VEs) are well known for their immunity toward the affect of water and oxygen, harmfullessness to environment, and extensive cure, together with low shrinkage, great impact strength and high adhesion. VEs are also considered as high reactive monomers which undergo a fast cationic polymerization in the presence of photogenerated protonic acids, so VE-based resins appear to be an attractive alternative to the widely used acrylate resins in UV-curing.

Fabrication of Silver Nanowires in situ in Si Chip Based on a Novel Electrochemical Method

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ABSTRACT

In this paper, we report a novel electrochemical deposition (ECD) method to fabricate silver nanoscale wires and dendrites. We carry out the electrochemical deposition (ECD) process on a small piece of Si wafer. On its surface, there are micro-scale predefined silver electrodes. We use organic solution (N, N-dimethylformamide (DMF)) instead of metal salt solution as the electrolyte. Usually the fractal structures can be formed in the electrochemical deposition (ECD) process. When an external resistor is introduced in the ECD circuit, instead of fractal structures, silver nanoscale wires and dendrites can be obtained between two electrodes in situ in the Si chip. The diameters of the silver

nanowires are about 40-200 nm and the electric properties of the silver nanowire with a diameter about 100 nm have been measured. We have proposed a possible formation mechanism for these silver nanoscale wires and dendrites.

Characterization of Ga-Doped ZnO Nanowires Grown by Thermal Chemical Vapor Deposition

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ABSTRACT

Ga-doped ZnO nanowire has a wurtzite hexagonal structure and has been prepared in a horizontal tube furnace by thermal chemical vapor deposition method. In this work, we fabricate the Ga-doped ZnO nanowires without a metalized catalyst through the thermal evaporation of the Zn powers and Ga metals at a low growth temperature of 550°C. Temperature is the critical experimental parameter for the formation of Ga-doped ZnO nanowires. This evaporation process can be attributed to the Ga dopant in the lattice position of he ZnO nanowires. As shown in scanning electron microscopy (SEM), nanowires of different diameters are evenly arranged on the Si substrate and nucleated via a self-catalysed mechanism by depositing a layer of ZnO film as the crystallization plant before growing ZnO nanowires on the film. Self-catalyzed growth of Ga-doped ZnO nanowires are of diameters 35-150nm and lengths up to several ones of micrometers. High resolution Transmission electron microscope (HRTEM) lattice image of Ga doped ZnO nanowires, wherein those nanowires are seen a lattice of a=3.25Å and c=5.19Å. As determine by selected area diffraction (SAD), the growth direction of Ga-doped ZnO nanowires is [001] and the nanowire consists of single-crystalline ZnO crystals.The luminescence spectra of the Ga-doped ZnO nanowires exhibit a UV band at 374 nm and a strong green band at 498 nm. In addition, the Ga-doped ZnO nanowires with different diameters have a larger green light/UV ratio due to the recombination of holes with the electrons occupying the singly ionized more O vacancies that are larger in number. By virue of the doping of Ga, we observe that Ga-doped ZnO nanowires becomes broader and shifts to a longer wavelength 498 nm at a lower energy and a strong green emission as compared to the undoped one in the cathodoluminescence and photoluminescence spectra. The Ga-doped ZnO nanowires have a greater field-enhancement factor than the undoped ZnO nanowies. The Ga-doped nanowires with a low turn on field ($12Vmm^{1}$) are

apparently lower than the undoped ZnO nanowires. Our results demonstrate that Ga-doped ZnO nanowires can provide the possibility of application in optoelectric nanodevices.

Keywords: Ga-doped ZnO, nanowires, optical property, fieldemission.

Synthesis of Carbon Nanofibers by Ethanol Catalytic Combustion

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ABSTRACT

The effects of position of substrates in flames, preparation time, stability of flames and catalyst precursors on carbon nano fibers are investigated in ethanol catalytic combustion. For investigating the effects of these influence factors on carbon nano fibers, several sets of controlled experiments are performed, such as different position of substrates, different preparation time, stable and unstable flames, different catalyst precursors. In our experiments, the catalyst precursors are iron nitrate, cobalt nitrate, nickel nitrate, and iron chloride, cobalt chloride, nickel chloride. The as-synthesized products are characterized by scanning electron microscopy, transmission electron microscopy, and Raman spectroscopy. Our results show that the optimal position of substrates in flames is more than 1cm and less than 2.5cm for massive yield, the optimal preparation time is more than 5min and less than 30min for massive yield, stable flames would be tent to synthesize carbon nano fibers with single-type morphology and could improve the graphitization of carbon nano fibers, and the catalyst precursors have obvious effects on carbon nanofibers.

Synthesis of R-SiC Nanowires Via Catalyst-Free Chemical Vapour Growth Route

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ABSTRACT

Rhombohedral-silicon carbide nanowires were synthesized using chemical vapour growth approach, which was conducted in a vacuum system. In the process of synthesizing SiC nanowires, activated carbon powder and Si wafer were used as source material. Heating temperature (1200–1350°C) and dwelling time (1–4 h) were systematically investigated. The morphology and chemical composition of the sample were evaluated using field-emission scanning-electron microscopy with energy dispersive X-ray spectroscopy, X-ray diffractometer spectroscopy, transmission electron microscopy, and Raman spectroscopy. The nanowires with diameter and length in the range of 10–30 nm and lengths up to several ten of micrometers, respectively, were obtained.

Electrical Characteristics of Organic Molecular Wires by Scanning Probe Microscopy

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ABSTRACT

Reportedly, molecular wires which have intrinsically different characteristics from semiconductor nano wires show some unique transport properties. However, it seems that there is not so much understanding about their local properties. So, in this work, we

characterized electrical properties of carotenoid which had differently substituted end-groups by using Scanning Probe Microscopy. To confirm the difference of the electrochemistry with substituted end-groups, we performed cyclic voltammetry in an aqueous solution. Electrochemical reaction was detected in the potential region between 0.5 and 0.75 V vs. Ag | AgCl | KCl (sat), whereas the conductance values were showed difference of differently substituted end-groups. Physisorptional effect between molecule and Au substrate was removed by introducing thiol[SH] group at each end of molecule resulting in covalent bond. After inserting these molecules into a 1-methylsulfanyl-octadecane monolayer pre-deposited on Au substrate, an Au nanoparticle is attached to the other end of each molecule via the protruding thiol group. To confirm the chemical conjunction between an Au nanoparticle and carotenedithiol molecule, we performed Electrostatic Force. These measurements allow us to simulate the transport property of carotenoid molecule. Followed I-V measurement reconfirmed the results. A PtIr coated AFM probe is used as an electrode to contact the molecule through the Au nanoparticle. They reveal that methoxy-phenyl substituted carotenedithiol molecules showed better conducting properties and bromo-phenyl substituted carotenedithiol molecules showed worse than phenyl-substituted one did. I also obtained that current-voltage (I-V) curves were quantized as integer multiples of one fundamental curve. These allow us to simulate the transport property of single carotenoid molecule.

Effect of Sputtered Cr Film on the Growth and Field Emission Properties of Carbon Nanotubes by Copper Catalyst

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ABSTRACT

Besides Ni, Co and Fe, copper (Cu) is a kind of good catalysts for carbon nanotubes (CNTs) fabrication in field emission display application. Because of the high diffusion and low adhesion of Cu on glass substrate, Chromium (Cr) film was fabricated as the barrier. In this study, Cr/Cu films were deposited by co-sputtering onto the glasses with the increase of Cu power from 100 W to 400 W. The alloy films were annealed at 600°C in hydrogen gas for few minutes to form nanoparticles and to grow CNTs under the atmosphere of C_2H_2/H_2 by chemical vapor deposition (CVD) method. The morphologies of as-grown CNTs films before and after adding Cr barrier were characterized by SEM. The field-emission current of the CNTs films were tested in a high vacuum system showed the different effect of Cr barrier with different Cu power. The results conclude that Cr is potential diffusion barrier materials for copper film in CNTs field emitter application with definite Cu power.

Keywords: Cu/Cr alloy films; Carbon nanotubes (CNTs); Field emission

Fabrication and Characterization of p-poly(9, 9-diethylfluorene)/ n-ZnO Nanorods Hybrid Heterojunction

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ABSTRACT

The p-poly(9,9-diethylfluorene) (PDEF)/n-ZnO nanorods (ZNR) heterojunctions were prepared by spin-coating p-type conductive organic polymer on as-prepared n-ZNRs which were fabricated by hydrothermal solution method. This hybrid nanorod *p-n* heterojunction shows good rectifying behavior with turn-on voltage of about 0.5 V at room temperature. A rectification ratio of 39.8 was realized. The hybrid nanorod heterojunction shows good responsivity toward visible light, and the current-voltage characteristics have been analyzed with and without visible light. These results present potential applications in the future nano-electronic and photonic devices based on organic and inorganic *p-n* heterojunction arrays.

Keywords: ZnO nanorods; hydrothermal method; Organic-inorganic hybrid system.

Application of Anion NanoSi-Tubes Additive in Textile

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ABSTRACT

The paper introduced Anion anionic additive, character and application. Anionic additive can apply in paint, textile, coating, foam, plastic, etc. The structure of opal shale and the mechanism of release anion were discussed. The opal shale was comminuted by the airflow method. The average diameter of the opal shale granule was observed by granularity instrument. The result indicated that size is about 400-5000nm and 5-30nm tuble. The printing textile with high performance was achieved by intermingle technology and the generally printing means. The anion number (4000 ions/cm^3) in printing textile was measured.

Growth of Vertically Well-Aligned ZnO Nanorods on P-GaN Using a Simple Aqueous Solution Method and their Electroluminescence Properties

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ABSTRACT

Zinc oxide (ZnO) is of great interest because of its large exciton binding energy of 60 meV, which can lead to exciton-recombination-based lasing above room temperature. However, the application of ZnO to homojunction diodes has been limited due to the absence of reliable p-doping processes and manipulation technologies for junction fabrication. As an alternative approach to utilize ZnO nanorods for optoelectronic application, a ZnO/p-GaN heterojunction structure was suggested and high efficiency from this junction was expected by improving carrer injection efficiency through the nanosized junctions demonstrating development potential

In this study, we fabricated p-n heterostructures based on nanosized n-ZnO nanorods/p-GaN film by a simple aqueous solution method at low temperature (90°C). In addition, their electroluminescence (EL) characteristics will be presented. ZnO seed layers on p-GaN substrates were formed by simple dipping process of the substrates into mixture solution of zinc acetate dissolved with de-ionized water. And then, the samples were pre-annealed for 20 min at 100°C before main growth. Vertically well-aligned ZnO nanorods on nano-sized ZnO seeds dispersed onto the p-GaN epilayer were grown by the " dipping-and-holding " process that the substrates maintain into the mixture solution consisting of de-ionized water, 25 mM zinc nitrate, and 25 mM hexamethylenetetramine for 4 hour at 90°C. It was found that the vertically well-aligned ZnO nanorods are of a perfect epitaxial relation with the p-GaN epilayer in synchrotron X-ray measurements. In addition, we could observe white light broad EL emission as well as UV emission in the EL measurements of the ZnO nanorod/p-GaN samples. We strongly believe that this method is greatly promising for application of white and UV LEDs with high efficiency through control in nanoscale.

Synthesis and Photocatalytic Characterization of Nano-Structured CR-Doped TiO_2

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ABSTRACT

Titanium (IV) oxide is well known for its chemical stability and photocatalytic activity. Surface science studies have been done to exploit the use of TiO_2 for cleaning and as a disinfectant for organic compounds and other pollutants. The photocatalytic reaction of TiO_2 is limited to UV-irradiation, which is 3-4% of natural light. This is on the condition that the UV-generated holes and electrons do not recombine before the hydroxyl radicals could degrade the organic substances. As a result many studies have been done to increase the efficiency of TiO_2 as well as modify it to narrow its band-gap. A successful method is by impurity doping of transition metals. The study was done to explore the possibilities of doping TiO_2 with Cr using the planetary high energy Ball Milling technique for the photocatalytic reaction of TiO_2 to take place under visible light. This technique is advantageous for its fast and reproducible results. The material has attained nanosize grains and different mixed phase TiO_2 ratio was achieved. The physical and optical properties would be discussed and the successful modeling of photocatalytic activity in visible light is presented.

Carbon Nanomattress

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ABSTRACT

An unconventional approach to the development of a new composite material via the fusion of different allotropies of carbon. Unique characteristics could be engineered into such hybrid materials purposefully for various applications. Unlike most hybrid materials where organic/inorganic materials are interfused for reinforcement purposes, carbon hybrids are essentially synthesized from the same element and may exhibit totally different characteristic from its parent components. From these special properties, an entire new range of smart materials can be engineered.

Nano-Scale Modification and Doping of Diamond: Interesting Science and Promising Technology

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ABSTRACT

Diamond is a unique material with outstanding physical and chemical properties. Amongst these are the very unusual properties of the diamond surface, i.e. its negative electron affinity when hydrogen terminated, the p-type 2D electrical conductivity it shows when exposed to different atmospheres and the fact that some specific impurity-defect configurations in diamond have unique luminescence properties. These make diamond a material of choice for the fundamental study of a variety of electron-emission processes as well as for their application, on the nano-scale. Furthermore, the optical properties of the nitrogen-vacancy (N-V) and the nickel nitrogen (NE8) color centers in diamond are amongst the most promising systems to realize spin based qubits, as required for quantum computers and other single photon based devices.

In the present talk we will discuss the uniqueness of the diamond surface, when hydrogen terminated and the quantization of the 2D surface conduction induced by it. Results on the emission of electrons from diamond induced by photons (photo emission), by an external electric field (field emission), by electron-impact (secondary electron emission) and by ion-impact (ion-induced electron-emission) will be reviewed.

Modifications of these properties on the nano-scale by single ion-impacts and by localized electric fields (from a STM tip) will be described. The observed huge ion-induced electron emission from hydrogenated diamond and its rapid degradation will be presented and explained. The latter is of great importance for the realization and detection of single ion implants as required for the realization of diamond-based qubits by ion-implantation. As the hydrogen termination of the diamond surface can be locally modified, on the nano-scale, by selected area removal of hydrogen, this opens up the possibility to realize nano-size electronic devices on the diamond surface. The possible application of the electron-emission from diamond for the realization of point sources of cold electrons and for nano scale electronic devices will be discussed. A novel, extremely simple, way of performing single ion-implantations will be described.

Home

Preparation and Electrical Conductivity of Ni/NiO Composites Using Microwave Radiation

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ABSTRACT

Nanocrystals of nickel (Ni) and nickel oxide (NiO) composites were synthesized in a short time by the microwave-assisted sol-gel process using nickel nitrate hexahydrate as the raw material and nitric acid as the catalyst. For conventional calcination, Ni/NiO composites showed the electrical conductivity in the range of 1.94×10^{-9}–8.40×10^{-9} S/m. For a microwave-induced solution combustion synthesis, the electrical conductivity of Ni/NiO composites was in the range of 0.1–3.4 S/m. The amount of Ni and its crystallite size can be tuned by the microwave parameters (microwave power and exposure time), leading to the formation of Ni/NiO nanocomposites. With increasing the total exposure energy above 40 kJ during microwave radiation, the crystallite size of NiO phase was enhanced and the electrical conductivity of Ni/NiO composites was reduced. Moreover, SEM and TEM analysis revealed that the Ni/NiO nanoparticles were obtained.

Preparation of SnO_2/TiO_2 Nano-Composite Thin Films by Liquid Phase Deposition

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ABSTRACT

In this paper, nano-composite thin films SnO_2/TiO_2 are first successfully prepared by liquid phase deposition in more moderate condition on different substates without post-processing. The photocatalytic properties of the SnO_2/TiO_2 films are systematic studied. The experiments of degradation of methylene blue show that the composite photocatalyst is better than pure TiO_2 photocatalyst. The photocatalytic effect of the composite photocatalyst is improved because of the existence of SnO_2 which can restrain recombining of electron-hole pairs generated from TiO_2 under UV irradiation. The optimum relative content of SnO_2 in composite film is approximately 8%. The photocatalytic effect of photocatalyst used nickel as carriers is obviously superior to the slide as the carrier, The process of degradation of MB finally results to CO_2 and H_2O, the removal of MB is about 90%.

Mechanisms of Conduction in Nanostructured SnO_2

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ABSTRACT

A deep analysis of conductance in nanostructured SnO_2 thick films has been performed. A model for field-assisted-thermionic barrier crossing is being proposed to explain the film conductivity. The model has been applied to explain the behavior of resistance in vacuum of two sets of nanostructured thick-films with grains having two well distinct characteristic radii (R = 25 nm and R = 125 nm). In the first case the grain radius is shorter than the depletion region width, a limit at which overlapping of barriers takes

place, and in the second case it is longer. The behavior of resistance in the presence of oxygen has been explained through the mechanism of barrier modulation through gas chemisorption.

Effects of Different Annealing Treatments on Soft Magnetic Properties of Finemet Alloy

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ABSTRACT

Amorphous ribbon of Finemet alloy was obtained by rapid quenching from the melt spinning technique. Normal heat treatment and Longitudinal Magnetic Field heat treatment methods were applied to anneal the Finemet amorphous ribbon. Microstructures of the annealed ribbons were detected by XRD. XRD results showed that nanocrystalline α-Fe(Si) phase formed in the amorphous matrix after both annealing treatments, resulting in the nanocrystalline/amorphous two-phase structure. Soft magnetic properties of the annealed ribbons were tested by TPS-200SA Soft Exchange Tester. It was found that soft magnetic properties were greatly improved by both annealing treatment methods, especially after the Longitudinal Magnetic Field heat treatment, the hysteresis loop was transformed to near-rectangle shape, with the magnetic permeability μ greatly improved.

Doping Cu into ZnO Nanostructures

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ABSTRACT

Controlled doping appropriate elements into semiconductor nanostructures is of vital importance to develop novel materials and functional devices. Herein, we present three methods to synthesize Cu-doped ZnO nanostructures by using a simple vapor phase transport process and adopting $CuCl_2$, CuO or Cu as doping precursors. The corresponding morphology, structure, and chemical composition were investigated using field emission scanning electron microscope, transmission electron microscope, X-ray diffraction and X-ray photoelectron spectroscopy. We show that these three methods produce nanostructures with different morphologies and doping levels. This work paves the way for investigating the physical properties of Cu-doped ZnO nanostructures and furthermore facilitates the synthesis of other transition-metal-doped nanomaterials.

Size-Selected Rare Earth and Palladium Nanoparticles for Hydrogen-Induced Switching and Sensing Applications

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ABSTRACT

This manuscript describes the effect of using nanoparticles of Pd and rare earth in switchable mirror devices. Overall improvements in the hydrogenation properties observed in Pr and Pd nanoparticle layers and size selected nanoparticles over the normally used thin films have been described.

Preparation of Nano-Structured $LiMn_2O_4$ Thin Films by Electrostatic Spray Deposition

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ABSTRACT

A novel fabrication technique has been used to prepare nano-structured $LiMn_2O_4$ thin films using electrostatic spray deposition (ESD) from suspensions containing $LiMn_2O_4$

fine particles. It is found that a mixture of acetylacetone and ethanol in a ratio of 1:1 by volume is a suitable suspension medium to disperse $LiMn_2O_4$ fine particles effectively and form colloidally stable suspension. The effects of the processing parameters, such as applied voltages, suspension flow rates and deposition times, on the surface morphology and microstructure of the thin films are examined with scanning electron microscopy (SEM). The results show that the deposited $LiMn_2O_4$ thin films are uniform, dense and well adhered to the substrates. Analysis of the crystal structure of the thin films using X-ray diffraction (XRD) indicates the deposited material as being spinel $LiMn_2O_4$, which is in fair agreement with the original fine particles.

Phase Analysis of Cobalt-Iron Films Electrodeposited from Ammonium Citrate Stabilized Electrolytes

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ABSTRACT

Co-Fe alloys are soft magnetic materials, which exhibit high saturation magnetizations and low coercivities, making them particularly useful for magnetic storage applications. Co-electrodeposition of Co and Fe, from a single electrolyte, represents a cost effective and reproducible means of fabricating the CoFe alloy films. Conventional Co-Fe electrolytes have stability issues; however, these can be alleviated by the addition of ammonium citrate as a complexing agent. In this work, we report on a series of electrodeposition experiments, where Co and Fe are codeposited from citrate-stabilized electrolytes, under various process conditions. The $[Co^{2+}]$ to $[Fe^{2+}]$ ratio in the electrolyte is varied, as is the electrolyte temperature (20–60°C).

The Co/Fe ratio in the electrodeposited films increases with increasing $[Co^{2+}]$ to $[Fe^{2+}]$ ratio in the electrolyte, as one might expect, and with increasing temperature. Deposition behavior depends on the electrolyte temperature, however. At lower temperatures (e.g., 23°C), anomalous deposition occurs, i.e., deposits are Fe-rich relative to the electrolyte composition. Thermodynamic calculation indicates that cobalt is more noble than Fe in the tested electrolyte, and would be expected to deposit preferentially. This anomalous behavior increases as the $[Co^{2+}]$ to $[Fe^{2+}]$ ratio in the electrolyte increases. At higher temperatures (e.g., 60°C), the behavior is as normally expected, i.e., the more noble metal (Co) is deposited preferentially; deposits contain more Co than the electrolyte composition. Microstructural analysis (using X-ray diffraction and electron microscopy) shows that a complex bcc phase (α-Mn type), containing Co and Fe, is favored at higher temperatures and higher Co contents, while a bcc α-(Fe, Co) solid solution forms at lower temperature and lower Co contents. A two phase structure, i.e., the α-Mn phase plus the bcc solid solution phase, forms at intermediate conditions. These results are in contrast to those reported in the literature for electrodeposited Co-Fe, where some combination of the bcc and fcc solid solution phases form and the formation of the α-Mn phase has not been reported, to our knowledge.

Keywords: Electrodeposition, cobalt, iron, ammonium citrate, X-ray diffraction, electron microscopy, microstructure

Synthesis of Self-Assembled Silicon Nanowires with Uniform Small Diameter

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ABSTRACT

Self-assembled silicon nanowires were synthesized with silicon monoxide as starting materials and argon as protection gas. The growth temperature was controlled at 480°C with the pressure at 2.8 MPa. Transmission electron microscopy (TEM) showed that the diameter of the silicon nanowries distributed form 5 nm to 7 nm. In the high-resolution TEM image, the crystalline silicon core with diameter about 3~5 nm was clearly revealed. When the growth time was prolonged, the lengths of the nanowires increased, but their diameters were still less than 7 nm. Influenced by the quantum effect, Raman spectrum of the silicon nanowires was found to be blue shifted. Considering thermodynamics of nucleation, we presumed that the ambiance pressure was the decisive factor for the small size nanowires growth.

Keywords: Self-assembled, Small diameter, Nanomaterials, Silicon nanowires.

Preparation of Nano-Powders of p-Type Transparent Conductive Copper Aluminum Oxide by Co-Precipitation Method

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ABSTRACT

Nano-powders of p-type transparent conductive copper aluminum oxide (CAO) have been successfully synthesized by co-precipitation method. By adding sodium hydroxide into the mixed solution of copper chloride and aluminum chloride, co-precipitate precursors of CAO with particle size around 50–60 nm were produced. After washing, filtering, and drying of the co-precipitates, nano-powders of $CuAlO_2$ were produced when the dried co-precipitate precursors were calcined at temperature above 1100°C. By aging at pH = 3.5 for six hours and co-precipitating at pH = 8.0, the atomic ratio of Cu/Al of the nano-powders can be maintained throughout the synthesis. After calcining at 1200°C in air for 4 hours, the CAO co-precipitate precursors totally transformed into nano-powders of $CuAlO_2$ with crystal size around 64 nm. Continued calcining at 1200°C above 4 hours led to the decomposition of $CuAlO_2$ into nano-powders of $CuAl_2O_4$ and volatile CuO with no significant change in crystal size. Finally, it was found that by calcining under inert atmosphere, the decomposition of $CuAlO_2$ could be suppressed at the expense of decreasing its crystallinity.

Electrical and Optical Properties of In_2O_3 Nanoparticles Prepared by MOCVD

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ABSTRACT

High sensitive ozone sensors working at room temperature were demonstrated based on In_2O_3 nanoparticles, which were deposited by metal organic chemical vapor deposition (MOCVD). The resistance of the In_2O_3 particle containing layer can be tuned over five orders of magnitude after ultraviolet light illumination and oxidation by ozone containing gases. To investigate the light induced effect on In_2O_3 layer, In_2O_3 nanoparticles were deposited at different substrate temperatures by MOCVD and the electrical and optical

properties of the layers were analyzed. It was found that the layers deposited above 220°C showed a typical linear I-V behavior while the layers grown below 220°C revealed a classical Schottky behavior. Furthermore, the In_2O_3 layers deposited below the critical temperature demonstrated not only an increasing absorption at 3.7 eV, which is the optical band gap of In_2O_3 thin films, but also two additional absorption peaks located at ~4.3 and ~5.3 eV, respectively. These differences in structural, electrical and optical properties of In_2O_3 layers lead to different ozone sensing properties.

Physics Based Current and Capacitance Model of Short-Channel Double Gate and Gate-All-Around MOSFETs

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ABSTRACT

We present a precise two-dimensional current and capacitance model for nanoscale double gate and gate-all-around MOSFETs covering a wide range of operating regions, geometries and material combinations. The modeling in the sub-threshold regime is based on conformal mapping techniques. In moderate to strong inversion, we obtain self-consistent results based on the 2D Poisson's equation. The results are in excellent agreement with numerical simulations.

Electronic Properties and Doping Mechanism in Cuprates by First-Principles Calculations

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ABSTRACT

The electronic properties of copper oxides represent an historical challenge for first-principles calculations, since the low-magnetization state (S=1/2) of Cu^{2+} ions is not

correctly described by standard theories (such as the local-spin density functional theory). Here we present results obtained through our novel self-interaction free density functional scheme (the pseudo- SIC [1]) for a range of different cuprates, with CuO_2 units arranged in 3-dimensional (CuO doped with Mn), bidimensional ($YBa_2Cu_3O_{6+x}$), and one-dimensional ($GeCuO_3$) fashion. In all the cases we give a sound description of the chemistry and the electronic and magnetic properties of these systems: In CuO Mn-doping acts as a single donor and induces a simultaneous insulating-to-metal and antiferromagnetic-to-ferromagnetic phase transition driven by double-exchange. In $YBa_2Cu_3O_{6+x}$ the phase transition from antiferromagnetic insulating to paramagnetic metal is mainly governed by the ordering of doping oxygens in the Cu(I)-O-Cu(I) chains.

Compact Model of Channel Electron Mobility for Nano Scale Strained-Si nMOSFET

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ABSTRACT

A compact model of channel electron mobility for strained-silicon is suggested in this paper. The model can be used for nano scale simulation since thin-film quantum confinement is considered. It is suitable for <100>/<110> channel nMOSFET.

An Analytic Potential-Based Model for Undoped Nanoscale Surrounding-Gate MOSFETs

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ABSTRACT

An analytic potential-based model for the undoped surrounding-gate MOSFETs is derived in the paper. The model is obtained from solving Poisson equation rigorously

together with the drain current formulation equivalent to Pao-Sah's double integral previously proposed for long-channel bulk MOSFETs. The model gives a fully self-consistent physical description for the channel potential, charge and current that is valid for the subthreshold, linear and saturation regions. The validity of the proposed model has been verified by extensive comparison with the exact numerical integrations and 3-D numerical simulation, demonstrating the model's accuracy and prediction capability.

Nanoelectronic Circuit Architectures Based on Single-Electron Turnstiles

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ABSTRACT

Single-electron devices (SEDs) have ultra-low power dissipation and high integration density, which make them promising candidates as basic circuit elements of the next generation VLSI circuits. In this paper, we propose two novel circuit single-electron architectures: the single-electron simulated annealing algorithm (SAA) circuit and the single-electron cellular neural network (CNN). We used the MOSFET-based single-electron turnstile [1] as the basic circuit element. The SAA circuit consists of the voltage-controlled single-electron random number generator [2] and the single-electron multiple-valued memories (SEMVs) [3]. The random-number generation and variable variations in SAA are easily achieved by transferring electrons using the single-electron turnstile. The CNN circuit used the floating-gate single-electron turnstile as the neural synapses, and the number of electrons is used to represent the cells states. These novel circuits are promising in future nanoscale integrated circuits.

3D Electro-Thermal Modeling for ESD Protection Structures in Sub-100nm CMOS

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ABSTRACT

This paper reviews advances in new 3D electro-thermal modeling technique for ESD (electrostatic discharge) protection structures. New 3D ESD device modeling is critical to full-chip ESD protection circuit design synthesis, verification, optimization and prediction, especially for IC designs in sub-100 nm CMOS technologies.

Design for Manufacturing (DFM) in Nano-CMOS Era

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ABSTRACT

This paper overviews DFM for IC design in nano-CMOS technologies. Process/device issues relevant to the manufacturability of ICs in advanced CMOS technologies will be presented first before an exploration on process/device modeling for DFM is done. The discussion also covers a brief introduction of DFM-aware of design flow and EDA efforts to better handle the design-manufacturing interface in very large scale IC design environment.

Path Integral Quantum Monte Carlo Simulation of a Parabolic Quantum Dot

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ABSTRACT

In this paper we present a numerical simulation for a two-dimensional parabolic quantum dot (2D-PQD) using path integral Monte Carlo (PIMC). We model a typical GaAs quantum dot (QD) which is centered in a square plane of size ~$(5nm)^2$. We calculate the energy of the quantum dot system in terms of temperature and number of confined electrons, with and without electron-electron interaction. We also calculate QD energy and electron density for the QD confining up to 20 electrons. Moreover, we describe the effect of electron-electron interaction and confining potential on electron distribution. We also compare electron density in both weak and strong interaction regimes. Then, we investigate shell-filling and formation of Wigner molecule structure in strong interaction regime. Finally, we study the effect of external magnetic field on QD energy and electron density. We demonstrate the compression of Wigner molecule and shell combination under applied magnetic field.

Calculation of Gate Leakage Current of a Double Gate MOS Structure Incorporating Wave Function Penetration Effects

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ABSTRACT

We present a simple and efficient method to calculate gate leakage current of an ultra-thin body double gate MOS structure incorporating wave function penetration effects. Using an accurate and numerically efficient fully coupled one dimensional Schrödinger-Poisson self-consistent solver, the gate leakage current have been calculated and presented for different values of dielectric and silicon body thickness and orientation of silicon. All the simulated results have been found to be in complete agreement with experimental results.

Effect of Interface States on C-V Characteristics of Double Gate MOS Structures

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ABSTRACT

Effects of interface states on the C-V characteristics of Double Gate (DG) MOS structures is investigated. An accurate and numerically efficient fully coupled one dimensional Schrödinger-Poisson self-consistent solver is used for this purpose. The Capacitance-Voltage Characteristics of the device is calculated incorporating the effect of interface states. The effect of interface states is found to be quite significant in both inversion and accumulation regions of DG pMOS and nMOS devices. The effect of interface states is more severe for low frequency (LF) operation in comparison to high frequency (HF) operation.

Analytical Threshold Voltage Model Using NEGF Approach for Nanoscale Double-gate MOSFETs

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ABSTRACT

An analytical compact threshold voltage model is developed, which accounts for the narrow-channel effect, the short-channel effect, and the oxide-thickness effect in the nanoscale double-gate (DG) MOSFETs. The two-dimensional non-equilibrium Green's function (NEGF) approach coupled self-consistently with Poisson's equation is applied to simulate the threshold voltage in comparison with the model. The results show that this model can accurately predict the threshold voltage. This model features simple forms and concise physical meanings, and can serve as a means in predicting the threshold voltage for nanoscale double-gate MOSFETs.

On Electrochemistry of Carbon Nanotubes: Fundamentals and Applications

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ABSTRACT

The fundamental reasons for electrochemistry of carbon nanotubes will be discussed as well as important applications for electrochemical sensing. Particular interest will be given these fundamental issues: a) the influence of defects sites of carbon nanotubes on their electrochemical properties, b) electrochemical properties of double wall carbon nanotubes c) the role of metal impurities in carbon nanotubes upon their electrochemical properties. The described applications focus on the ones solving major practical problems of electrochemical biosensors

Fabrication of Multi-Walled Carbon Nanotubes/Nickel Nano-Composite Films By Electrochemical Processing

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ABSTRACT

The combination of electrophoretic deposition and electrodeposition was used to prepare multi-walled carbon nanotubes (MWNTs) /metal nano-composite films. Multi-walled carbon nanotubes with a diameter range of 20 to 30 nm were dispersed in the organic solvent to form stable suspension. The MWNTs film was prepared by EPD using the mixture of acetyleacetone and etanol in a ratio of 1:1 by volume as suspension medium. The nano-sized nickel particles were then deposited on the surface of carbon nanotubes to form carbon nanotubes/nickel nano-composite films by electrodeposition. SEM and EDS were used to characterize the morphology and composition of the prepared nano-composite films. The results show that nickel nano-particles with high dispersions and high loadings can be coated uniformly on the surface of carbon nanotubes.

Tunning Electrical Characteristics for Networked Carbon Nanotube Field-Effect Transistors Using Thiolated Molecules

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ABSTRACT

We examine the effects of adsorption of four thiolated molecules (HS-$C_{10}H_{21}$, HS-$C_{11}H_{22}$OH, HS-$C_{10}H_{20}$COOH, and HS-$C_2H_4C_4F_9$) on the electrical characteristics of single-walled carbon nanotube network FETs (SNFETs). Measuring the work function of the electrodes before and after molecule adsorption and performing Schottky barrier energy extraction for SNFETs provide direct evidence that the device characteristics of SNFETs after SAM adsorption are altered primarily due to the change in energy-level alignment between the Au and SWNTs. We also demonstrate that the electrical characteristics of SNFETs can be modified by introducing thiolated heme on Au electrodes and by using the location-selective photo-irradiation method, which provides an effective methodology for the fine-tuning and performance optimization of these devices in a controllable way.

Effect of Different Gas Medium on Carbon Nanotubes Synthesis by Arc Discharge

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ABSTRACT

Carbon nanotubes (CNTs) were synthesized in different gas medium by arc discharge. Optical emission spectroscopy (OES) was used *in situ* to investigate the formation mechanism of CNTs. Field emission scanning electron microscope (FE-SEM) and transmission electron microscope (TEM) were used to characterize CNTs. FE-SEM observation reveals that a few CNTs synthesized in $N_2/C_2H_2/CO_2$ medium ($CNTs_{N2/C2H2/CO2}$) are open-ended or porous ones and the impurity amount adhered on

$CNTs_{N2/C2H2/CO2}$ or $CNTs_{He/C2H2/CO2}$ is smaller than that adhered on $CNTs_{N2/C2H2}$ or $CNTs_{He}$. TEM characterization results show that the wall of $CNTs_{N2/C2H2/CO2}$ is partly damaged because of being oxidized, which led to its diameter is smaller than that of $CNTs_{N2/C2H2}$. OES diagnosis results show that active radicals including C_2 and CH are the precursors of CNTs formation while CO_2 acts as the etching species to eliminate amorphous carbon in the presence of CO_2. A possible formation process of CNTs is proposed on the basis of the results of OES diagnosis and FE-SEM as well as TEM observation.

Effect of Single Walled Carbon Nanotubes on the Performance of Poly-(3-hexylthiophene) Solar Cell

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ABSTRACT

Thin films of P3HT formed from sonicated solutions were found to have larger absorption than those formed from homogenised solutions because of improved ordering of polymer chains. Single walled carbon nanotubes (SWNTs) were dispersed in poly-[3-hexylthiophene] (P3HT), and were found to quench the photoluminescence (PL) of P3HT, both in solution and thin film form. The PL peak intensity of P3HT thin film was reduced by 4 orders of magnitude with the addition of 2 wt% SWNTs. P3HT-SWNT bulk heterojunction organic solar cells were fabricated with varying SWNT content. The solar cell efficiency increased by 2.4 times when the SWNT content is increased from 0.2 wt% to 2 wt% because of increased open circuit voltage and short circuit current.

Fabrication of Carbon-Nanotube Enhanced Piezoelectric Membrane-Based Biosensor

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ABSTRACT

In this article, we report a novel method of fabrication of carbon-nanotube (CNT) enhanced piezoelectric membrane-based biosensor. The piezoelectric membrane was fabricated by micro-machining technique and CNTs were synthesized on the backside of the membrane using thermal chemical vapor deposition. CNT has extraordinary electrochemical property and it possesses a hollow core and large specific surface area which is suitable for storing guest molecules. Therefore, it was introduced onto the piezoelectric membrane as bio-receptor to capture the bio-molecules.

Electron Irradiation Effects in Carbon Nanostructures: Surface Reconstruction, Extreme Compression, Nanotube Growth and Morphology Manipulation

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ABSTRACT

It will be demonstrated, that irradiation exposure at elevated temperatures, can be used as an effective tool to covalently weld SWNTs in order to create molecular junctions of various geometries [1-3]. We have fabricated Y, X and T-like junctions that are stable [2]. Tight binding molecular dynamics calculations demonstrate that vacancies, formed under the electron beam, trigger the formation of molecular junctions involving seven or eight membered carbon rings. We envisage that these results will pave the way towards controlled fabrication of novel nanotube-based molecular circuits, nanotube fabrics and network architectures. In this context, novel super architectures, using carbon nanotubes as building blocks will be discussed, and their mechanical and electronic properties presented, as well as their possible applications [4]. We will also show that the melting and solidification behavior of metal crystals can be drastically altered when they are encapsulated in fullerene-like graphitic shells [5]. The melting temperature of low melting point metal crystals (e.g. Bi, Sn, Pb, etc.) inside graphitic shells is increased relative to the bulk melting point by a much larger amount than that observed for metal crystals embedded in other materials. It appears that graphite is the ultimate material for enhancing the melting/solidification hysteresis of small crystals or clusters. Therefore, metal clusters encapsulated by graphitic shells may be potentially advantageous in temperature-resistant crystalline composite materials. In addition, we will demonstrate that controlled irradiation of MWNTs can cause large pressure buildup within the nanotube cores, to the extent of being able to plastically deform, extrude, and break solid materials that are encapsulated inside [6]. We further show by atomistic simulations that the internal pressure inside nanotubes can reach values higher than 40 GPa. Nanotubes

can thus be used as robust nanoscale jigs for extruding hard nanomaterials and modifying their properties, as well as templates for other high-pressure applications at the nanoscale. Finally, it was observed that when MWNTs containing metal particle cores are electron irradiated, carbon from graphitic shells surrounding the metal particles is ingested into the body of the particle and subsequently emerges as single- or multi-walled nanotubes inside the host nanotubes. These observations at atomic resolution in an electron microscope and indicate that bulk diffusion of carbon through the body of catalytic particles is the growth-limiting process [7].

Performance of Various Quantum-Key-Distribution Systems Using 1550nm Up-Conversion Single-Photon Detectors

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ABSTRACT

We compare the performance of various quantum-key-distribution (QKD) systems using 1550 nm up-conversion single-photon detectors. The analysis is based on the error rate and the secure communication rate as a function of distance for three QKD protocols: the Bennett-Brassard 1984, the Bennett-Brassard-Mermin 1992, and the coherent differential-phase-shift keying (DPSK) protocols. We discussed that the security of DPSK protocol against any type of individual photon splitting attack and concluded that the simple and efficient DPSK protocol allows for more than 200 km of secure communication distance with high communication rates.

Keywords: Differential-phase-shift keying protocol; Communication rate; Error rate

CVD Synthesis and Purification of Multi-walled Carbon Nanotubes

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ABSTRACT

Multi-wall carbon nanotubes (MWNTs) have been synthesized by catalytic chemical vapor deposition of acetylene over Fe loaded mesoporous silica. The raw product contains the aerogel support, catalyst particles, and a small amount of amorphous carbon (mostly as a coating on the catalyst nanoparticles) as impurities. Before these materials can be used in many applications, these impurities must be removed. A variety of purification processes, both chemical and physical, have been reported in the literature to remove metal catalyst, catalyst support and undesired carbonaceous phases from MWNTs. In this work we report on an effective purification method for the removal of the catalyst. The as-grown MWNTs are purified using a two-step purification procedure involving acid washing and oxidation in diluted air. Such oxidation steps burned the carbon coating on the catalyst particles, making them exposed to acid attack, while leaving MWNTs unaffected because of the higher stability of MWNTs against oxidation compared with amorphous carbon. MWNTs are characterized as-grown and purification by thermogravimetric analysis (TGA), scanning electron microscopy (SEM), transmission electron microscopy (TEM) and energy dispersive spectrometry (EDS). It is observed that most of the mesoporous silica and metal particles have been removed from the as-grown MWNTs by these treatments. The carbon content of MWNTs material obtained after the purification is found to be more than 95 wt%. This procedure presents a nondestructive, commercially viable purification method for carbon nanotubes.

ZnO_x-decorated Vertically Aligned Carbon Nanotubes Prepared by Vapor Phase Transport Technique

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ABSTRACT

In this work, vapor phase transport technique for well ordered ZnO_x nanoparticles decoration on vertically aligned carbon nanotubes (CNTs) is developed. Vertically aligned CNTs are grown by thermal chemical vapor deposition (CVD) with gravity effect and water assisted etching at 700°C. Vertically aligned CNTs of 8–15 nm in diameter and ~80µm long are achieved with low defects and catalyst residues. ZnO_x is then decorated on CNTs by exposing CNTs to evaporated ZnO_x vapor under H_2/Ar ambient at different

pressures. The effect of process pressure on structural, chemical and electron field emission properties of ZnO_x decorated vertically aligned CNTs are characterized. Zn nanoparticles are observed to be deposited on top of CNTs. Low pressure (5–20 Torr) results in fine ZnO_x nanoparticles of 5–15 nm in diameter uniformly distributed on the cap of CNTs while high pressure (> 100 Torr) result in large ZnO_x particles and agglomeration on CNTs. In addition, electron field emission from vertically aligned CNTs is found to be further improved by ZnO_x nanoparticle decoration at low pressure and low turn-on electric field of ~1.5 V/μm is observed. On the other hand, large ZnO_x particles decorated at high pressure result in electron field emission degradation.

Effect of Acid Treatment of MWCNTs on Dielectric Constant of PVDF Based Nanocomposites

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ABSTRACT

In order to improve the compatibility of multi-walled carbon nanotubes (MWCNTs) with polyvinylidene fluoride (PVDF) matrix, surface treatment of MWCNTs by concentrated acid is carried out. PVDF based nanocomposites filled by unmodified MWCNTs (U-MWCNTs) and acid treated MWCNTs (A-MWCNTs) are prepared. The morphologies of the fractured surface of MWCNTs/PVDF nanocomposites are characterized by FESEM, and the dielectric constant of the nanocomposites are measured and analyzed in this paper. The FESEM images prove that the dispersibility of A-MWCNTs in PVDF matrix was remarkably improved, and compact continuous percolation networks formed by self-connecting of A-MWCNTs can be viewed. The dielectric constant of A-MWCNTs/PVDF nanocomposites accords with the prediction of percolation theory, the percolation threshold, $f_c \approx 0.035$, which is merely one fifth of that of common two-phase random composites. The dielectric constant of U-MWCNTs/PVDF and A-MWCNTs/PVDF reach 1258 and 7419 at their percolation threshold, which are 146 times and 862 times of that of PVDF matrix separately. Meanwhile, the dielectric constant of A-MWCNTs/PVDF nanocomposites is about six times of that of U-MWCNTs/PVDF nanocomposites. In addition, the dielectric loss of A-MWCNTs/PVDF decreases to about a half of that of U-MWCNTs/PVDF nanocomposites on the frequency of 100 Hz. It is conclude that better dispersibility of A-MWCNTs in PVDF matrix is essential for attractive high dielectric constant nanocomposites.

Nano-Tailoring of Carbon Nanotube as Nano-Fillers for Composite Materials Applications

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ABSTRACT

The development of higher performance materials is a crucial requirement in almost every industry. Intrinsic material properties play an important role in the overall functioning and limitations of any physical device. Moreover, the conception of a device will be strongly dependant of the features of the materials used. On top of that, due to new socio-economical considerations, a lot of effort is devoted to the invention of low cost, environment friendly and easily processed materials.

Ballistic Quantum Transport in Nano Devices and Circuits

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ABSTRACT

Ohm's law, a linear current-voltage pattern, has been and continues to be the basis for characterizing, evaluating performance, and designing integrated circuits, but is shown not to hold its supremacy as channel lengths are being scaled down. In a *nanoscale* circuit with reduced dimensionality in one or more of the three Cartesian directions, quantum effects transform the carrier statistics. In the high electric field, the collision free ballistic transform is predicted, while in low electric field the transport remains predominantly scattering-limited. In a *micro/nano*-circuit, even a low logic voltage of 1 V is above the critical voltage V_c ($V >> V_c$) triggering nonohmic behavior that results in ballistic current saturation. The saturation current is now controlled by ballistic (B) saturation velocity that is comparable to an appropriate thermal velocity for a nondegenerate and Fermi velocity for a degenerate system with given dimensionality. A quantum emission may lower this ballistic velocity. A review of the physics behind breakdown of Ohm's law

and existence of quantum effects in engineering low-dimensional nanoelectronic devices is given.

Fabrication, Optimization and Application of Complementary Multiple-Gate Tunneling FETs

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ABSTRACT

We present fabrication, optimization and application aspects of complementary Multiple-Gate Tunneling FETs (MuGTFETs). Tunneling FETs are implemented in a MuGFET technology for the first time. N- and p-type tunneling currents are observed within a single device structure. Digital and analog device performance is analyzed. Measured devices show low oncurrents in the tens of nA regime due to not optimized doping profiles. However, promising analog characteristics are obtained with intrinsic gain of more than 300 for 65nm channel length devices. The scaling potential of multi-gate tunneling FETs is proven by measurements and device simulations that reveal a low dependence of the device characteristics on the channel length. The devices feature low temperature dependence and competitive matching behavior. A new voltage reference circuit is proposed as potential application for the MuGTFET.

Alcohol Gas Sensors Based on Magnesium Tetraphenyl Porphyrins

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ABSTRACT

Metallo-porphyrins thin films have been demonstrated as optical gas sensors for detecting various kinds of gases. In this work, magnesium 5,10,15,20-tetraphenyl porphyrin (MgTPP) thin films were prepared by spinning the solution using chloroform as solvent onto clean glass substrates, then subjected to a thermal annealing at 280°C in the argon atmosphere. These MgTPP optical gas sensors have higher responses with methyl alcohol than ethyl alcohol based on dynamic flow of alcohol vapors at 25°C. Quantum mechanical calculation based on density functional theory has found that the interaction energy between MgTPP with methyl alcohol is higher than ethyl alcohol. Principal component analysis (PCA) was used to classify the data from the optical absorbance spectra into three groups of alcohols, which are MeOH (100%), EtOH (100%) and a mixture of MeOH (50%) and EtOH (50%). From these results, MgTPP thin film can be an efficient sensing material to discriminate alcohols.

Nano Phototubes-A New Approach Towards Electronics

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ABSTRACT

A new electronic device, the "Novatron", is presented. The Novatron is a nano-scale triode vacuum tube in which electrons are liberated from the cathode via photo-emission instead of thermo-emission. The new technology enables the production of very high frequency devices approaching terahertz frequencies and opens new venues for integration of electronic elements.

Highly Sensitive Waveguide-Based Porous Anodic Alumina Nanosensors for Monitoring Atomic Layer Deposition

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ABSTRACT

A novel optical method for monitoring atomic layer deposition (ALD) is proposed by using porous anodic alumina (PAA) films as planar optical waveguides to measure changes in the effective dielectric constants of these films during TiO_2 ALD. It is shown that the sensitivity of the method is good enough for monitoring ALD growth, and the coupling angle proportionally shifts to the higher value with the increment of the ALD thickness over the film. Our method is applicable to monitor ALD not only on the flat substrate, but also inside the PAA pores.

Investigation of Silicon NC Memory with Improved Threshold Voltage Window

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ABSTRACT

Memory capacitors with the structure of thin tunneling oxide layer/silicon nanocrystal (NC) layer/thick controlling oxide layer were fabricated by both LPCVD method and low energy ion implantation method. The silicon NC formation condition, its size and density which have great influence on silicon NC memory characteristics are experimentally investigated in this paper. Silicon NC memory with a 2V threshold voltage window was obtained by optimized silicon ion implantation technology, which is beneficial to the practical application of the silicon NC memory device.

Nanoscale Analytical Modeling and TCAD Simulations of a Novel Gate Dielectric Stack SDPI MOSFET

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ABSTRACT

In this paper, the electrical characteristics of dielectric stack SDPI MOSFET have been discussed in conjunction with long term requirements of ITRS. Using Evanescent Mode Analyses (EMA), an efficient 2-D analytical model to analyze drain current, transconductance and drain conductance, in entire regime of operation-from subthreshold to saturation region including the effect of velocity overshoot has been presented. Furthermore, the analog performance metrics- g_m/I_{DS} (transconductance generation efficiency), R_{out} (output resistance), V_{EA} (early voltage) & g_m/g_d (intrinsic gain); device linearity metrics- VIP_2 & VIP_3 and intermodulation distortion- IMD3 of the proposed structure has also been discussed.

Effect of Channel Length on NBTI in Sub-100nm CMOS Technology

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ABSTRACT

The channel length dependence of NBTI degradation in a sub-100 nm CMOS technology is studied. It is shown that the enhanced interface trap generation near the gate edge is primarily responsible for the channel length dependence of NBTI degradation. The possible contribution of oxide charges, although may not be ruled out, plays a less important role.

Investigation of Turn-On Speeds of Electrostatic Discharge Protection Devices Using Transmission-Line Pulsing Technique

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ABSTRACT

As process technologies advance into deep sub-micrometer and nanometer scale, the charged device model (CDM) is now considered an important stress model for defining electrostatic discharge (ESD) reliability of integrated circuits. Thus the turn-on time of the ESD elements used in the protection circuit becomes important. At this time, there is no good method to evaluate the CDM ESD device turn-on speed. Equipment like VF-TLP and CC-TLP are too complicated and not precise for this purpose. A new method to evaluate the ESD device turn-on speed is presented in this paper. Based on this novel approach, some CDM ESD devices are analyzed based on the transmission line pulsing (TLP) tester. The designed devices include diodes, grounded-gate NMOS, SCR's (silicon controlled rectifier), and Modified-Lateral SCR's (MLSCR). The rising time of the pulse is set at 200 psec to accurately simulate real CDM pulses. The time-dependent voltage and current data are extracted and calculated from each pulse in the Time Domain Reflection (TDR) TLP tester. Two new ESD turn-on conditions are proposed and defined based on the transient currents in order to compare the relative speed of different ESD devices. The results show that the normalized turn-on time of different devices with various sizes and finger numbers do not correlate well with that obtained under the normal DC conditions, and the same device shows different turn-on characteristics under different pulses. These results enable devices to be designed for improved CDM ESD protection levels, and the present method can be used for ESD design for future nanometer technologies.

Nanophotodetector Array for Near-Field Nano-Imaging

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ABSTRACT

A novel near-field nano-imaging device based on nanophotodetector (NPD) array is presented. Simulation shows the smallest obtainable resolution is 150 nm for 1.55μm

wavelength. Various photolithography, e-beam lithography, wafer bonding and etching back techniques have been developed to realize the thin-film based photodetector structures. A slab version NPD device has been successfully fabricated. The smallest pixel size is as small as 100nm.

Size Effect in Cu Nano-Interconnects and its Implication on Electromigration

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ABSTRACT

With the interconnect dimensions approaching the length of the mean free path (MFP) of the electron, size effects are becoming important. This is manifested in the increase of the resistivity for nano-interconnects. This change in the electrical properties will pose new challenges in the EM performance for Cu nano-interconnects.

Keywords: Size effect, Nano-interconnect, Electromigration.

Volatile Organic Compound Sensor Arrays Based on Zinc Phthalocyanine and Zinc Porphyrin Thin Films

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ABSTRACT

In this paper, organic thin films based on two types of metal-macromolecules, i.e., zinc-2,9,16,23-tetra-*tert*-butyl- 29H,31H-phthalocyanine (ZnTTBPc) and zinc-5,10,15,20-tetraphenyl-21H,23H-porphyrin (ZnTPP), were demonstrated to discriminate among diverse volatile organic compounds (VOCs) even if they have very similar functional group. The ZnTTBPc and the ZnTPP thin films have been prepared by spin coating technique and then were tested for their optical response to VOCs, which share a similar carbonyl (C=O) group, namely acetone, formaldehyde (in a mixture form with methanol) and acetic acid, based on UV-Vis absorption. The transduction employs the optical response of selected spectral ranges arranged in an array configuration, which is then subjected to the principal component analysis (PCA). The PCA results have shown successful discrimination of these VOCs. Density functional theory (DFT) calculation was employed to study the interactions between these VOCs and the sensing materials. The calculation yields different degrees of interactions for each VOC, in compliment with the experimental results. This work supports the prospects of this organic sensor for beverage industry where VOCs are abundant in their products.

$Gd_2(MoO_4)_3$:RE Nanophosphors for Photonics and Solar-Cell Applications

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ABSTRACT

The generation of a higher energy visible or near-infrared (NIR) photon from at least two lower energy photons by exploting upconversion mechanism has been extensively investigated since the 1960's [1,2]. Silicon solar cells only absorb NIR light with energies greater than the band gap of 1.12 eV corresponding to wavelengths shorter than 1100 nm and could benefit from the upconversion of NIR light to visible/NIR light, which wavelengths shorter than 1100 nm. On the contrary, the energy of a vacuum ultraviolet (VUV) photon is twice more than that of a visible photon. Theoretically, it is possible to generate two visible photons for a single VUV photon absorbed, this two-photon luminescence phenomenon is called quantum-cutting (QC) [3]. QC materials might have potential application in solar cells, if conversion of one UV-visible photon into two NIR photons is realized [4-6]. The most widely used solar cells are based on crystalline Silicon. NIR QC phosphors could greatly benefit the development of solar cells because its emission energy is just above the band gap of Silicon. In this paper, an efficient NIR to visible upconversion process, involving the emission of a higher-energy visible photon

from absorbed two or three NIR photons via an excited energy transfer in $Gd_2(MoO_4)_3:Er^{3+}$ nanophosphors havs been investigated. We report also an efficient NIR QC phenomenon in $Gd_2(MoO_4)_3:Tb^{3+}$, Yb^{3+} nanophosphors. The results show that in principle an efficiency luminescent converter that, in an ideal case, converts NIR photons into visible/NIR photons by exploting upconversion mechanism, or converts visible photons into two or more NIR photons via cooperative QC mechanism. The development of upconversion and/or QC nanophosphors could opens up a new possibility to realize high efficiency silicon-based solar cells.

Keywords: Nanophosphors, Upconversion, Downconversion, Rare-earth ions, Solar cells.

References

[1] F. Auzel, Chem. Rev. 104(2004)139.
[2] A. Shalav, B. S. Richards, T. Trupke, et al., Appl. Phys. Lett. 91(2007)051903.
[3] R. T. Wegh, H. Donker, K. D. Oskam, etal., Science 283(1999)663.
[4] P. Vergeer, T. J. H. Vlugt, M. H. F. Kox, et al., Phys. Rev. B 71(2005)014119.
[5] T. Trupke, M. A. Green, and P. Wurfel, J. Appl. Phys. 92(2002)1668.
[6] Q. Y. Zhang, G. F. Yang, and Z. H. Jiang, Appl. Phys. Lett. 91(2007)051903.

Polarization-Independent Micro-Ring Resonator on Silicon-on-Insulator

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ABSTRACT

Polarization-independent laterally-coupled micro-ring resonator has been designed and demonstrated. The origin of the polarization-sensitivity of the photonic wire waveguide (PWW) was analyzed. A polarization-insensitive PWW structure was designed and a polarization-insensitive MRR based on this PWW structure was designed by finite difference time-domain method and was fabricated on an 8-inch silicon- on-insulator wafer. The offset between the resonant wavelengths of the quasi-TE mode and the quasi-TM mode is smaller than 0.15 nm. The FSR is about 17 nm, extinction ratio about 10 dB and Q about 620.

Multiphoton Induced Photoluminescence of Nanostructural ZnO

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ABSTRACT

Due to the rich morphologies and corresponding characteristics, nanostructural ZnO has attracted attention for its promising applications as multifunctional optoelectronic nanodevices. The previous reports have demonstrated the UV laser, field emission, biosensor, piezoelectricity of ZnO nanostructres. In general, the spontaneous emission of the nanostructural ZnO displays a UV spectrum from the band edge exciton recombination under a proper UV excitation. In this report, we investigate the frequency up- conversion behaviors of ZnO nanorods. the ZnO nanorods emitted strong UV emission when they were excited by the long wavelength laser from 450 nm to 1450 nm. This behavior demonstrated the two-photon, three-photon and four-photon induced photoluminescence. The emission intensity increased with the excitation intensity in square, cubic and biquadratic powers.

This work was supported by the NSFC (60725413, 60576008 and 10674023), 863 program (2006AA03Z313), 973 program (2007CB936300) and RFDP (20050286004).

Magnifying Nanoscale Objects by an Optical Hyperlens

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ABSTRACT

Magnifying a nanometer scale object by a conventional optical lens has long been considered impossible due to the diffractive nature of light. A silver superlens shows resolution of λ/6 utilizing a surface plasmon enhancement mechanism, however the high resolution image only exist in the near field. Recent theories have predicted an artificial metamaterial lens can project a sub-diffraction-limited object into the far field. Such devices have interesting hyperbolic dispersion such that ordinary evanescent waves become propagating along radial direction of the layered metamaterials. This provides new possibility for deep-sub-wavelength optical imaging in the far field.

For the first time, we experimentally demonstrated such a magnifying hyperlens [1, 2]. The optical hyperlens consists of curved multilayer of Ag (35 nm)/Al_2O_3 (35 nm) deposited on a half-cylindrical cavity fabricated in quartz substrate (Fig 1a and b).

Nanoscale objects are inscribed into a 50 nm thick top-most chrome layer. The anisotropic metamaterial is designed to have a hyperbolic dispersion. Upon the light illumination, scattered evanescent field from the object enters the anisotropic metamaterial and become propagating along the radial direction. The image can be gradually magnified when the light waves travel outwards. Once the magnified features become large enough outside of the hyperlens, it can be imaged by a conventional optical microscope at the far-field.

In our experiment, an object of a 35 nm wide line pair with 130 nm spacing (see SEM image in Fig. 1c) is imaged through the hyperlens using a mercury lamp (λ=365nm). The magnified image taken by a classical optical microscope (NA=1.4) through the hyperlens clearly resolves the object with sub-diffraction-limited resolution (Fig. 1d). This demonstrates that the hypelens is capable of magnifying and projecting a nanoscale image to the far-field. In the control experiment (data not shown), the same line pair could not be resolved without the hyperlens due to the diffraction limit (λ/NA =260 nm).

Ternary Bulk Heterojunction Organic Photovoltaic Cell

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ABSTRACT

In this paper, a ternary bulk heterojunction organic photovoltaic cell was designed to improve the device performance. The performance of the device containing Poly(phenyleneethynylene), single walled carbon nantube, and (N,N'-diphenyl-N,N'-di-(m-tolyl)-p-benzidine is much better than a control BHJ device compring Poly(phenyleneethynylene) and single walled carbon nantube. We propose that the retard of the charge recombination may be a key factor in the device performance improvement.

The Effect of Scattering Particles on the Photoluminescence of Organic Dye Films

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ABSTRACT

The strongly scattering and high gain in the active medium are necessary to produce the random laser. The random laser has been one of the focused research area in the laser scopes because of the random direction of the laser emission, small bulk, having no outside resonator, and potential applications in many fields. The PVK:Alq3:DCM organic films with TiO_2 scattering particles were manufactured by spin coating. The average radius of the TiO_2 particles is ~ 150nm. The PL spectrum at the range of 400nm to 750nm was measured by the fluorescence spectrograph when the films were irradiated with a 390nm pumping light. The PLE spectrum from 310nm to 580nm was measured by the fluorescence spectrograph at the 590nm emission light. From the PL spectra of the organic film with the TiO_2 scattering particles and the pure organic film (without the TiO_2 scattering particles), it is showed that the fluorescence of the organic film increase when the TiO_2 scattering particles are introduced into the organic film. And PLE spectrum does also. From the above experiments, the random laser should be realized combing the PVK:Alq3:DCM organic films with the TiO_2 scattering particles in the coming research work.

Gain and Noise Characteristics of Single-Mode $Er3^+/Yb3^+$ Co-doped Phosphate Glass Fibers

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ABSTRACT

Single-mode highly Er^{3+}/Yb^{3+} co-doped phosphate glass-fiber has been fabricated by rod-in-tube technique. Gain and noise measurements of the phosphate glass fiber have been performed by dual-pump configure with two 976 nm fiber-pigtail LDs using a highly Er^{3+}/Yb^{3+} co-doped phosphate fiber with a length of 5.0 cm. Gain spectra and noise figures with different input signal powers of -30, -10, and -1 dBm have been investigated when the signal wavelength was tuned from 1525 to 1565 nm. A peak net gain of 16.5 dB at 1534 nm with a -30 dBm input signal from a micro erbium-doped fiber amplifier (EDFA) based on the 5.0-cm-long phosphate fiber has been achieved, that is, a net gain coefficient as high as 3.3 dB/cm, which is to the best of our knowledge, the highest from this kind of fiber amplifiers reported to-date. At the -30, -10, and -1 dBm input signal levels, less than 8.0 dB noise figures over the whole C-band have been obtained.

Gain and Noise Characteristics of Single-Mode $Er3^{+}/Yb3^{+}$ Co-doped Phosphate Glass Fibers

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ABSTRACT

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Polarization Control for Quadruple Extension of Display Area

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ABSTRACT

A liquid crystal display (LCD) recently comes into common use. It is possible for this display unit to provide the same size of displaying area as the image screen on the panel. Thus the conventional display can show only one screen, but it is impossible to enlarge the size of a screen, for example twice. To enlarge the display area, the authors have developed an enlarging method of display area using a mirror. Our extension method enables the observers to show the virtual image plane and to enlarge a screen area twice. In the developed display unit, we made use of an image separating technique using polarized glasses, a parallax barrier or a lenticular lens screen for 3D imaging. The mirror can generate the virtual image plane and it enlarges a screen area only twice. In this paper, we present a new extension method to enlarge a screen area quadruple.

Photoluminescent Properties of Organic Salt Doped Polymer Film in Microcavity

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ABSTRACT

By using the organic/polymer host-guest doping system basing Forster energy transfer, the luminescence efficiency of the guest will increase rapidly because that the absorption loss of the guest at the pumping wavelength decreases. The low threshold organic lasing will occurs by introducing the microcavity and dye doping system. Besides the good single-photon and two-photon luminescence and lasing property, ASPI have the effective and reliable red electroluminescence property. The excited state energy transfer process and the photoluminescence property in the PMMA:Alq3:ASPI organic doping film were investigated combining the Forster energy transfer theory with the steady luminescent spectrum. The micro cavity of DBR/PMMA:Alq3:ASPI/Ag was made with a DBR and an

Ag layer as a reflector. The photoluminescence of the organic salt doping system in the microcavity including ASE and SE was studied. This type of doped systems is expected to have the good application foreground in the field of organic red electroluminescence and organic solid lasers.

The ASPI, Alq3 and PMMA of 1:25:100 (weight ratio) were dissolved in cyclopentanone while the concentration of PMMA in cyclopentanone is 40mg/ml. the 210-nm-thick active film was deposited onto the surface of a DBR dielectric mirror stack by spin coating (2000r/min) before drying. A 200-nm-thick Ag layer is deposited in high vacuum ($1^{*}10^{-3}$Pa) by thermal evaporation onto the active layer finally. The same thick organic film was deposited directly on the quartz substrate to measure the steady luminescence spectrum of the organic doping film.

The absorption spectrum of the organic doping film was measured by the UV-VIS spectrophotometer. The steady photoluminescence spectrum and the photoluminescence excitation spectrum were recorded by the fluorescence spectrograph. The organic microcavity was optically pumped with a third harmonic laser (355 nm, 8ns) from a YAG laser. The focused pump beam was incident on the organic film surface at a 45° angle through the DBR stack, which had 46% transmission at 355 nm. The stimulated emission spectrum from the microcavity was analyzed by an OMA with a CCD at the vertical direction of the DBR.

There is a broad luminescence band with a peak of 598nm and FWHM (Full Width at Half Maximum) of about 80nm from the PL spectrum of organic film. The single mode emission from microcavity has a peak of 592nm and FWHM of 4.0nm. The FWHM of the stimulated emission from the microcavity narrows sharply 19 times of the FWHM of PL spectrum of single organic doping film.

Electronic Polarizabilities of ions in Lithium Tantalate (LiTaO3) Optical Wave Guide from Natural Birefringence Data

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ABSTRACT

The ever increasing demand in the field of signal processing, computing, and communication has ushered in integrated devices in optical systems. Several materials have been used for fabricating optical wave guides, components and devices adopting a variety of techniques. However, among the many device materials, lithium Tantalate remains one of the prime candidates owing to its excellent piezo electric, Electro-optical and wave guiding properties. The active and passive structures of dielectrics also include two dimensional optical wave guides. The field of integrated optics is primarily based on the fact that light can be guided and coupled in very thin films of transparent materials on suitable substrates. - optical wave guides in Lithium tantalate crystal form the basis of many integrated optical devices. In characterizing these devices the refractive index is an important parameter and understanding of this parameter from atomic point of view is very essential. since RI is due to dipole moments of ions it can be expressed in terms of polarizabilities of the ions and electric field. The Electronic Polarizabilities of ions in Lithium Tantalate (LiTaO3) Crystals are evaluated from the data on the Natural Birefringence of these crystals. An accurate calculation of Electronic Polarizabilities of ions is indispensable in the understanding of problems regarding the Piezo - Optical and Electro-Optical behavior of these crystals

Keywords: Polarizabilities, Localfield, anisotropy, dipolemoment, Claussius Mossoti equation and Lorentz Lorenz equation, susceptibility Lattice summation, Refractiveindices, Birefringence

Directional Lasing and Energy Transfer in ZnO Nanotree

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ABSTRACT

The obliquely branched nanotree structures have been synthesized with the one-pot synthesis directly on the Zn substrate. The directional lasing spectroscopy of the nanometer branched ZnO crystallite arrays has been measured under high intensity femtosecond laser pulse excitation with femtosecond synchroscan streak camera as the detection system. The directional dependant ultrafast fluorescence emission gives clear

evidence that there exists intelligent energy flow of ZnO nano-tree structures. Such processes open a way to fabricate the integrated optoelectronic apparatus.

UV ZnO Random Lasers

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ABSTRACT

Ultraviolet semiconductor laser diodes find enormous applications in commercial products (e.g., ultrahigh-density storage in CDs and DVDs), scientific research (e.g. low-cost activated biological or chemical sensors) as well as military applications (e.g., portable on-site detector for natural or human caused epidemics). ZnO has a band-gap of 3.37 eV and a large exciton binding energy of 60 meV at room temperature. Furthermore, ultraviolet lasing has demonstrated from mirrorless ZnO thin films with random media at room and evaluated temperature. Hence, it is believed that ZnO semiconductor is one of the most promising candidates to realize ultraviolet laser diodes. However, the practical application of ZnO random media as the active layer in semiconductor laser diodes is still a major challenge due to the problems of 1) achieving high optical gain under electrical excitation and 2) high scattering loss from the random media.

In this presentation, we will discuss on our recent development of the fabrication of high-crystal-quality ZnO films which are suitable for the realization of device-quality ultraviolet light emitting devices. We will also demonstrate the fabrication of hetero-junction light emitting diodes with ultraviolet emission by our filtered cathodic vacuum arc technique. Hence, the approach to realize ultraviolet ZnO random hetero-junction laser diodes will be explained. Furthermore, we will study the possible methods to enhance the internal and external conversion efficiency of the ZnO random media as the active layer. It is believed that our proposed modification of ZnO random media is suitable to realize practical room-temperature operated ultraviolet laser diodes.

Keywords: ZnO, random lasing, laser diodes, heterojunction, ultraviolet emission.

Copper Phthalocyanine Thin-Film Transistors with Polyimide as Dielectric

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ABSTRACT

Copper phthalocyanine (CuPc) thin-film transistors (TFTs) have been fabricated using 400 nm polyimide cured at 250° as gate dielectric. The root-mean square surface roughness of polyimide films is 30Å. An individual patterned bottom gate, staggered structure was selected to study the device performance. The devices showed p-type electrical characteristics with field-effect mobility, threshold voltage and current on/off ratio values around $1.44\times10^{-3}cm^2V^{-1}s^{-1}$, 1.1 V and 12, respectively. The threshold voltage is near zero showing an enhancement mode which is very important from the viewpoint of the applications of organic integrated circuits.

The Role of Solitons on the Properties of Electron Transport through CNT/DNA/CNT Transistor-a Green's Function Approach

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ABSTRACT

In this work, we present a theoretical study of the conductance properties of molecular transistor model. The model considered has CNT/DNA/CNT structure. Using a tightbinding Hamiltonian model and the method based on generalized Green's function theory with the Lowdin partitioning technique and also Nonlinear model for describing the soliton in DNA, we investigate the role of the solitons in DNA electronic states and in the I-V characteristics of the CNT/DNA/CNT transistor. Our results show that in the presence of a distribution of soliton the band structure changes greatly and soliton states are created within the gap. In addition the voltage gap of the I-V curve vanish in the presence of solitons.

Effect of Temperature Variation on the Gain and Noise of Double Carrier Multiplication APDs

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ABSTRACT

In this paper we investigate the characteristics of gallium arsenide avalanche photodiodes (GaAs-APDs) over a range of temperature from 77 to 300 K. We show that the gain, breakdown voltage, and performance factor at a given bias voltage, increase while the excess noise factor decreases through the decrease in temperature. For calculation the gain and excess noise factor we use the recurrence equations method and effective value of nonlocalized ionization coefficient (width independent ionization coefficient) for GaAs-APDs.

Keywords: Temperature effects, recurrence equation, nonlocalized ionization coefficient, GaAs-APDs.

The First-Principles Calculation of the Effects Oxygen Defect on the Electronic Structure of SnO_2

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ABSTRACT

In order to investigate the effects oxygen defect on the electronic structure of SnO_2, the structural change, band structure, density of states, and electron density difference of $(\bar{1}10)$ surface of SnO_2 in the rutile lattice phase were performed by the first-principles calculation of plane wave ultra-soft pseudo-potential technology based on the density function theory. The calculated conclusions were revealed that the oxygen defect changed the inner energy of SnO_2 crystal; the SnO_2 with oxygen vacancy defects had high conductivity of semiconductor; while the defect of surplus oxygen atom in interstitial position cause to enhance the degeneracy of VBs and weaken the communizing motion of electrons. The research results strongly guide the technical process of preparing SnO_2 thin film and powder in theory, and have scientific and theoretical value.

Keywords: SnO_2, First-principles, electronic structure, transparent conducting films.

Conductivity Enhancement of PEDOT:PSS Films with Ionic Materials as Dopants

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ABSTRACT

The ionic materials were added to PEDOT:PSS solution as secondary dopants. The conductivity of PEDOT:PSS film improved with adding ionic materials. The film of PEDOT:PSS with 1% pyridinium p-toluene-sulfonate showed the conductivity of 23 S/cm, which is increased about three orders than the film of origin PEDOT:PSS with 0.028 S/cm. The surface morphology of films of PEDOT:PSS mixture is investigated by atomic force microscope. The AFM showed the increasing of grain size with the addition of pyridinium p-toluene-sulfonate. The conductivity of PEDOT:PSS film with p-toluene-sulfonate decreased with adding glycerol and the phase separation was observed by AFM.

Nickel Chemical Mechanical Polishing

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ABSTRACT

Chemical Mechanical Polishing (CMP) is widely used in nano/MEMS fabrication processing, especially in Complex multi-layer Structure. Nickel is, Nickel and Ni based alloys are exploited to realize movable structures in nano/MEMS devices and considered as an ideal candidate for the application in nano/MEMS due to high deposition rate, easy stress control, low resistivity, low deposition temperature and good mechanical properties. Chemical Mechanical Polishing for Nickel is studied in this paper. The electrochemical potential of Nickle is analysed by Potentiodynamic polarization. The Surface is analyse by XPS and SEM. Ni removal rate have a peak while H_2O_2 concentration is 1%. Ni removal rate increases with the addition of H_2O_2, EDTA and nickel chloride. Significant different potentiodynamic polarization behavior of Ni was observed under static and dynamic conditions. The XPS analysis indicates that NiO and $Ni(OH)_2$ were present on Ni when exposed to peroxide-free solutions and solutions with peroxide. Surface chemistry and electrochemical characteristics of Ni play an important role in controlling the polishing behavior.

Keywords: CMP, nano/MEMS, Nickel, Potentiodynamic.

Synthesis of PMN by Mechanochemical Process

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ABSTRACT

PMN ($Pb(Mg_{1/3}Nb_{2/3})O_3$) is used in many high-tech fields due to its dielectric and other advantages, the preparation of PMN by traditional methods exists some problems, such as impurity phase. In this paper a novel mechanochemical method to synthesize PMN was reported, MgO, PbO and Nb_2O_5 without any purification utilized as raw materials were mixed by ball-milling in advance, and the mixture was characterized by XRD, BET and SEM to identify the structure and the dispersion. It was indicated that the materials were dispersed better and no crystal phase transformation was observed after pre-milling. Then the pre-milling powders were poured into the milling jar to grind under different conditions. As-received powders were examined by XRD and SEM. The influence of milling time on the structure of the products was analyzed, which could obviously indicate the solid-state reaction route during grinding. The radio of raw materials and the speed of milling were changed gradually, and their effects on solid-state reaction were studied in details. All samples synthesized at different conditions were testified by XRD to confirm the chemical composition. The morphology were analyzed by SEM, which revealed typical microstructure of nano scale. It was found that the speed of rotary was the key factor to influence the solid state reaction. It came to the conclusion that the pure PMN

could be produced at the lower speed. It was considered that mechanochemical process was an efficient, fast and easy way to prepare the nano-scale PMN.

Large-Scale Synthesis of Water-Soluble Nanorods

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ABSTRACT

Highly water-soluble Na_2So_4 nanorods have been prepared by introducing Ca^{2+} as a shape-control agent. The diameter of the as-synthesized nanorods is basically in the range of 20–40 nm and the length is in the range of 500–800 nm. It is also found that the NO_3 also plays an important role in the formation of the nanorods and the Cl^- may help to form uniform of the nanorods. The synthesis procedure is also facility, and the as-synthesized nanorods may provide ideal templates for preparing nanotubular materials.

Synthesis of Fe^{3+}-Dopped Polyaniline Conductive Nanomaterials *via* Interfacial Polymerization

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ABSTRACT

A series of Fe^{3+}-dopped polyaniline nanomaterials with different morphology and a higher conductivity were successfully synthesized using a simple and static interfacial polymerization in the presence of surfactants CTAB and SDS and $FeCl_3$ as both oxidant

and dopant. The samples were characterized by Transmission Electron Microscopy (TEM), SDY-4 probes conductivity meter, X-ray Diffractometry (XRD), Energy dispersive spectroscopy (EDS) and Fourier transform infrared (FT-IR) spectroscopy techniques. TEM images of these samples showed that their morphologies changed with the dosage of $FeCl_3$ and the type of the surfactant. And adding surfactants CTAB and SDS into the Fe^{3+}-dopped PANI (Fe^{3+}/PANI) nanomaterial, forming CTAB/Fe^{3+}/PANI and SDS/Fe^{3+}/PANI nanomaterials, not only brought about different morphology but also remarkably improved the conductivity of the material. For example, the conductivities of CTAB/Fe^{3+}/PANI and SDS/Fe^{3+}/PANI nanomaterials were respectively about 4.8×10^{-2} and 1.3×10^{-2} S/cm while the conductivity of Fe^{3+}/PANI was found to be 1.5×10^{-4} S/cm. The different morphology and high conductivity may be ascribed to the mutually effects of the surfactant and the oxidant. Compared with the traditional polymerization, this method is more simple and facile because $FeCl_3$ acted as oxidant and dopant at the same time.

Stabilization of a Multiplexing Fiber Michelson Interferometer for Precision Measurement

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ABSTRACT

A servo electric control system is presented to stabilize a multiplexing fiber Michelson interferometer. The multiplexing fiber interferometer is configurated by employing the characteristics of fiber Brag gratings. Thus, two fiber Michelson interferometers are overlapped. One of the interferometers is used for the stabilization while the other one is employed for the measurement operation. The noise resulting from temperature fluctuation and other types of environmental disturbance can be compensated for by keeping the phase difference in quadrature between the two arms of the stabilizing interferometer. The stabilizing operation is realized while the servo electric feedback system controls a piezoelectric tube wound the fiber in the reference arm. The dynamic range of the servo electric feedback system is between 0Hz and 5 kHz, sufficiently wide to include information signals and noise.

Fabrication of PZT Thick Film by Two Spin-Coating Methods Based on Sol-Gel

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ABSTRACT

Two spin-coating methods of depositing PZT ($Pb(Zr_{0.52}Ti_{0.48})O_3$) thick film on $Au/Cr/SiO_2/Si$ substrate by sol-gel have been investigated in this paper. PZT nanopowder which is identical with the PZT clear sol in composition dispersed into PZT clear sol and mixed by ultrasonic processing obtained PZT sol suspension, the grain size of PZT nanopowder is approximately 50–10 nm. The XRD analysis indicates that the both thick films possess single perovskite phase structure. The SEM micrographs show that the surface of first thick film is coarse and the second thick film is dense, uniform and crack-free. Their thicknesses are both about 4 μm. The ferroelectric hysteresis loops of both PZT thick films, which were tested under the frequency of 1 kHz, show that they have the coercive field of 30 kV/cm and 50 kV/cm, the saturation polarization of 45 $\mu C/cm^2$ and 54 $\mu C/cm^2$, the remnant polarization of 25 $\mu C/cm^2$ and 30 $\mu C/cm^2$, respectively, the second thick film has higher direct current compression resistant properties, keeps good ferroelectric properties under electric field intensity of 300 kV/cm. Thus, the second spin-coating method could improve the surface morphology and the ferroelectric properties of PZT thick film.

Luminous Performance of YAG:Ce Powder Synthesized via Self-Propagating Synthesis Process

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ABSTRACT

White LED offers a useful technology for appropriate utilization of energy, relieving energy crisis and giving green lighting. In this paper, by using Y_2O_3, $Al(NO_3)_3$, $Ce(NO_3)_3 \cdot 6H_2O$, EDTA, etc. as raw materials, nano-YAG:Ce powder was obtained by self-propagating synthesis method. Samples were checked by X-ray diffractometer and flexstation II spectrophotometer. The self-propagating synthesis method lowed the calcining temperature and single-phase YAG:Ce powder was obtained at 900°C. The highest emission intensity and excitation intensity of as-calcined YAG:Ce powder reached 800Mcd. Luminescence intensity of YAG:Ce powder decreased with the increasing of Ce content. Putting the gel in the drying oven can effectively restrain the agglomeration between the particles and thus improved the luminescence property, although the resulting particles became large.

Quantitative Analysis of Si/Ge Quantum Structures by High-Resolution Transmission Electron Microscopy

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ABSTRACT

Quantitative high-resolution transmission electron microscopy was used to examine structural peculiarities of SiGe quantum islands on an atomic scale. A combination of high-resolution transmission electron microscopy and geometric phase analysis was applied to study the deformation fields of SiGe quantum islands grown on a Si(001) substrate by an ultrahigh vacuum chemical vapor deposition system. The numerical moiré method was applied to visualize the lattice fringe surrounding the interface defects.

Keywords: Si/Ge quantum island, strain, high-resolution transmission electron microscopy, geometric phase analysis.

Nanoscale Strain Analysis of Si/Ge Heterostructures

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ABSTRACT

We report the quantitative characterization of strain components in semiconductor heterostructures of silicon-germaniums ($Si_{0.76}Ge_{0.24}$) grown on Si substrate with an inserted Ge layer by an ultrahigh vacuum chemical vapor deposition system. Strain analysis was performed using a combination of high-resolution transmission electron microscopy and geometric phase analysis. The numerical moiré method was applied to visualize the lattice fringe surrounding the defects. The strain components ε_{xx}, ε_{yy}, ε_{xy} of interfaces and defects were mapped, respectively. The strain was about 3% in the interface region.

Keywords: Si/Ge heterostructures, strain, high-resolution transmission electron microscopy, geometric phase analysis.

Effect of Substrate Temperature on Properties of Bi-2212 Thin Films Using rf Magnetron Sputtering Technique

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ABSTRACT

We were prepared superconducting Bi-2212 thin films on MgO (100) substrate single crystal using rf-magnetron sputtering. A series of thin made annealed in chamber with environment oxygen. Target Bi-2212 have been use in this technique. The films were annealed for different period of time in oxygen at 1atm and the films were deposited at different temperature substrate. Effect of annealing time and the temperature of the substrate on the quality and the phase formation of Bi-2212 thin films have studied. The influence of substrate temperature also has been investigated by X-ray diffraction, scanning electron microscopy (SEM), resistivity and ac-susceptibility. It was found have get the good Bi-2212 thin films with condition was annealed in environment oxygen at 1atm C for 4 hours and deposited at 600°C substrate temperature.

Keywords: Bi-2212 thin films, rf magnetron sputtering.

Periodic Nanoscale Si Structures by Ion Beam Induced Glancing Angle Deposition

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ABSTRACT

The dot and ripple surface topography emerging on Si, Ge and compound semiconductor surfaces during low-energy (≤2000 eV) noble gas ion beam erosion at oblique ion incidence is studied. The results show that there is a much more complex behavior of the surface topography with ion energy, ion fluence, angle of incidence, etc.

Performance of a Soft X-ray Splitter Grating Parallelism Measuring System by Diffraction Method

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ABSTRACT

We present new progress in the diffraction grating interferometer being pre-aligned used a double frequency grating. To measure the parallelism of the double frequency grating to a nicety before built in the interferometer, a device based on Diffraction Technique for measuring the parallelism of the double frequency grating is designed. It is built of a semiconductor laser, a collimator, gratings, a precision turnplate, a beeline workbench, a redressal shelves, a ccd detector. The system error of the device is analyzed in this paper, and the parallelism of the double frequency grating is measured by this device.

The results demonstrate that the diffraction measuring device suits the parallelism measured the diffraction grating interferometer based on the double frequency grating of that parallelism can attain a high pre-aligning precision.

In situ Manipulating and Measuring Carbon Nanotubes

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ABSTRACT

Carbon nanotubes (CNT) have outstanding electrical properties and high performance CNT field effect transistors (FET) have been made. However, bending or controlled deformation may change the energy structure and the electronic properties of the CNT. Special structure formed from CNT like CNT rings may also have fascinating properties. These directions are rarely explored due to the lack of proper methods. Here, we report our method to measure electronic property of any specified CNTs or other nanostructures. We also generate a method to shape a CNT into ring and to measure it.

Nanomanipulators installed in scanning electron microscope (SEM) are used. A specified CNT was firstly picked up using a tungsten nanoprobe from a platinum tip that had been dipped in CNT powder. The CNT was then placed across three pre-defined TiN/AlSi electrodes on SiO_2/Si substrate (see Figure (a)). The electrical properties of the CNT device were then studied using the three tungsten nanoprobes. Similarly, we also picked up CNTs from a copper grid after they had been observed by transmission electron microscope and we then placed the CNT on pre-defined electrodes to fabricate devices. The electrical properties were studied, and were correlated to the CNT atomic structure.

CNTs were also shaped into varied forms after they were placed on substrate under the manipulation of nanomanipulators. Figure (b) shows that a multi-walled CNT was shaped into a closed ring, and that its I-V property was measured using two nanoprobes. More than CNT rings, CNT helixes can also be formed. CNT helixes can be used as inductance.

Our methods are not only useful for CNTs but also valuable for the study of other nanostructures, like nanowires, nanojuctions and complex nanostructures.

Microstructure and Soft Magnetic Properties of a New NANOPERM-Type $Fe_{84.6}Nb_6B_8P_1Cu_{0.2}Mn_{0.2}$ Nanocrystalline Alloy

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ABSTRACT

A new NANOPERM-type $Fe_{84.6}Nb_6B_8P_1Cu_{0.2}Mn_{0.2}$ alloy was obtained through the single-roller spinning technique. Proper heat treatment was adopted to anneal the NANOPERM-type alloy amorphous ribbon. Microstructures of the annealed ribbons were examined by XRD and TEM methods while the soft magnetic properties were tested by TPS-200SA Soft Exchange Tester. XRD and TEM results indicated that α - Fe nanocrystallites formed in the amorphous matrix after annealing under vacuum at 753~843 K for half an hour, resulting in the nanocrystalline and amorphous two-phase structure. The VSM and B-H analyzer shows that the new NANOPERM-type alloy $Fe_{84.6}Nb_6B_8P_1Cu_{0.2}Mn_{0.2}$ exhibited an excellent combined soft magnetic property.

The Giant Magnetostriction and Magnetic Properties of the Amorphous Tb/Fe/Dy and Fe/Tb/Fe/Dy Nano-Multilayer Films

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ABSTRACT

Giant magnetostriction has been studied by the amorphous alternant Tb/Fe/Dy (sample A) and Fe/Tb/Fe/Dy (sample B) nano-multilayer films at the room temperature. The magnetic hysteresis loops show that sample B has better soft magnetic properties than sample A, and easy magnetic direction changes from perpendicular the film plane to parallel the film plane. The sample B has good low-field giant magnetostriction, and it is five times higher than sample A at H=100 kAm^{-1} from 16 ppm to 82 ppm.

Giant Magneto-Impedance of Glass-Covered Co-Rich Amorphous Wires

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ABSTRACT

The length effect on giant magneto-impedance in glass-covered Co-rich amorphous wires were studied in this paper. The measurements of the magneto-impedance of the samples with different length and the driver current frequency (from 100 KHz to 1 MHz) were carried out. It was found that the variation of GMI of the longer sample was more evident. The circular permeability was further calculated. The study of the circular permeability indicates that GMI effect is influenced by the domain and demagnetization energy after longitudinal saturated magnetization. Without dc field, the circular permeability of samples is approximate equality and this phenomenon was explained by the core-shell model. After longitudinal saturated magnetization, the circular permeability of the longer sample is smaller for the demagnetization energy effect. Thus, the variation of the circular permeability becomes more severe for the longer sample. The conclusions will deepen the understanding of GMI effect.

Keywords: Giant magneto-impedance, domain, demagnetization energy.

Microwave Electromagnetic Properties of Discontinuous CoFeB-MgO Magnetic Multilayer Films

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ABSTRACT

A series of multilayer of CoFeB-MgO was fabricated by means of DC/RF magnetron sputter deposition. The excellent soft magnetic and high frequency properties along with high electrical resistivity are achieved in the discontinuous multilayer structure of $[Co_{44}Fe_{44}B_{12}$(7 Å)/MgO(4 Å)$]_{40}$ film. This film exhibits high magnetic loss (μ") as well as high permeability (μ') in the GHz frequency range with saturation magnetization of 1.2 T and high in-plane uniaxial anisotropy field of 5500Å/m along with resistivity of 3.3×10^3 μΩcm. The real part of complex permeability μ' is nearly constant at about 170 below 1.8 GHz and larger than 100 until 2.1 GHz, while the imaginary part μ" is larger than 100 from 1.5 GHz until 3.3 GHz for this film. The results indicate that the discontinuous CoFeB-MgO multilayer film has potential for serving as the microwave absorber and EMI shielding materials in the GHz frequency range.

Electrical Transport Properties and Magnetoresistance of $La_{0.7}Sr_{0.3}MnO_3$:$xZn_{1-y}Co_yO$ Composites

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ABSTRACT

The $La_{0.7}Sr_{0.3}MnO_3$:$xZn_{1-y}Co_yO$ (x = 0.0, 0.1, 0.2, 0.3, 0.4 mol, y = 0.05) composites were prepared via a sol-gel process. The temperature dependence of the resistivity and magnetoreisitance of the composites with different $Zn_{1-y}Co_yO$ were investigated. X-ray diffraction reveals that both the compounds maintain their identities, that is, there is no evidence of reaction between the $La_{0.7}Sr_{0.3}MnO_3$ (LSMO) and $Zn_{0.95}Co_{0.05}O$. Magnetization is observed to decrease as the $Zn_{0.95}Co_{0.05}O$ content is increased. Moreover, it is found that the change in MR is greater in the doped composites with x = 0.1, 0.2, 0.3, as compared to pure LSMO. At the same time, on the addition of weak magnetic $Zn_{0.95}Co_{0.05}O$, the spin disorder is produced through the tunneling process at the grain boundaries and when a magnetic field is applied, the spin disorder is suppressed, resulting in a high MR at the low field 5 kOe.

The Size Effects of the Magnetic Properties for the 200-nm Co Nanorings: Monte Carlo Simulation

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ABSTRACT

In this work, using Monte Carlo simulation, we study the magnetic properties of individual Co nanorings with the outer diameter of 200 nm, the thickness of 10 nm, 20 nm, 30 nm and the varying width from 10 nm to 90 nm, obtaining various spin configurations. The simulated results indicate that, there exist evident size effects on the magnetic states and magnetization processes of the nanorings; in the magnetization reversal process there exist the onion-type state for the narrow rings, and the vortex-type state and onion-type state for the wide rings, respectively. The vortex-type spin configuration is responded for the step of hysteresis loops, which is named as the second stable state. At the same time, it is found that the stability of the second stable state has evident size effect. Moreover, the simulated results are consistent with experimental facts.

Structure and Ferromagnetic Properties Co-Doped TiO_2 Films Prepared by Plasma Enhanced Chemical Vapor Deposition

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ABSTRACT

For the anatase Co-doped TiO_2 polycrystalline films fabricated with plasma enhanced chemical vapor deposition technique at low temperature followed by thermal treatment at 520°C for 5 minutes, the influence of the dopant concentration and oxygen-plasma annealing on ferromagnetism of films have been investigated systematically. XRD and Raman measurements show the Co-related secondary phase is responsible for the degradation of the magnetization of Co-doped TiO_2 film. In addition, the magnetization of the films has been found to decrease with the increase of oxygen-plasma processing duration, indicating the negative role of oxygen-rich on ferromagnetism of anatase Co-doped TiO_2 polycrystalline films.

Ferromagnetism in Cubic $Ga_{1-x}Cr_xN$ by Density Functional Calculations

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ABSTRACT

We report the results of a theoretical study of magnetic coupling between Cr atoms doped in cubic GaN. The calculations are within the framework of density functional theory with the generalized gradient approximation to the exchange and correlation potential. By varying the concentration of doped Cr atoms and the sites they occupy, the electronic structure and magnetic properties of Cr-doped cubic GaN are calculated. It is found that the ferromagnetic phase of $Ga_{1-x}Cr_xN$ is energetically the most preferable state irrespective of the concentration and site occupation of the Cr atom. Cr atoms cluster around N and couple ferromagnetically, while the neighboring N atom is antiferromagnetically coupled to the Cr spin in the zinc blende $Ga_{1-x}Cr_xN$. The origin of the ferromagnetism in the Cr-doped cubic GaN can be understood by double-exchange mechanism. The calculated results are consistent with the recent experimental discovery of ferromagnetism in Cr-doped GaN single cubic phase.

First-Principle Calculations of Wurtzite 3d Transition Metal Oxides CrO

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ABSTRACT

The electron structure and half-metallic properties of CrO with a wurtzites structure (w-CrO) were invesigated by first-principles calculation using generalized gradient approach (GGA) and GGA+U methods. It was revealed that w-CrO is a half-metal resulting from the strong hybridization between Cr 3d and O 2p states. w-CrO may be a promising half-metallic electrode for some technologically important wide gap semiconductors in spintronic applications due to its lattice constant matches that of ZnO.

The Theory Study and Realization Based on Cross Coupled Resonator Filters and Diplexer

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ABSTRACT

The formulas for the design of the cross-coupled resonator filter and diplexer were presented by using the frequency transform technique to revise the traditional lowpass prototype synthesis method. At the same time, the coupling matrix is optimized by using least square method and the optimal coupling structure may be gotten. The cross coupled resonator passband filter and diplexer can be achieved by using this approach, the designed example is presented and the results validated its effectiveness.

Keywords: Lowpass prototype; frequency transform method; cross-coupled; resonator filter; diplexer; least squares method (LSM).

Theoretical Investigation on Structural, Electronic and Optical Properties of Sb-Doped ZnO

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ABSTRACT

The geometric structure, electronic structure, and the formation energy of impurities of Sb-doped ZnO with wurtzite structures have been investigated using a first-principles ultra-soft pseudo-potential approach of the plane wave based upon the Density

Functional Theory (DFT). The calculated results indicate that the volume of ZnO doped with Sb add up, and the Sb substitutional system of ZnO yields the lowest the formation energy of impurities. Furthermore, Sb dopant occupy the octahedral sites of wurtzte lattice behaves as a deep acceptor and shows p-type degenerate semiconductor character. In addition, the DOS moves towards lower energy and the optical band gap is broadened. It is also found that our results are in good agreement with other experimental results. the calculated results also enables more precise monitoring and controlling during the growth of ZnO p-type materials as possible.

Keywords: Zinc oxide, a first principles, doped, density function theory(DFT).

Numerical Simulation of Ballistic Carbon Nanotube Field-Effect Transistors

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ABSTRACT

In this paper we consider a Carbon Nanotube Field Effect Transistor with coaxial symmetry terminated with metallic contacts on both sides and surrounded with a metallic gate. We calculate band structure of carbon nanotube using the tight-binding approximation and extract useful parameters such as energy bandgap and effective mass from it. We solve the system of coupled Schrödinger-Poisson equations to obtain the wave function of carriers in the channel by using appropriate normalization of wave function. We also investigate the current-voltage characteristics of the device.

Circuit Modeling of SAGCM-APD

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ABSTRACT

In this paper, we present a circuit model for SAGCM (separate absorption, grading, charge and multiplication) APD. It is based on the carrier rate equations in the different regions of the device. We deduced the characteristic equations of photo-current and dark current, respectively. According to these current equations, a PSPICE model, which is

used in device and circuit simulations, is constructed. Using this model, we simulated the main parameters of SAGCM APD, such as photo-current, dark current and gain. The results are excellent agreement with experimental data over a wide range of bias voltage. This model can also be applied to SAM APD and SACM APD by modifying its equivalent circuits.

Molecular Dynamics Simulations to Investigate the PMMA/NanoG Nanocomposites Interfacial Microcosmic Structure and Interaction

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ABSTRACT

Interfacial microcosmic structure and interfacial interaction in majority of engineering nanocomposites are difficult to measure experimentally, since many nanocomposites are usually insoluble in solvents, and are sometimes poorly characterized. Therefore, applying molecular modeling strategies would be helpful in such situations in order to provide useful information, which would be difficult to get by other methods. Poly(methyl methacrylate)/Graphite nanosheets (PMMA/NanoG), is a electrically conducting composite has been extensively investigated in the past few decades. Therefore, we have selected PMMA/NanoG to perform the molecular dynamics simulations to investigate its interfacial microcosmic structure and interfacial interaction. The COMPASS force field methodology was used in the study for polymers and non-polymer that are closely agreeable with the experimental data. Molecular dynamics (MD) simulations have also been performed to explore the polymers with several non-metallic materials, because such studies are important in developing polymer nanocomposites. In the article we compute these nanocomposites to investigated the interfacial microcosmic structure and their stabilization, also, we study the interfacial interactions to interpret the PMMA and graphite nanosheets how to interact.

Intersubband Scattering Effects on the Carrier Velocity of a AlGaAs/GaAs Single-Well Heterostructure

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ABSTRACT

In this paper, we present an accurate model for scattering rates in a AlGaAs/GaAs single-well heterostructure, based on new extended relations for wave functions and subband levels. In this structure, the wave functions and energy levels of two dimensional electron gas are derived by a variational method. The effect of fourth subband level on the scattering rates and carrier velocity are evaluated by Monte Carlo simulation

Theoretical Investigation on Electronic and Optical Properties of ZnO Doped with Al, Ga and In

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ABSTRACT

The effect of Al, Ga or In doping on the electronic structure and optical properties of ZnO were performed by the first-principles calculation of plane wave ultra-soft pseudo-potential technology based on the density function theory (DFT). The calculated results revealed that due to the shallow donor doping, there were lots of free carrier in the bottom of conduction band. Furthermore, Al, Ga or In ion occupy the Zn sites of wurtzte lattice behaves as a shallow donor, which improved greatly the conductivity of semiconductor. the optical band gap was broaded and moved towards low energy, and were made the transparent conducting films. It is also found that our results are in good agreement with other experimental results. In addition, The design and application of optoelectronics materials of ZnO were offered in the theory data. Furthermore, the calculated results also enables more precise monitoring andcontrolling duringthe growthof ZnO materials as possible.

Keywords: Zinc oxide, a first principles, doped, optical properties, density function theory(DFT).

Study on the Atomic-Scale Friction Behavior between Diamond Films and Copper Using Molecular Dynamics

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ABSTRACT

Classic molecular dynamics simulations are employed to investigate the atomic-scale friction behavior between diamond films and copper counterface. The simulation system is composed of a diamond bulk and a (8×8×4) face-centered-cubic (FCC) copper lattice. The (111) surface of diamond lattice is brought to slide against the (100) surface of copper counterface. Periodic boundary condition is applied in the sliding interface to simulate an unlimited sliding surface. A compression process is firstly performed to generate various normal loads on the sliding interface and then the sliding movement is accomplished by moving the copper counterface along [110¯] and [112¯] crystallographic direction of diamond film. The effects of crystallographic sliding direction, normal load, and sliding velocity on the friction force on sliding interface are investigated and the atomistic sliding mechanism is discussed from the viewpoint of atomic motion.

Quasiparticle Band Structures of Wurtzite ZnO

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ABSTRACT

The theoretical calculation of the band structure of ZnO mostly involves the local-density approximation (LDA) method, which usually seriously underestimates the band gap. So, it is desirable to calculate the band structures in a more reliable method. In this paper, we present the band-structure calculations of wurtzite ZnO within the framework of density-functional theory (DFT) in LDA, employing the correction for band structures of wurtzite ZnO with GW approximation (GWA) using the ab *initio* pseudopotential method. The Zn 3d electrons are considered as valence states both in LDA and quasiparticle

calculations. The LDA spectrum shows that ZnO is a direct band-gap semiconductor. The differences between the band structures obtained by the GWA and LDA are discussed.

AB *initio* Study of Ferromagnetism in N Doped ZnO and its Stabilization by Li Co-Doping

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ABSTRACT

Spin-resolved electronic properties of N doped ZnO is investigated from *ab initio* calculations based on density functional theory (DFT). It is found that single N atom at O site in ZnO becomes spin polarized with its many neighboring atoms with a total magnetic moment of 1.0 $_{\mu B}$. Band structure of ZnO doped with 6.25% of N shows a half metallic character with hole states in the minority channel. Though the ferromagnetic coupling is weak in the system, Li co-doping greatly enhance the ferromagnetism. The results of our calculations suggest the possibility of fabricating ZnO based DMS by (N, Li) co-doping.

The Effects of Surface Roughness Upon Ferromagnetic Films' Magnetism

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ABSTRACT

In this paper, using Monte Carlo method, the effects of surface roughness upon the magnetism of free and coated ferromagnetic films are studied. It is suggested that the surface roughness γ need to be defined as γ+ and γ− according to variant films' structures. The simulated results indicate that: (1) The γ+ dependence of magnetic properties is different from the γ− dependence of those; (2) The surface roughness is associated with the coordination number, and they influence evidently the magnetic properties of the films; (3) The effects of surface roughness upon the magnetic properties of free and coated ferromagnetic films exist evident differences, which is due to the strong enhanced the magnetization at the surface of the free films.

First-Principles Study of Work Function of $Ni_{1-x}Pt_x$ Alloy Gate Electrode

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ABSTRACT

In this work, first-principles calculations are carried out to study work function of $Ni_{1-x}Pt_x$ alloy (001) surface. It is shown that the work function of $Ni_{1-x}Pt_x$ alloy increases with increasing Pt content in the $Ni_{1-x}Pt_x$. The work function increases from 5.03 eV to 5.31 eV when the Pt content is increased from 0 to 25%. A tuning range (0.28 eV) for vacuum work function was achieved theoretically, which exhibits the proper work function as PMOS gate electrode candidates.

Ferromagnetism of Cu Doped ZnO: First-Principles Calculation and Monte Carlo Simulation

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ABSTRACT

In this work, the electronic structure and the stability ferromagnetism of Cu-doped ZnO are studied by first-principles calculations and Monte Carlo simulation. The calculated results from first principles indicate that the ferromagnetic ground state is stabilized by its half-metallic electronic structure which originates from the strong hybridization between Cu-3d and O-2p electrons. Meanwhile, through the coupling strength from first-principles calculations, the Monte Carlo simulated results predict that the Curie temperatures of $Zn_{1-x}Cu_xO$ (x = 5.55%, 8.33%, 12.5%) are 140, 480, 530 K, respectively, which is generally consistent with some theroetical and experimental results.

Theoretical Study on Effective Permittivity of Nanowire Mesh Electromagnetic Crystal

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ABSTRACT

In this paper, we consider the effective dielectric constant of a 3d metal nanowire mesh configurated in a simplesimplecubic lattice based on the dipole approximation. If a plane wave of electromagnetic radiation is incident on the lattice, it is partly scattered and the rest transmits into the nanowire mesh, so fields outside the nanowire mesh are represented by the local field plus the scattering fields. We assume that the direction of the axis of the wire is *z* direction, as the metal nanowire is cylindric, the effective dielectric constant is not the same in the *x* and *z* direction. Using method of EM scattering, we develop an analytical formula and calculate the effective dielectric constant of the lattice in the *x* and *z* direction respectively. And we find that the real and the imaginary part of the effective dielectric constant can be affected by many factors, such as the metal concentration, the conductivity of the metal nanowire as well as the nanosize effect. We have made comp uter simulation which indicate how the metal concentration, the conductivity of the metal nanowire and the nanosize affect the effective dielectric constant.

High-Frequency Ferromagnetic Properties and Monte Carlo Simulation of FeCoZr Thin Films Prepared by Gradient Sputtering

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ABSTRACT

Nanocrystalline FeCoZr films were prepared by a gradient sputtering method at room temperature. A gradient Zr composition was present in the films from one side to the other. It was revealed that magnetic properties of the films dramatically depend on the Zr composition. With the increase of Zr composition, the saturation magnetization of the films first increased from 18.6 to 19.1 kG, then decreased to 14.7 kG. A distinct uniaxial magnetic anisotropy (UMA) up to 300 Oe, was obtained, which values depend on Zr composition. On the other hand, high resonance frequency over 3 GHz was achieved in the magnetic annealed films. The origin of UMA was investigated by Monte Carlo simulationg of the Zr composition depended hysteresis loops, considering the intrinsic stress in the gradient films. It is revealed that UMA in the gradient films as well as the promising high-frequency ferromagnetic properties can be attributed to the uniaxial stress gradient, which is induced by uniaxial gradient Zr composition.

Research of Mechanism on the Improvement of Silicon Carbide Ohmic Contact Property Influenced by Nanometer Metal Particles

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ABSTRACT

It has been proved by experimental results that the ohmic contact property of silicon carbide can be improved by using some specific nanometer metal particles. In this paper, authors have constructed a quantum tunneling models to explain the experimental results. The influences of parameters on the ohmic contact characteristics have been calculated based on the models. The values show that the tunneling effect can be observed by adding nanometer particles. The tunneling probability has been increased. Moreover, with the existence of nanometer particles, pinning of Fermi level has been conquered. So, it is an effective method by using specific nanometer metal particles to improve the characteristic of P-type silicon carbide ohm ic contact.

A Carrier-Based Analytic Model for Finite Doped Symmetric Double-Gate MOSFETs

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ABSTRACT

A carrier-based analytic model for finite doped symmetric double-gate (DG) MOSFETs is presented in this paper. Utilizing a superposition of the contributions of the depletion charge and inversion charge on Poisson's equation solution and Gauss's law, the current-voltage model is derived for the DG MOSFETs from Pao-Sah dual integral under the Gradual Channel Approximation (GCA). The entire current-voltage characteristics for all regions of MOSFET operation are covered under one set of continuous carrier-based expression. The prediction has also been verified by 2-D simulation, proving the validity of the presented model.

Ab initio Study on the Magnetism in Transition Metal (TM) Co-Doped ZnO-Based Diluted Magnetic Semiconductors

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ABSTRACT

The magnetism and the electronic structure of ZnO-based diluted magnetic semiconductors (DMSs) codoped with transition metals (TMs) investigated based on the KKR-CPA-LDA calculations. The effection of different impurities and their concentrations on the ZnO-based DMS materials were analyzed. Through the comparison among different TM-codoped systems either in ferromagnetic states or in anti-ferromagnetic states, we find that: (i) the ferromagnetic states of MnCo- and MnNi-codoped systems are stable; (ii) the magnetic property of CoNi-codoped system changes as a function of the impurity concentration.

Keywords: ZnO, DMS, KKR-CPA-LDA, TM-codoped

The Design of Switched-Current High Order Elliptic Low-Pass Filter

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ABSTRACT

A novel general synthesis method for switched-current (SI) high order elliptic low-pass filter circuit is presented. The designing procedure is from RLC prototype filter, active RC filter, switched capacitor filter to switched current filter. A 5th order switched current elliptic low-pass filter is designed in this paper. ASIZ simulation results for frequency response to verify the technical requirement.

Keywords - Filter; Active RC ; Switched capacitor; Switched current; Signal flow graph;

Molecular Dynamics Simulation of Heat Distribution during Nanometric Cutting Process

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ABSTRACT

In nanometric cutting process the actual material removal can take place at atomic level, which makes the acquisition of heat distribution difficult or impossible, however a detailed investigation of heat distribution is crucial for understanding the nature of material removal mechanisms, chip formation and surface generation etc. In this work, molecular dynamics (MD) is used to study heat distribution during nanometric cutting of single-crystal silicon with the aid of Tersoff potential. The MD calculation data are converted into continues heat distribution and showed with different colors in 3D images under various cutting parameters. The result of the simulation shows that there is a narrow region with high temperature under tool edge where most of heat generated due

to plastic deformation of workpiece material, the high temperature extends from here to chip, diamond tool and workpiece, but the highest temperature lies in chip. The heat distribution is roughly concentric around the tool edge and a steep temperature gradient is observed between diamond tool and chip. A higher temperature region below the tool edge implied a larger shear stress is built up in a local region at high cutting speed with a rougher machined surface behind than at low cutting speed.

A Netlist Partition Method Based on Evolutionary Technique

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ABSTRACT

The problem of partitioning appears in several areas ranging from VLSI, parallel programming, to biology. The interest in achieving better partitioning of any system is growing rapidly especially in VLSI, and has been a hot issue in recent years. In VLSI circuit partitioning, the problem of obtaining a minimum cut has been of prime importance and most literature available is for this single objective optimization. However with current technology tends partitioning has become a multi-objective problem (MOP), In our paper, the multi-objective optimization problem at the partitioning phase in VLSI physical design step is addressed. This problem involves multiple, possible conflicting objectives; hence fuzzy rules have been incorporated in designing the overall cost function. Iterative algorithms are tailored for finding good quality solutions for the above mentioned MOP problem. The experiment results show the efficiency.

Keywords: Netlist partitioning, Evolutionary technique, multi-objective optimization

Theoretical Study on Optical Scattering and Aborption Behavior of Spherical Nanopaticle

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ABSTRACT

This issue is numerically investigated by schematic model in which the optical scattering and aborption behavior of sphereical nanopaticle is discussed. On the basis of classics effective medium theoretical, the renormalized effective parameters have been introduced. The simulation results are presented by comparisons with effective property models, the screening effect is also discussed in alalyzing the cross-sections in different nanometric size. The phenomena of the shift in resonance frequency by varying the radii of the grain has been shown by the theoretical result.

First-Principles Study of Atomic Oxygen Chemisorption on Outer Surface of Bent Single Wall Carbon Nanotubes

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ABSTRACT

A first-principles approach of Car-Parrinello molecular dynamics is used to study the chemisorption of a single oxygen atom on the outer surface of a zigzag single-wall carbon nanotube (SWCNT) with bending angle. The adsorption energy E_b and pyramidalization angle Θ_p are obtained by structural relaxation calculations, and ground-state electronic structures are described according to density functional theory (DFT) within a plane-wave pseudopotential framework. For bending SWCNT, both E_b and Θ_p vary with adsorption sites, the E_b is higher at sites with larger pyramidalization angles, and an approximate linear relation between faceΘ_p and E_b can be obtained. It can be concluded that the surface reactivity of CNTs which is mostly determined by its

pyramidalization angle of carbon atom can be changed under bending deformation that alters the pyramidalization angle of carbon atoms at different sites. Therefore, we can tune the surface reactivity of CNTs by mechanical method, such as bending that is easy for CNTs with high length-to-diameter ratio. Furthermore, the method offers site selectivity, as the adsorption is facilitated on the sites with higher pyramidalization angles.

Fault-Injection Algorithm for the Error of the Single-Event Upset and Calculation for the Error Resistance by Coated Nanofilms

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ABSTRACT

In this work, the R_T_S model based on simultaneous equations (R, T and S) and Catastrophe Theory is performed to describe the behavior of fault injection and the influence of fault injection on a system. The system was selected as a chip in a microelectronic device of a satellite, which is often failed to work by an error of the single-event upset (SEU). A fault-injection algorithm (FI_S) based on the S attribute of the model R_T_S is designed to analyze the errors in the attacked system. Based on silsesquioxane derive from hydrolytic condensation of [(*γ*-glycidoxy)propyl]trimethoxysilane (GPMS), [(*γ*-methacryloxy)propyl]trimethoxysilane (MPMS) and (vinyl) trimethoxysilane (VMS), three nanofilm (f-GS, f-MS and f-VS) was coated on chips to protect from the fault. The equation expressing the relationship between the energy and the displacement of a charged particle was deduced. The total displacement where the higher energy was reduced by the inhibition of the nanofilm, can be calculated. As the result of the calculation, the f-VS coating has the best resistance to the SEU error because of its denser nanostructure.

Angular Dependence of Inelastic Cross Sections for Electrons

Crossing the Indium Nitride Surface

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ABSTRACT

A dielectric response theory was used to study the inelastic cross sections for low-energy electrons crossing the indium nitride surface. The inelastic cross sections contain information on both the surface and volume excitations. Parameters in the extended Drude dielectric function were determined from the fits of this function to experimental optical data. The differential inverse mean free path, inverse mean free path, and surface excitation parameter were calculated for either incident or escaping electrons with different electron energies and crossing angles. The angular and energy dependences of the calculated results were analyzed.

Novel Approach to Simulation of Nanoscale HEMTs with Finite Elements Method

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ABSTRACT

We have developed a simulator for Nanoscale HEMT transistors, in which solution of self-consistent Poisson-Schrödinger equations is obtained with finite element method. In this simulator we solve the exact set of nonlinear differential equations to obtain electron wave function, electric potential distribution, electron density, Fermi surface energy and current density distribution in the whole body of device. For more precision, local decreasing of carrier mobility with both doping profile and electric field distribution is considered. In addition we analyze different structures of HEMTs and compare their maximum carrier density, carrier confinement and cut-off frequency using our simulator. Comparison is made to a recent experimental measurement and complete agreement is observed.

Keywords: High Electron Mobility Transistor (HEMT), Finite Element Method (FEM), Nanoscale electronics, Simulation.

Application of Density-Gradient Model to Nanoscale MOS Structures

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ABSTRACT

The density-gradient (DG) model as a generalized drift-diffusion (DD) model is applied to investigate the quantum confinement in MOS structure. Both of the electron and hole profiles are calculated for the entire structure using the DG model. The electron effective mass fitting is made by comparing with the calculation from Schrodinger-Poisson (SP) model in which up to 40 subbands are accounted, yielding a electron effective mass of $m_n^* = 0.27m_0$. The quantum confinement is observed in both the inversion layer and poly-gate layer. The variation in quantum potentials and the shift in threshold voltage are also presented.

Effect of Asymmetry on the Threshold Voltage of Single Electron Transistors

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ABSTRACT

In this paper, we derive a closed-form expression for the threshold voltage at which the metallic island of an asymmetric single-electron transistor exits from Coulomb Blockade condition. To accomplish this purpose, we compare the Fermi's energy levels of source and drain with discrete charging energy level inside the island. First, the effects of voltage gate and inequality of the source/drain tunneling resistances ($R_S \neq R_D$) on the value of threshold volt-age are investigated, separately. Then, we have shown that the inequality of source/drain capacitances ($C_S \neq C_D$) and gate voltage can cause a breaking point in I_D-V_{DS} characteristic near the threshold voltage. Finally, we have demonstrated that, the asymmetric behavior of SET, due inequality $C_S \neq C_D$, can be cancelled by applying an appropriate gate voltage.

Keywords: Single Electron Transistor, Coulomb Blockade, Master Equation, Threshold Equation

Home

On the Self-Consistent Calculation of Ultra Thin Body Double Gate MOSFET

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ABSTRACT

An accurate and efficient one dimensional self-consistent numerical solution of double gate MOS structure is presented based on finite element method. The solution is developed using FEMLAB considering wave function penetration effect into gate oxide. Hence, penetration effect is revealed and presented for full depleted double gate MOSFET. Accuracy of the model has been verified by comparing with established results.

Atomistic Simulation of CNTFETs with Gradual Doping Profiles at the Channel Terminals

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ABSTRACT

Effects of the doping profile of the carbon nanotube (CNT) near the source and drain regions of the carbon nanotube field effect transistors (CNTFET) has been investigated. The electronic properties of the gradually doped CNTFETs (GD-CNTFETs) have been simulated using Non-Equilibrium Green's Function (NEGF) formalism. We have investigated a CNTFET in which the source and drain terminals have been doped gradually. After comparison with conventional CNTFETs, It has been shown that the doping profile plays an important role in electrical properties of the device. The gradual doping modifies the energy band diagram of the transistor so that the band to band tunneling leakage current decreases and the ambipolar behavior of the CNTFET becomes negligible.

Magnetic Dynamic Properties for Quasi-Two-Dimensional 4×4 Quantum Dots: Monte Carlo Simulation

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ABSTRACT

In this paper, an in-plane quasi two-dimensional 4×4 quantum dot array (QDA) has been considered. Base on Monte Carlo simulation, the effect of exchange interaction constant J, dipolar interaction constant D, magnetic anisotropy constant K on spin configuration and magnetic properties of QDA have been studied. The simulated results indicate that the quantum dot array display interested magnetization behavior for different value of J and D. The magnetization curves of QDA and single quantum dot (SQD) show very different behavior. QDA has paramagnetic phase while SQD in QDA does ferromagnetic phase. The simulated results may be well explained by analyzing vary of spin configuration in difference magnetic field. The temperature dependence of coercivity of QDA is similar to that of single magnetic cluster. Also, the hysteresis and spin configurations in different magnetization processes have been investigated. The minimum in the simulated thermal coercivity is considered to be originated from the competitve roles among the anisotropy, thermal fluctuation and easy magnetization direction.

Design and Time Dependent Simulation of Two-Stage Heater Continuous Flow PCR Microfluidic Chip

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ABSTRACT

Nowadays DNA amplification by Polymerase Chain Reaction (PCR) technique is performed on the large and expensive instrument. There have been several attempts to produce PCR on chip which is cheap and portable. In this paper, the design of continuous flow PCR chamber and the simulation of time dependent heat transfer between micro-heater and poly-(methyl methacrylate) (PMMA) chamber are studied before fabrication of PCR devices. The simulation was performed by ANSYS program. The 1 μm thick micro-heaters to be fabricated by evaporation technique were located at 1mm below the chambers. The device consists of 3 PMMA microchambers connected through via 100 μm wide, 100 μm long and 100 μm thick PMMA channels. The chamber 1 and chamber 3, which have the heating area about 20 mm^2 were heated at denaturation and

extension temperatures, respectively. The chamber 2 with the water drop shape was designed to exploit the temperature gradient between denaturation (92-95°C) and extension (72-75°C) chamber so that its temperature is in the range of 37-60°C. The simulation results show that the temperature of the annealing chamber can be maintained as desired for 6 s. In addition, the electrical power required for the heater to obtain the temperature in denaturation and extension chamber at 95 and 75°C are 6 and 4 Watt, respectively.

RF Magnetron Sputtered Indium Tin Oxide Thin Films for Application in Solar Cells

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ABSTRACT

Indium tin oxide (ITO) films were deposited at room temperature with no oxygen flow on glass substrates by RF magnetron sputtering. The effects of sputtering power and argon ambient pressure were investigated. The morphology, structural and optical properties of ITO films were examined and characterized by X-ray diffraction (XRD), atomic force microscopy (AFM) and UV-VIS transmission spectroscopy. The deposited ITO films with 300nm thickness show a high transparency between 80 and 90% in the visible spectrum and 15Ω square sheet resistance. The ITO films are suitable for application in $CuInSe_2$ thin film solar cell as transparent conductive electrode layers.

Keywords: Indium tin oxide (ITO) films, sputtering, room temperature.

Fabrication of $CuInSe_2$ Thin Film Solar Cells by Selenizing Sputtered CuIn Precursor Layer in a Closed Graphite Box

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ABSTRACT

Manufacturing processes and investigation of properties of thin film materials forming the $CuInSe_2$ (CIS) solar cell have been described. CuIn precursor layers were deposited onto Mo-coated glass substrates by magnetron sputtering. High-quality CIS absorbers have been prepared by the layers were selenized in a partially closed graphite container using selenium pellets at 500°C for 30 mins. The CIS films were characterized to evaluate their physical behaviour by X-ray diffractometry, scanning electron microscopy, energy dispersive X-ray analysis and Raman spectroscopy. The deposited CIS absorbers exhibited a single phase chalcopyrite structure with a preferential orientation in the (112) direction. These layers were uniform, and the crystals were densely packed with a grain size of about 3µm Cadmium sulfide buffer layer was manufactured by chemical bath deposition (CBD) method which offers the films with optimal properties. Bi-layers ZnO/ZnO:Al were prepared by RF magnetron sputtering deposition. Thin film CIS solar cells with the efficiencies of the order of 6.5% have been produced without antireflective films. Further improvement in technology leading to CIS cells with better parameters has been discussed.

Keywords: solarcell, Sputtering, selenization.

Ultra-Narrow Bandwidth Filter in Fractal Photonic Crystal Containing Negative Material

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ABSTRACT

In this paper, the self-similarity behavior and the ultra-narrow bandwidth filter character are demonstrated theoretically based on a new one-dimensional fractal photonic crystal containing negative material. There are transmission peaks in the photonic band gap, which show the self-similarity splitting behavior, and the ultra-narrow bandwidth filtering property in the infrared communication band. The width of the transmission peaks become smaller exponentially as fractal level increasing, and it can be less than 0.00001 nm at the infrared 1550 nm when the fractal level more than four. This filtering property is more superior to other kind narrow band filters, and this fractal photonic crystal filter may have many applications in optical communications, such as Dense Wavelength Division Multiplex.

The Effects on Band Gaps for the Cross Section's Shape of the Medium Column in 2-D Photonic Crystals

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ABSTRACT

Due to three types of conventional 2D photonic crystals with medium column's cross sections' shapes of hexagon, rectangular and circular, the symmetry of the structures are decreased through changing the length proportion in X and Y directions of cross sections and central rotary angle in Cartesian coordinate system, with simulation using planar wave expansion method and comparisons, the conclusion is made that photonic crystal with this structure has the largest absolute PBG when the length proportion p in X and Y directions is about p=2, and the central rotary angle is about 60°~ °or 110°~120° for rectangle lattice structures and about 0° or 180° for triangle lattice structures.

Photoconductivity Analysis of ZnO Thin Films Annealed in Different Temperatures

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ABSTRACT

ZnO thin films were grown on SiO_2/Si substrates by radio frequency magnetron sputtering technique and annealed in different temperatures. Based on the ZnO thin films, photoconductive type MSM UV detectors were fabricated by lift-off technique. Response time and I-V characteristics by different anneal temperatures was investigated respectively.

Nonlinear Optical Fluorinated Polyimide from Diaminoazobenzene Chromophore with High Stability

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ABSTRACT

2,4-Diamino-4'-(4-nitrophenyl-diazenediyl) azobenzene (DNDA) was successfully synthesized through diazonium coupling reaction. Nonlinear optical fluorinated polyimide (FPI) was prepared through 4,4'-(hexafluoroisopropylidene) diphthalic anhydride (6FDA) and DNDA. Fourier transform infrared spectroscopy (FTIR), thermogravimetric analysis (TGA), differential scanning calorimetry (DSC) and ultraviolet-visible (UV-visible) spectra were used to characterize its structures and properties. FTIR results confirmed that the fluorinated polyimide was successfully synthesized. The fluorinated polyimide possessed high T_g (286°C) and decomposition temperature at 5% weight loss (405°C). A corona poling process was employed to orient the NLO chromophores. UV-Visible spectra showed that the poled fluorinate polyimide displayed good transparency and high poling order. The second harmonic coefficient d_{33} of the second-order NLO polymeric film was characterized by the Maker-fringe method. The poled fluorinated polyimide possessed 6.3 pm/V of d_{33} value, which is large enough for the application. Temporal stability of d_{33}

values of the polyimide was studied at different temperatures. At room temperature, NLO fluorinated polyimide was stable and there was little decay in d_{33} values for 100 days. At 200°C in air, the poled fluorinate polyimide exhibited excellent stability of d_{33} because 75% of the original d_{33} remained over 90 hrs. Based on the above results, the NLO fluorinated polyimide could be a potential NLO material for real applications.

Near-Field Imaging with Amplitude Type Photon Sieves

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ABSTRACT

Photon sieves as a novel focusing diffraction optical element (DOE) are used to X-ray imaging, microscopy and trace element analysis in materials, environmental, and biological science. which provide with the advantage of higher resolution suppress secondary maxima and improved image contrast compared with Fresnel zone plates (FZP), More importantly, the photon sieves breakthrough the resolution limit of zone plate determined by the outermost zone width. With the development of microelectronic fabrication technique, the small feature size of photon sieves has reached to nanoscale for higher resolution necessary. In this situation, both the small feature size and the near observation distance make us consider near field of photon sieves. So the analysis of photon sieves requires a more rigorous vector diffraction model based on electromagnetic theory to achieve accurate results. In this paper, we adopt FDTD method to analyses and simulate near field imaging of nanoscal photon sieves, calculating the amplitude and intensity distribution. Then analyses tie photon sieves diffraction efficiency, NA, and focus depth. At last, we fabricate amplitude photon sieves and phase photon sieves, with work length are 632 nm, the outmost are 900 nm, 1.5μm, we measure the optical intensity distribution at near field, and get the focusing photos with CCD. The results proved that the models which used for analysis and simulate near field diffraction of nanoscal photon sieves with FDTD method are consistent with experiment results.

Design and Analysis of Two-Dimensional Photonic Crystals Resonant Cavity

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ABSTRACT

A novel three-port resonant cavity in two-dimensional photonic crystals (2D PCs) with two wavelength-selective reflection micro-cavities is proposed. In the structure, three micro-cavities are used. One is used for a resonant tunneling-based input waveguide and the others are used to realize wavelength-selective reflection feedback. According to coupled mode theory in time, the conditions to achieve ultra-high quality in the system are derived thoroughly. The performance of the designed resonant cavity has been numerically calculated by using the finite-difference time domain (FDTD) method and the results imply that the design is feasible.

Open-Circuit Voltage Improvement by Using TiO_2 Nanotubes as a Working Electrode of Dye-Sensitized Solar Cell

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ABSTRACT

The titanium dioxide nanotubes (TiNTs) were directly fabricated from commercial P25 TiO_2 via alkali hydrothermal transformation. The optimized synthesis, thermal and hydrothermal stability, and consequent optical properties of the titanate nanotubes were systematically studied. The TiO_2 nanotubes were characterized by transmission electron microscopy. Dye-sensitized solar cells (DSSCs) were constructed with films made of grown TiO_2 nanotubes as working electrodes. The nanocrystalline TiO_2 pastes were prepared with PEG (Mw 20000) and as made TiO_2 nanotubes. The titania thin films were grown by screen printing method in order to efficiently control the DSSC fabrication process. The microstructures of nanoporous films in solar cells were characterized by scanning electron microscope (SEM) and Brunauer Emmett Teller (BET) analysis. A metal-free organic dye (referred to as D102 dye) was used as a sensitizer. A high conversion efficiency of light-to-electricity of around 6% under illumination of simulated AM1.5 sunlight (65mW/cm^2) was achieved with the TiO_2 nanotube cell. Compared with the case of DSSCs with TiO_2 nanoparticles, the open-circuit voltage and fill factor of

DSSCs with TiO_2 nanotubes increased significantly. The related mechanisms are discussed.

Keywords: dye-sensitized solar cells, titanium dioxide nanotubes, open-circuit voltage, fill factor

Preparation of ZnS Thin Films by an Improved Chemical Bath Deposition with Substrate Vibration

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ABSTRACT

Zinc sulphide (ZnS) thin films have been prepared by an improved chemical bath deposition (CBD) technique on glass substrates deposited at 80-82°C using a mixed aqueous solution of zinc sulfate, ammonium sulfate, thiourea, hydrazine hydrate and ammonia at the alkaline conditions. Both the traditional magnetic agitation and the substrates vibration by hand frequently were done simultaneously during the deposition. The substrates vibration has reduced the formation and residence of gas bubbles on the glass substrates during growth and resulted in growth of clean ZnS thin films with high quality. During deposition, ammonia and hydrazine hydrate were used as complexing agents. It is found that hydrazine hydrate plays an important role in growth of ZnS films. The structure and microstructure of ZnS films are characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD) and UV-VIS spectroscopic methods. The film thickness is measured using a Dektak 3030 profilometer. The XRD shows a hexagonal structure. The surface morphology of the films is homogeneous with compact and small particles. The films show good optical properties with high transmittance in the visible region and the band gap value was estimated to be 3.70 eV.

Keywords: ZnS; Chemical bath deposition; Thin films

Electrochemic Growth of $CuInSe_2$ Thin Film on ITO/Soda-Lime Glass from Acidic Medium

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ABSTRACT

The simultaneous electrodeposition of the Cu-In-Se system was investigated. The study was carried out at pH 1.8 using Sodium citrate as complexing agent for the Cu^{2+} ion. The synthesis of $CuInSe_2$ semiconductor thin film was carried out by electrodeposition on indium-tin oxide (ITO)/soda-lime glass. The simultaneous codeposition of the Cu, In, and Se was achieved by constant potential electrolysis technique in aqueous solutions containing $CuCl_2$, $InCl_3$, and H_2SeO_3. The as-deposited and annealed films were characterized by scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDX), X-ray diffraction (XRD), and Raman spectroscopy. Homogeneous films were deposited with a well-defined composition and chalcopyrite structure. The crystallinity of the films was improved by annealing. The deposited stoichiometric $CuInSe_2$ layers were about 2 μm in thickness. The annealed film is with a perfect crystallized and single chalcopyrite structure. It is suitable for photovoltaic applications.

Keywords: Electrodeposition; $CuInSe_2$ (CIS); Chalcopyrite; ITO; sodium nitrate; Raman spectroscopy.

p-Type ZnO Nano-thin Films Prepared by Oxidation of Zn_3N_2 Deposited by rf Magnetron Sputtering

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ABSTRACT

p-type ZnO:N thin films were prepared by thermal oxidation of RF magnetron sputtered Zn_3N_2 films on glass substrates. The effects of oxidation temperature on the structural, optical and electrical properties of the samples were investigated by X-ray diffraction (XRD), scanning electron microscopy (SEM), optical transmittance, photoluminescence (PL) and Hall effect measurements. XRD analyses revealed that Zn_3N_2 films entirely transformed into ZnO:N films after annealing Zn_3N_2 films in oxygen at 500°C for 2 hours.

Hall effect measurements confirmed p-type conduction in ZnO:N films with a low resistivity of 4.8 Ω·cm, a high hole concentration of 9.6×10^{18} cm^{-3} and a Hall mobility of 2.1 cm^2/Vs. the films are highly transparent in the visible region and the absorption edge blueshifts with increasing oxidation temperature from 450-550°C. The films exhibited strong excitonic UV emission and weak deep-level emission. Our results demonstrate a promising approach to fabricate low resistivity p-type ZnO with high hole concentration.

Keywords: p-type ZnO films, RF magnetron sputtering, XRD, Photoluminescence.

A Light Propagation Model for Light Emitting Diodes (LEDs) Based on Finite Element Method (FEM)

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ABSTRACT

A novel LED light propagation model is demonstrated theoretically by Finite Elemental Method (FEM). Specifically, a non-coherent spherical wave source acts as the basic element of the active layer, simulating the radiation pattern of spontaneous emission. The light propagation of AlGaAs based red LEDs is simulated to verify the model. Photonic Crystal (PHC) structure could be a promising approach to the long-standing problem of poor light extraction from high refractive-index semiconductors in LEDs. By using Taesung Kim's research [1], we simulate the PHC structure manufactured by Taesung Kim and the light extraction efficiency is enhanced between 30% and 100%, compared with 30% and 120% enhancement in the experiment.

Keywords: Light-emitting diode (LED), external quantum efficiency.

The Effect of Zn^{2+} Doping on the Photoluminescence of Sr_2CeO_4 Phosphor

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ABSTRACT

Zn^{2+}-doped Sr_2CeO_4 phosphors were prepared using the combustion synthesis, and their photoluminescence of the phosphors were characterized by luminescence measurement. The influence of preparation condition on the photoluminescence was studied. It is showed from the experiment results that doping amount of zinc ion and sintering temperature have an important effect on their photoluminescence of Sr_2CeO_4 phosphors, and that doping a small of Zn for Sr in Sr_2CeO_4 phosphor is effective to promote the luminescence intensity. Compared with pure Sr_2CeO_4 phosphor, the $Sr_{1.9}Zn_{0.1}CeO_4$ powder sintered at 1100°C for 4 h has higher photoluminescence intensity.

Keywords: $Sr_{2-x}Zn_xCeO_4$; combustion synthesis; phosphors

Preparation, Characterization and Electro-Optic Properties of Polyimide/SiO_2 Nanohybrid Materials

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ABSTRACT

A series of the polyimide-silica NLO nanohybrid materials were synthesized from 3,3', 4,4'- Bisphenyltetracarboxylic (BPDA), 2,2-Bis(3-amino-4-hydroxyphen-yl) hexafluoropropane (6FHP), nonlinear optical (NLO) molecule 4-(N-2-Hydroxyethyl-Nmethylamino)- 4'-[(6-nitroben-zothiazol-2-yl)-diazenyl] azobenzene (HNBDA), coupling agent APTES and hydrolysate of TEOS via sol-gel process. The TEOS contents in the hybrids were varied from 0 to 22.5/wt%. The prepared polyimide/silica hybrids were characterized by FT-IR, differential scanning calorimeter (DSC), thermogravimetric analysis (TGA), scanning electron microscopy (SEM), Transmission Electron Microscope (TEM), X-ray diffraction (XRD) etc. The glass transition temperature (T_g) and the decomposition temperature (T_d) at 5% mass loss were in the range 215~364°C and 320~430°C, respectively. These results showed that these hybrid materials had excellent thermal stability. The hybrid solutions could be spin coated on the indium-tin-oxide (ITO) glass to form optical quality thin films. The electro-optic coefficients (γ33) at 832 nm for polymer poled were in the range of 21-50pm/V and the values remained well (retained > 88% for more than 100 h). The experimental results suggest that the hybrid thin films have potential applications as passive films for optical devices.

Keywords: Nonlinear optical (NLO); polyimide; electro-optic properties.

The Effect of Precursor on Photocatalytic Activity of Flame-Made Titania Nanoparticles

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ABSTRACT

Recently, numerous studies have been focused on the photodegradation of organic compounds using semiconductor particles as photocatalysts. Among them, flame made titania (TiO_2) is a widely used commercial product, for its stability, low cost, ease of availability, non-toxicity, electronic and optical properties. However, to the best of our knowledge, all effects of experiment parameters except precursor source on photocatalytic activity (PCA) have been detailedly discussed. Herein, the effect of titanium source on particle size, phase composition and photocatalytic activity of flame-made TiO_2 nanoparticles was investigated at the same conditions in a diffusion flame reactor using titanium tetrachloride ($TiCl_4$) and tetrabutyl titanate $Ti(OC_4H_9)_4$ as precursor respectively. Resultant TiO_2 nanoparticles were characterized by XRD, FT-IR, nitrogen physisorption and UV-Vis to determine the degree of crystallinity, surface condition, specific surface area and optical characteristics, and the photocatalytic degradation of Rhodamine B (RhB) under UV, had been taken as the measure of the photocatalytic activity. Particles generated by using $Ti(OC_4H_9)_4$ as precursor tend to have bigger specific surface area and less rutile TiO_2 content than the ones made by employing $TiCl_4$ as precursor, this is attributed primarily to the insufficient particle residence time and the presence of carton in the former flame. In contrast, the photocatalytic activity of particles from $TiCl_4$ was 2.5 times higher than that from $Ti(OC_4H_9)_4$, and 1.5 times higher than the commercial Degussa P25. We contribute the lower photocatalytic activity of TiO_2 from $Ti(OC_4H_9)_4$ mainly to the poor dispersion by comparing Zeta potential between both particles. Generally speaking, flame-made TiO_2 particles using $Ti(OC_4H_9)_4$ as precursor are not recommended to be used as photocatalysts, but their higher specific surface area may favor sensing application. Furthermore, the different results with both precursors also promote the research of particle growth mechanisms in flame.

Keywords: photocatalytic activity (PCA); flame aerosol synthesis; precursor.

Improved Heat-Dissipating Silicone by Nano-Materials for LED Packaging

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ABSTRACT

Nano-diamond particles with the size of 5 nm were dispersed into silicone materials to form diamond/silicone nano-composite films. The films were characterized with scanning electron microscopy, UV-Visible optical transmittance spectroscopy, and Hot Disk thermal constant analysis instrument. The results showed that the thermal conductivity of silicone was enhanced twice without much sacrifice of transmittance when silicone was doped with 0.02% nano-diamond particles.

Keywords: LED packaging; Thermal conductivity; Nano-diamond.

Quasi-Solid-State Dye-Sensitized Solar Cells Prepared with a D102 Sensitizer and a Polymer Electrolyte

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ABSTRACT

Dye-sensitized Solar Cells (DSSCs) have been constructed by using quasi-solid polymer electrolytes containing polyethylene oxide (PEO). TiO_2 viscous pastes were prepared by grinding TiO_2 powder (P25) with terpineol, ethylcellulose and acetylacetone. Nanostructured mesoporous TiO_2 photoanodes were prepared by the screen-printing method on FTO substrates. TiO_2 porous electrodes were sensitized using a metal-free organic dye named D102. The quasi-solid-state electrolytes were grown by incorporating LiI-I_2 solutions into a polyethylene oxide (PEO) matrix supported by TiO_2 filler, and polyvinylidene fluoride (PVDF) was added to enhance the conductivity of the slurry. The morphologies of dried electrolytes were characterized by scanning electron microscope (SEM). The dependence of the conductivity of the system on the weight ratio of PEO to PVDF in the composite electrolyte was investigated. The polymer gel electrolytes were incorporated in dye sensitized solar cells and the measured energy conversion efficiencies were successfully correlated with their morphological and conducting properties.

Keywords: dye-sensitized solar cells, quasi-solid-state electrolytes, polyvinylidene fluoride (PVDF), TiO_2 fillers.

The Synthesis and Photoluminescent Properties of Zinc-Added $SrAl_2O_4$: E^{2+},DY^{3+} Phosphors

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ABSTRACT

Zinc-added $SrAl_2O_4$:Eu^{2+}, Dy^{3+} composites were prepared by a coprecipitation-precursor calcination method. The structural and photoluminescent characteristics of the $Zn_xSr_{1-x}Al_2O_4$:Eu^{2+}, Dy^{3+} phosphors were investigated using X-ray powder diffraction (XRD), scanning electron microscopy (SEM) and photoluminescence spectroscopy (PL). The experimental results revealed that the addition of zinc (Zn^{2+}) influences the structural and luminescent properties by tuning the content of zinc. It could be seen from the SEM images that $Zn_{0.2}Sr_{0.8}Al_2O_4$:Eu^{2+}, Dy^{3+} with better crystallinity was composed of larger irregular particles coexisting with some conglomeration, which may attributed to the enhancement of photoluminescent emission intensity discussed later. The

photoluminescent intensity reaches the strongest at the host composition of $Zn_{0.2}Sr_{0.8}Al_2O_4:Eu^{2+}$, Dy^{3+}, which shows much higher emission intensity than pristine $SrAl_2O_4:Eu^{2+}$, Dy^{3+} phosphors. The research into multicomponent $M_xSr_{1-x}Al_2O_4:Eu^{2+}$, Dy^{3+} expanded the scope and application of long afterglow phosphors.

Diffusion Screen for 3D Imaging on Virtual Display

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ABSTRACT

The conventional display can show only one screen, but it is impossible to enlarge the size of a screen, for example twice. Meanwhile the mirror supplies us with the same image but this mirror image is usually upside down. Assume that the images on an original screen and a virtual screen in the mirror are completely different and both images can be displayed independently. It would be possible to enlarge a screen area twice. This extension method enables the observers to show the virtual image plane and to enlarge a screen area twice. Although the displaying region is doubled, this virtual display could not produce 3D images. In this paper, we present an extension method using a unidirectional diffusing image screen and an improvement for displaying a 3D image using orthogonal polarized image projection.

Touch-Panel Interface System which Can Recognize who Touched the Screen and where was Pointed

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ABSTRACT

A touch-panel is useful for a computer interface. The touch-panel is display overlays which have the ability to display and receive information on the same screen. The advantage of this touch screen is that it is easy for all users to operate intuitively. In addition, a touch-panel interface is utilizable for multi-users. However a conventional system cannot recognize who touch the screen on a display among users. Especially our

developed tabletop display can provide different image to each user so as not to perceive an upside down image. Moreover, the users work their own task on the computer screen independently using this multi-views display. Thus, the usages of these displays with a touch-panel become a new problem. In the collaborative work surrounding round table among multi-users, it is important to recognize who touched the screen and where was pointed. This paper describes the multi-users' touch-panel interface system which can recognize who touch the screen on a display. To recognize user's operations, our touch-panel interface system detects user's hands on a screen and distinguish users from the directions of fingertips using imaging sensors. We develop the recognition system for four users' operations and an interactive game program using this interface system. We evaluate the result of recognition by prototype system and made sure that performance required for practical use.

Effect of Structure on Third Order Nonlinear Optical Performances for ZnO Nanocomposites

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ABSTRACT

The third order nonlinear optical properties of ZnO nanorods and ZnO nanoparticles in water, N,N-dimethyll formaide and ethanol were comparatively investigated by using Z-scan technique under nanosecond pulses at 532 nm. Experimental results show that the structure of ZnO nanocomposites has effect on their third order nonlinear optical performances, and the third order nonlinear optical properties of ZnO nanorods are larger than that of ZnO nanoparticles. The results were analyzed by use of the Maxwell-Garnett Effective Medium theory.

Synthesis and Light Conversion Property of Nanoparticles $Sm_xTb_{1-x}(N\text{-}hpa)_3(phen)$

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ABSTRACT

A kind of novel complexes of rare earth (Sm^{3+}, Tb^{3+}) with N-phenylanthranilic (N-hpa) acid and 1, 10-phenanthroline (Phen) was synthesized. The new nanoparticles were characterized by elemental analysis, transmission electron microscope (TEM), UV spectrum, IR spectrum, fluorescence spectra and thermal stability analysis. The results show that the thermal stability of the Sm (III) complexes increases in the following order: the mononuclear complex $Sm(N\text{-}hpa)_3(Phen)$, the polynuclear complex $Sm_xTb_{1-x}(N\text{-}hpa)_3(phen)$. And the formation of the ternary structure of the new complexes appears to be responsible for the enhancement of their thermal and optical stability. The enhancement of samarium fluorescence in the new complexes can be observed by the addition of Tb^{3+}. The bright blue-red luminescent plastics can be obtained when the content of Sm (III) complexes is above 0.5% (mass fraction). Furthermore, the main fluorescence emission peak of this complex is at 440 nm and 645 nm, which is more close to the photosynthesis spectra of vegetables. And the nanoparticles have good stability as well as good compatibility with resin.

Optimization of 2D Photonic Crystal Structures for Light Extraction Enhancement

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ABSTRACT

It has recently been suggested that photonic crystal structures can enhance light extraction efficiency dramatically. By using the finite-difference time-domain (FDTD) method, effects of finite air-hole depths and lattice periods are investigated. Using electron-beam lithography and following plasma etching, the patterns containing 16 units with different periods and depths are fabricated on the quartz substrate. The transmittance of each pattern unit is characterized by the mircro-Raman spectroscopy. Comparing the actual test result with the theoretical calculations, the optimal 2-dimensio photonic crystal structures are presented finally. It provides a practical evidence for the further usage of photonic crystal structures in light emit diode to enhance the external light extraction efficiency.

An Improved Design Method of Symmetrical Multiplexers

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ABSTRACT

In order to solve the problem of many signal transmission, This paper studies the same prototype low pass filter and gets the direct design formulas for symmetric band pass channel multiplexers. Which allows rapid design of the channel multiplexers using direct-coupled resonator filters. Computed results for a prototype multiplexer are given with optimized technique, and results are presented for a symmetric passive multiplexer, which demonstrate the high performance possible using the improved technique.

Keywords: Low pass prototype three-channel multiplexer insertion loss group delay least square method(LSM)

An Improved Design Method of UWB Linear Phase Bandpass Filter

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ABSTRACT

This paper improves the conventional filter anticipated aberrance design method and finds a new design method of bandpass filter. It overcomes the question between the narrow band and linear phase in adapting the direct coupling capacitance or inductance. The Utra-Wide Band and Linear Phase bandpass filter can be designed by using this new method. Finally it is effective by giving an example.

Keywords: BPF Ultra-Wide Band(UWB) Linear Phase Group delay.

The Revised Sensitivity Theory on Cross-Coupled Resonator Filter with Multiple Input/Output Coupling

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ABSTRACT

The revised sensitivity theory of cross-coupled resonator filter with multiple input/output coupling is studied in this paper. And the sensitivity theoretical expressions of the filter parameters were given. It shows that the sensitivities of the network are all determined from the return loss. The affected degree of the circuit might be determined by Monte Carlo analysis and the perfect cross-coupled resonator filter can be designed.

Keywords: Multiple input/output coupling; cross-coupled; resonator filter; sensitivity; Monte Carlo analysis.

USB2.0 Endpoints Controller in 180nm CMOS Process

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ABSTRACT

The endpoints controller is designed in Verilog HDL for USB2.0 device controller. It is user-configurable up to 16 endpoints. The endpoints controller supports 8-bit/16-bit USB interface, 8-bit/16-bit/32-bit AHB or 8051 interface and 32-bit DMA interface. It is implemented in 180nm CMOS process and all functions have been proved by testing

The Design for a MEMS Gyroscope Based on Tunneling Effect

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ABSTRACT

This paper presents a new structure of tunnel current-type gyroscope which is high-accuracy, low-range compound beam. The structure is designed and manufactured by standard silicon micro process technology. This design combined high sensitivity of tunneling effect with Coriolis principle. Besides, the driving and the detecting beams were also analyzed in detail using mechanical principle, and static and model simulation was made in this paper. The simulation result is perfect and is close to the principle. At the same time, feasible technological processes were set in this paper and the key technologies needed in the process of processing were presented too. Manufacture technology of the tunneling point is also stressed. In the end, research was summarized and the following designing way was presented.

Keywords: Gryoscope, Tunneling effect, Processing technology.

The Characterization and Fabrication of Pyroelectric Infrared Sensors and Application of Gas Monitoring

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ABSTRACT

In the paper the pyroelectric infrared sensor with the lead zirconate titanate (PZT) ($PbZr_{0.3}Ti_{0.7}O_3$) thin film has been successfully fabricated. Prepared by a sol-gel process, the PZT thin film, which is chosen as infrared sensing film, uses lead acetate trihydrate, zirconium acetylacetone, acetylacetone, and titanium isopropoxide as starting materials. The fabrication process of device is discussed in detail. A new Au Pt-PZT-Pt infrared detecting structure on silicon substrate with a micro bridge is designed. Under the response and reference dualelement configuration, undesirable signals, caused by

vibration, ambient temperature change and sunlight, are cancelled out at the input of the preamplifier circuit. The dual-element Structural design of device is discussed and analyzed in detail. In experiment, in order to use this infrared sensor to monitor gas concentration, we designed a detection device in the light of certain gas absorbs infrared radiation at specific (and often unique) wavelengths. Therefore, the narrow band filters are selected, 3.31±0.03 um for methane characteristic absorption peak, and 3.91±0.03 um for reference characteristic absorption peak, two filters are separating installed before in response and reference element of detector. The gas concentration is obtained by designing weak signal detect circuit and data arithmetic. First measurement for methane is reported. Experimental result shows the ability of methane detecting of the system based on the IR sensor.

Keywords: Sol-Gel, Pyroelectric Effect, PZT, Infrared Dedector, Gas Monitoring.

Photoresponse of PdO/TiO_2 Film Under Visible Light

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ABSTRACT

PdO/TiO_2 nanocomposites were prepared by ployol method. TEM, XPS and FSEM were used to observe and measure the microstructure and chemical state of the PdO/TiO_2 film. In this process, $Pd(acac)_2$ was a Pd precursor, ethylene glycol was a reductant, and nano TiO_2 powder (Degussa P25) was a support, in which the nanopaticles of Pd were highly dispersed on the surface of TiO_2. The Pd/TiO_2 was deposited on the alumina substrate with a comb-like gold electrode, then it was calcined at various temperature in air. XPS shows the Pd on the Pd/TiO_2 film is in the form of oxide, while FSEM showed that the PdO/TiO_2 film is porous. The photoconductivity of the PdO/TiO_2 film is measured under visible light in room temperature in pure N_2 or N_2 doped with 1000 ppm O_2 respectively. The results show that, in pure N_2, the photoconductivity of the PdO/TiO_2 film is strongly influenced by the sintering temperature. The photoconductivity of the sample sintered at 350°C was higher than that in 550°C. The photoconductivity of the film is also influenced by trace O_2 in N_2. Under continuous light irradiation, the photoconductivity of the film is responded to the doping of O_2 in N_2, which could decrease the photoconductivity remarkably. By this phenomenon, it is suggested that a trace oxygen sensor can be developed, which can work in room temperature.

A High Responsivity and Fast Response Ultraviolet Detector Based on a ZnO Film by LMBE

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ABSTRACT

A high responsivity and fast response metal-semiconductor-metal (MSM) ultraviolet (UV) detector was fabricated based on a ZnO film. The highly c-axis oriented ZnO film was grown on a c-plane sapphire by O plasma-assisted laser molecular beam epitaxy (LMBE). The I-V measurements demonstrated a low dark current of 700 nA and a high photocurrent of 3.71 mA, respectively at 5 V bias, which indicating a responsivity of 325.3 A/W under UV illumination (365 nm, 11.39μW). The response time measurement showed a rise time (10%-90%) of 22.52 ns and a decay time (1-1/e) of 5.9μs.

Design of Multi-Bit Operation NAND CTF Memory Cell with High Reading Speed by Utilizing Separated Control Gate

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ABSTRACT

Unique NAND charge trap flash (CTF) memories by utilizing separated control gate (SCG) were designed to increase bit per cell and reading speed. The electrical properties of the nitride-trapping flash memory cells with SCG were investigated to clarify the charging effects in the nitride-tapping flash memory cells. When the program voltage is supplied to the each gates of the SCG NAND CTF flash memory cells, the electrons and trapped in the nitride region of the oxide-nitride-oxide layerunder gate to supply program voltage. Subsequently, the V_{th} of programmed region are increased due to the trapped electrons. The simulated results indicate that the proposed unique NAND CTF memories with SCG were designed to increase bit per cell reading speed.

Impact of Control Dielectric Layer on Nanocrystals Floating Gate Memory Device

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ABSTRACT

Metal-Oxide-Semiconductor (MOS) capacitor structure with gold nanocrystals embedded between the tunneling oxide layer and the control oxide layer is studied for the application of nonvolatile memory. In this paper, two different methods are adopted in fabricating the control oxide layer of MOS capacitor structure, being the plasma enhanced chemical vapor deposition (PECVD) and e-beam evaporation. The capacitance versus voltage (C-V) curves and the capacitance versus time (C-t) curves are comparatively analyzed. It can be concluded that the quality of the control oxide is critical for the correct operation of the MOS capacitor structure.

Simulation, Fabrication and Characteristics of Nanocrystal Non-Volatile Memories

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ABSTRACT

Recently, non-volatile memory (NVM) devices utilizing discrete nanocrystals (nc) as floating gate have received considerable research interests due to their excellent memory performance and high scalability. In this paper, we will present an overview of this type of memory devices investigated in our laboratory. Key issues involving nanocrystal selection, fabrication and tunnelling barrier engineering are discussed. It is found that non-volatile memory devices utilizing nanocrystals show promising characteristics as candidates for the next generation memories, especially when metal nanocrystals and high-k tunnelling dielectrics are adopted.

Characterization of Precisely Controlled Quantum Dot Fabricated on SOI

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ABSTRACT

A novel technique, based on electron-beam lithography (EBL) and anisotropic reactive ion etch (RIE), was developed in this work for the fabrications of single electron transistors with ultra small junctions as well as break junctions in silicon on insulator (SOI). As small as 10 nm junctions have been fabricated, which can be further reduced by a thermal oxidation process. Electrical characterization at low temperature has demonstrated clear Coulomb blockade gap in the measured I-V curves, indicating that such narrow junctions finally formed by RIE are still functional. It also be demonstrated that the gate modulation factor achieves 0.5 in the fabricated SET device. This process eases the difficulty in EBL for 10 nm feature size by the controllable lateral dry-etch on the sidewall of the silicon thin layer, opening up a prospect for routine manufacture of single electronic devices and circuits on SOI with ultra small tunneling junctions, which possesses broad applications in metrological measurement and IT technology.

A Study on the Image Processing of Nano Scale Using Wavelet

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ABSTRACT

Nanotechnology has been implemented efficiently to analyze and understand the properties of matter at atomic and molecular level. The nanoindenter allows users to characterize the mechanical properties of materials on nanometer length scales. This work describes a novel algorithm to process image from nanoindenter. By noise reduction, enhancement and extraction of object, more accurate data can be acquired from nanoindenter. The image processing algorithm mainly based on wavelet.

Keywords: Nanoindenter; Nano scale; Dilation; Erosion; Wavelet Transform; Denoising

Miniature and Tunable Filters with MEMS Switches

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ABSTRACT

In this paper, fully monolithic tunable millimeter-wave filters with tapped-line feedings are proposed using the CPW-based periodic structures with novel multiple-contact MEMS switches. Millimeter-wave low-pass were designed, fabricated, and tested. The cascaded CPW-based periodic structures, with low-pass intrinsic filtering characteristics, are reconfigured into a self-similar single unit cell by the operation of the novel multiple-contact MEMS switches with single actuation. The measured results of the reconfigurable low-pass filter show the 3-dB cutoff frequency change from 19 to 11 GHz with very small change in the average insertion loss from 1.3 to 1.9 dB. The chip size of the low-pass is 4.0mmx1.6 mm.

Development of ZnO-TFT

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ABSTRACT

As a wide band gap optoelectronic semiconductor material, ZnO has many uses in the reality life. For example, UV photodetectors, surface acoustic waves, varistors and so on. As the active channel layer, it can also be used in fabricating ZnO-TFT. In this paper, we described the properties of some ZnO-TFTs, some of the typical structure of ZnO-TFT and the operating principles of some of ZnO-TFT. In the same time, some of the advantages and the problems of ZnO-TFT are pointed out.

Key words: Zinc Oxide; TFT; Transparent

Quantum Tunneling Behavior of Nanocrystalline Silicon/Crystalline Silicon Heterostructure Diode

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ABSTRACT

We report the observation of various quantum behaviors of nanocrystalline silicon/crystalline silicon heterostructure diodes. Tunneling has been proved to be the dominant transport mechanism for the device-grade diode operating below 80 K. For the sample which is composed by highly ordered nanocrystalline silicon, interesting physical phenomena have been revealed, which include high electron mobility, resonant tunneling and periodical negative differential conductivity under different reverse bias regions. A number of temperature dependent current-voltage measurements have been done to support our observations. Theoretical self-consistent calculations further explain the quantum tunneling mechanisms behind the experimental results.

Analysis of Interconnect Sensitivity to Process Variation in 90 nm

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ABSTRACT

With development of deep sub-micro technology, process-induced variation has become much more important on IC design than other challenges for high yield. Qualitative analysis and quantitative analysis of the correlation between interconnect electrical parameters and physical parameters are shown by statistical method and curves fitting technology. It indicates that electrical parameters are more sensitive to metal width and thickness than others distinctly.

Three Kind Test Circuits Based on the Output Characteristic of GaAs Resonant Tunneling Structure

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ABSTRACT

Currently, the application of resonant tunneling microstructure is put a premium on. And the output test of its electricity characteristics is a key link in its application. Derected at the characteristics of resonant tunneling microstructure which are oscillating characteristic in negative resistance region, the intrinsic bistability and piezo-effect, this paper offers three different test circuits that are oscillation frequency testing circuit, bridge test circuit and peak-to-volley in negative resistance region test circuit. Experiments are made on three different circuits and these results show that three different circuits all can fulfill the needs for test. Besides, bridge test circuit has a good effect on micro-accelerometer based on resonant tunneling

Keywords: resonant tunneling microstructure, test circuit, GaAs, experiment

TCAD Investigation of Hot Carrier Reliability Issues Associated with GEWE-RC MOSFET

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ABSTRACT

The paper assesses the hot carrier reliability performance of Gate Electrode Workfunction Engineered Recessed Channel (GEWE-RC) MOSFET: An outcome of channel recession and gate electrode workfunction engineering amalgamation using ATLAS device simulator. TCAD simulations reveal reduction in hot electron injected gate current; reduced electron velocity and reduced electron temperature near the drain end;

and further, reduction in impact ionization substrate current; thereby, enhancing the hot carrier reliability of the device proving its efficacy for highperformance wireless applications.

Design of a New SMA Micro-Actuator

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ABSTRACT

In this study, a new type of micro-actuator based on silica gel rod with embedded off-axis SMA wires was presented. The 3D formulation was presented. Using the 3D formulation and continuity theory of rod-wire interface, the equilibrium equations for SMA wires are obtained. By this equation, the forces and moments of this micro-actuator is yielded in theoretical predictions. To verify these formulations, we first use the finite element method to simulate and analyze. And then, a SMA test stand was established and property experiments were conducted. All results show these equations are correct.

The experiments were conducted and the relationship between input voltage and output power of this micro-actuator was obtained.

Fabrication of the $Si_2Sb_2Te_5$ Phase Change Cell Structure for PCRAM by Using UV Nanoimprint Lithography

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ABSTRACT

Phase-change random access memory (PCRAM) is emerging as one of the most promising non-volatile memories for the next generation media due to its fast write/read speed, wide dynamic range, high degree of cycling endurance, excellent data retention, simple structure, low operating voltage, good compatibility with CMOS technologies, and easy applicability. The PCRAM utilizes a reversible phase change phenomena between crystalline and amorphous states of chalcogenide materials by electrical resistive joule heating. A resistance of the crystalline phase (set) is much lower than that of the amorphous phase (reset). Being able to pattern and etch phase change memory in nanometer scale is essential for low power consuming operation of PCRAM device. In particular, high-density electronic memory, uniform, consistent and smooth sidewall storage unit structure for the electrical properties of memory is essential. UV nanoimprinting lithography (UV-NIL) is a new emerging lithographic technique in which patterns as small as sub-100 nm can be easily replicated onto a resin layer from surface protrusions of a stamp with a potential for high throughput at low cost, and a promising as one of the next generation lithography. This study uses the UV-NIL for patterning the PCRAM device. Si wafers coated with SiO_2 were used as substrates. Titanium bottom electrode, TiN contact layer, and $Si_2Sb_2Te_5$ (SST) were deposited by sputtering method. The thicknesses of Titanium, TiN and SST layer is about 100, 40, and 200 nm, respectively. Patterns of UV imprinting resin were formed using UV-NIL on the surface of SST films, and that were etched using SF_6/O_2 plasma in a RoTH&RAU MS-350 reactive ion etching (RIE) etcher. The experimental results show that by using UV-NIL processing uniformly consistent, high-quality edge smooth sidewall structure for PCRAM devices is obtained. The operation behaviors of the fabricated devices were characterized by using electrical measurement system, SST material possesses lower threshold current with a resistance ratio of 65 has been achieved.

Keywords: PCRAM, UV-NIL, SST, uniform, smooth sidewall.

Physical and Electrical Properties of the High-κ Dielectrics with Ni and Al Inclusion in HfO_2

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ABSTRACT

The thermal stability and the resistance to oxygen diffusion of $(HfO_2)_x(Al_2O_3)_y(NiO)_{1-x-y}$ gate dielectrics deposited on p-type Si (100) substrate by laser molecular beam epitaxy technique (LMBE) have been investigated. X-ray diffraction (XRD) results indicate that the crystallization temperature significantly increases with Ni and Al added into the HfO_2 film. Atomic force microscopy (AFM) testing shows that the surface of these films after annealing in N_2 is continuous and flat at the atomic level with no pinhole observed. No silicate interfacial layer is found in the high-resolution cross-section transmission electron microscope (HRTEM) images of the $(HfO_2)_x(Al_2O_3)_y(NiO)_{1-x-y}$ films after 900°C annealing in N_2. It is indicated that the interposed layer of Ni-Al-O between the oxide film and the Si substrate enables to avoid the formation of low-k silicate interfacial layer, which is favorable for MOS to further downscale.

A 90 nm Process Interconnect Statistical Analysis for Metal Thickness Variation in CMP

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ABSTRACT

CMP used in copper Damascene process make metal thickness variability through full-chip severely because of pattern dependant within die. For accurate interconnect metric in 90 nm process, we propose a novel method which can implement statistical analysis for the impact of metal thickness variation in CMP efficiently, by modeling interconnect with the parasitical parameters' means and standard deviations extracted from TCAD. Experiment shows the method is very practical interconnect simulation in 90 nm process.

Plate-Form Negative-Pole in Precise Removal of ITO Thin-Film from Color Filter Surface

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ABSTRACT

The defect rate of ITO thin-film is easily existent through the process of semiconductor production. By establishing a recycle-process of the ultra-precise removal of the ITO thin-film nanostructure, the semiconductor optoelectronic industry can effectively recycle defective products, both production costs and pollution. This study presents a new nanotechnology application of recycle-process of ITO thin-film removal using a plate-form negative-pole offering a fast removal rate from color filter surface of TFT-LCD. In the current experiment, the design features of the removal process for a thin-film nanostructure of ITO are of major interest. An effective tool-electrodes design and a low-cost recycle processes using the electrochemical removal just needs quite short time to make the ITO thin-film nanostructure remove easily and cleanly.

Electrical Transport Properties of Single Silver Nanowire

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ABSTRACT

Nanoscaled silver has important application in Suface-Enhanced Ramman Scattering, electronic devices, biology sensors and immunity analysis, etc. The silver nanowires were synthesized by polyol reduction using PVP as the capping agent. The silver nanowires were highly dominated by the nanowires with a diameter of about 50nm and a length of about 1 mm. The single silver nanowire devices were fabricated by a conventional photolithography and the electronic transport properties of single silver nanowire have been investigated. Our experiment showed that the resistivity of single silver nanowire approaches to the theoretical value, and all the plotting of current-voltage curves yield straight lines. The resistance decreases with increasing temperature. The melting phenomenon of the silver nanowire was observed when the current exceeded a certain value, and the mechanism of the phenomenon was discussed. Our experimental results redound to applications of silver nanowires in electronic devices and biosensors in the future.

The Ge Enhance the Sensitivity for Bio-Sensor

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ABSTRACT

Nanowire is mainly used in biological sensor because it has the high surface-to-volume ratio. In this study, we have successfully fabricated the N-SiGe nanowire with different Ge concentration by side-wall spacer technique respectively. The 3-amino-propyltrime-thoxy-silane (APTS) was used to modify the surface, which can connect the bio-linker. The conductance of SiGe nanowire increases owing to APTS with positive charge. The bis (sulfosuccinimidyl) suberate sodium (BS3) as the bio-linker connects to APTS, and the conductance decreases because of negative charge. Finally, the protein immunoglobulin G (IGG) is linked to BS3, and the conductance reduces for negative charge. Comparing the conductance change; the SiGe nanowire with higher Ge concentration improved the sensitivity. But the over-higher Ge concentration (40%) did not increase the sensitivity; the reason maybe the higher defect appears at the surface as higher Ge concentration.

Comparative Study of Quartz Crystal Microbalance, Polyethylenimine, Glutaraldehyde to Diagnose Cardiac Troponin T in Flow Injection Biosensor System

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ABSTRACT

Detection of Cardiac Troponin T (CTnT) is essential for the risk assessment of acute myocardial infarction (AMI), which leads to higher number of death in many countries every year. Immunoassay modified biosensor is a promising technique for rapid analysis, good selectivity, high sensitivity, thermal stability, linearity and relatively low cost. There have been consistent efforts to improve the performance of the Immunosensors which include functionalization of the working surface by polymer or nanomaterials. In this paper, a CTnT sensor is developed based on quartz crystal microbalance (QCM) with

polymer coating and antibody immobilization. QCM surface is first functionalized with Polyethylenimine (PEI) and antibody is immobilized on PEI via cross linking with glutaraldehyde (GA) by spin coating technique. Scanning electron microscopic characterization reveals polymerantibody nanoparticle coating on QCM surface. Fourier transform infrared spectroscopy is then used to confirm that the coated nanoparticles are PEI-GA CTnT antibody composite. The fabricated sensors have been characterized for CTnT detection in the concentration range between 0.122 and 1.220 mg/ml by electrical frequency measurement. Frequency shift versus log of CTnT concentration curves show the linear relationship. The linear relationship between the CTnT concentration and the log of frequency shift could be observed in the concentration range of 0.1-0.001 mg/ml with good sensitivity. Then, the fabricated bioprobe is effective for CTnT detection in normal range of CTnT concentration in human blood.

pH-Sensitivity Investigation of Carboxymethyl Chitosan Modified Nanoliposomes

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ABSTRACT

The CMCT modified pH-sensitive doxorubicin (DXR) nanoliposomes were prepared by reverse phase evaporation-pH gradient method in this article. The encapsulation efficiency reached 87% and higher. CMCT modified liposomes were dispersed spherical particles with the narrow volume particle size distribution and a mean diameter of (74.7 ±11.5) nm. The zeta potential of DXR liposomes increased after CMCT modification, suggesting the formation of CMCT layer on the nanoliposomes surface. From DXR release profile of CMCT modified nanoliposomes, it was found that the CMCT substitution degree and molecular weight had great effects on the pH-sensitivity of DXR nanoliposome, while the effect of the CMCT concentrations on the DXR release was not remarkable.

Keywords: Nanoliposomes, pH-sensitivity, carboxymethyl chitosan, doxorubicin.

Physical Characteristics of Single DNA Molecule Studied with Atomic Force Microscopy

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ABSTRACT

The structural characteristics of a single dsDNA molecule which was immobilized on various treated surfaces such as 3-aminopropyltriethoxysilane (APTES) treated substrate (APTES/substrate) or alkylthiol treated substrate (alkylthiol/substrate) have been investigated. The DNA chains were horizontally immobilized on the substrate through a strong covalent bonding between amino groups of the APTES linkers and phosphate groups of DNA backbone (DNA/APTES). However, when the substrate was treated by alkylthiol, only 5' end of DNA was covalent bonding with hydroxyl group of alkylthiol (DNA/alkylthiol), and the remaining chain was physically adsorbed on the surface. Biotin molecules which could capture the 3' end of the dsDNA were chemically adhered to AFM tip. By approaching the functionalized tip to the free DNA end and performing a force vs. distance curve (F-D), the structure transition of the dsDNA would be observed. That F-D curve would be used to analyze the dsDNA melting, stretching and transforming from B-form to S-form or DNA Young's modulus as well as persistence length. The force needed to lift up and to do the dsDNA transition for the chain on APTES/glass is greater than that on alkylthiol/substrate due to the chemical characteristics on the substrate. This implies that Young's modulus value obtained on DNA/alkylthiol is more accurate than that on APTES/substrate. The peaks of around 66 pN and 300 pN obtained on the retraction curve may be attributed to the transformation from B to S-forms and the melting mechanism, respectively. The DNA would be stretched at a force of greater than 300 pN depending on the pull-off length. The obtained Young's modulus and persistence length are also agreeable with other published values.

Safety of Cholesteryl Cetyl Carbonate Mixture Nanosystems Containing Amphotericin B Antifungal Dry Powders Formulations

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ABSTRACT

The present study involved the preparation and evaluation of the safety of Amphotericin B (AmB) nanosystems. The formulations were prepared by melting incorporation of AmB into cholesteryl cetyl carbonate mixtures (CCCM). CCCM contains cholesterol, cetyl alcohol and cholesteryl carbonate. Either lactose or mannitol was added to the AmB-CCCM dispersion to form a dry powder. Lactose was found to be the best carrier to improve flowability and bulk of powder. CCCM nanosystems were generated by the dispersion of AmB-CCCM into aqueous media, these nanosystems had a particle size of 300 - 425 nm. AmB dry powder showed mass median aerodynamic diameter (MMAD) less than 6 µm and gave 11.3 - 36.3% of fine particle fraction (FPF). AmB in dry powder form retained its AmB content after storage at 2-8°C and at room temperature for 3 months. The range of MICs for *Cryptococcus neoformans* was 0.03 - 0.06 µg/ml and 0.25 - 0.50 µg/ml for *Candida albicans*. NR 8383 cell line was used in the cytotoxicity study and immunological response. AmB nanosystems at concentration less than 62.5 µg/ml did not cause toxicity to the cell line and, nor did they stimulate any immune responses, because the cells produced a much smaller amount of toxic cytokines (IL-1β and TNF-α) when compared to lipopolysaccharide (LPS) from *E. coli*. These results suggest that the AmB in CCCM nanosystems is safe *in vitro*, and such formulations have the potential for use in dry powder inhalers.

Home

Effects of Reynolds Number Variations on Fluid Flow Around a Nano-robot Inside Human Blood

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ABSTRACT

The idea of nano-technology started in 1959. It has been used in different applications since its creation. One of its new areas of applications is in medicine. From medical instruments (i.e. sensors etc) to medical treatments nano- technology is playing a major role. Application of nano-robot inside human blood for health purposes is a promising one. The purpose of this study is to investigate the flow field and heat transfer modeling of a nano-robot inside the biggest human vein, Aorta. In our formulation of governing nonlinear partial differential equations, momentum and energy equations are applied to the blood and the nano-robot. To solve these equations a computational fluid dynamic code is utilized. The velocity profile, pressure and temperature distribution nano-robot in direction of the blood stream as well as in opposite direction of the blood stream are calculated. Results are verified with a known experimental condition. Results shows that nano-robot do not introduce a significant effect on the blood stream. Therefore it is safe to use such devices inside blood stream for medical purposes.

Keywords: Nano-robot, Heat transfer, Momentum equation, Energy equation, Aorta, Reynolds

The Photoluminescence of Sr_2CeO_4 Phosphor Prepared by Modified Citrate-Gel Method

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ABSTRACT

In this paper, blue-emitting Sr_2CeO_4 powders were synthesized by modified citrate-gel process using corresponding metal carbonates, citrate acid and ammonium nitrate as raw materials. The luminescent properties of the samples were investigated by fluorescence spectrophotometer. The results show that the excitation and emission spectra of the as-prepared Sr_2CeO_4 phosphors show broad bands, and that a small amount of NH_4NO_3 and appropriate sintering temperature are benefit to the gain of the Sr_2CeO_4 phosphor with high luminescent intensity.

Keywords: Modified citric-gel method ; Sr_2CeO_4 ; phosphor; photoluminescence.

Comparison Between Chemically Purified Frustules and Diatom Cells Cultivated with/without Baking on a Functionalized Mica Surface by using Scanning Electron Microscopy

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ABSTRACT

By using scanning electron microscopy, we compared chemically purified diatom frustules and cultivated diatom cells with/without baking. When the frustules were purified using the standard chemical treatment, every component of the frustules was dissociated, and curled epitheca or hypotheca were mainly observed. When living diatoms were cultured and baked directly on a functionalized mica surface, more than half of the frustules retained the native conformation of every component such as the epitheca, hypotheca, and bands. Prior to the cultivation, a mica surface was functionalized with self-assembled monolayers of 3-aminopropyltriethoxysilane. Diatom cells were successfully grown on the mica surface. When the sample was baked at 400°C for 2 h, frustule structures without the organic components of a diatom cell were successfully observed. On the other hand, more than half of the unbaked cells were deformed after dehydration; this was observed even after the cells were fixed with 1% glutaraldehyde for 1 h. Our results reflect the advantage of using the baking method over the usual chemical treatment for studying the nanostructures of frustules.

Saccharomyces Cerevisiae Studied by Confocal Microscopy and Atomic Force Microscopy

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ABSTRACT

We examined the physical properties of the surrounding yeast cell walls by using atomic force microscopy (AFM). The yeast cells were prepared on a cleaned glass substrate for CM observation and were mechanically trapped into a porous membrane for AFM measurement. The confocal image of the yeast cells was measured in air meanwhile the AFM topography images of the cells were measured in both de-ionized (DI) water (pH = 6.9) and phosphate-buffered saline (PBS) solution (pH = 7.4). No significant differences between the AFM topography images of the yeast cells measured in DI water and in phosphate buffered saline (PBS) solution could be inferred. In order to get the quantitative information on the sample elasticity, the force curves between an AFM tip and the yeast cell have been measured. These curves were measured in both DI water and in PBS solution on the same yeast cell using the same AFM cantilever to get the reliable result. The contact region of these force curves in approach mode was then converted into force versus indentation curves. These curves would be fitted with Hertz-Sneddon model for the calculation of the elasticity. Analysis of the curves indicates that there is a difference of the Young's modulus values of the yeast cell in various environments. These data show that the salt buffer solution increases the rigidity of the biological system.

Keywords: S. cerevisiae, AFM, Elasticity, CM, nanoindentation.

Effects of Synthetic Liquid Crystals on Amphotericin B Properties

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ABSTRACT

Liquid crystals are new approach in the design of novel nanosystems of Amphotericin B (AmB) with decreased drug toxicity and increased stability. The objectives were to synthesize and characterize cholate cetyl ether (CCE) liquid crystals and to use these to form nanosystems containing AmB. AmB stability and toxicity in CCE were evaluated,

and compared to data for pure AmB and AmB in cholesteryl olyel carbonate ester (COC) nanosystems. CCE was identified by thin layer chromatography (TLC), fourier transformed infrared (FTIR) spectroscopy, mass spectrometry (MS) and nuclear magnetic resonance spectroscopy (NMR). Differential scanning calorimetry (DSC) and X-Ray diffraction (XRD) were employed to monitor crystal properties. Drug stability was measured by UV spectroscopy. The size stability of nanosystems was also determined. It is evident that CCE contains three parts; a steroid nucleus, hydrocarbon chains and ether linkage between the steroid ring and one hydrocarbon chain. DSC and XRD revealed that CCE was in an amorphous state. CCE is in a semi-solid state at room temperature and is insoluble in water, When the CCE was dispersed in water it formed a nanosystem, in a manner similar to a surfactant with a size of 243.90± 48.80 nm. AmB-CCE nanosystem was in a monomeric form, with drug content degrading during storage. AmB COC nanosystems gave similar results, but the extent of drug degradation was greater in this system. In terms of stability, AmB-CCE nanosytems were more stable than AmB-COC nanosystems. Safety testing with a monocyte cell line revealed that CCE was not toxic.

Design and Fabrication of Nanoliter-Scale Magneto-Hydrodynamic (MHD) Flow Rate Sensor

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ABSTRACT

Nanoliter-scale flow sensing is one of the most essential aspects in nano-bio systems. This paper describes the design, numerical modeling and fabrication of a nanoliter-scale magneto-hydrodynamic (MHD) flow rate sensor (MFRS) for nano-bio systems. The operation principle of the proposed MFRS is based on Faraday's electromagnetic induction rule that electromotive force (EMF) induced across conductive fluid through a magnetic field is proportional to the velocity of that conductive flow. Theoretical analysis and multiphysics modeling involved fluid dynamics and Maxwell's equations are applied to investigate the performance of MFRS, which demonstrates that induced electromotive force (EMF) shows good linearity to the flow rate. A polymerized polydimethylsiloxane (PDMS) cap is bonded to a glass substrate with a 10 μm-depth microchannel and

patterned Cr/Au (50/150 nm) electrodes on the vertical sidewall of microchannel to form a MFRS prototype for testing.

Macrowave-Assisted Growth and Characterizations of Water-Dispersed Glutathione-Capped ZnSe Nanocrystals

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ABSTRACT

In this paper, a novel method is presented for the rapid synthesis of glutathione (GSH)-capped ZnSe nanocrystals in aqueous phase assisted with microwave irradiation. The as-prepared ZnSe nanocrystals have tunable fluorescence emissions between 360 and 410 nm with narrow full width at half maximum (FWHM) of 21 nm. Moreover, the luminescent properties were greatly improved through photochemical treatment. Their photoluminescence quantum yields (PLQY) reached as high as 55% after illumination. The key synthesis parameters (molar ratio or reagents, pH values, reaction temperature, and time) are fully discussed. The facile synthesis of glutathione-capped ZnSe nanocrystals is free of complicated manipulations and cost-effective. Furthermore, the water-dispersed ZnSe nanocrystals with high luminescence and favorable biocompatibility allow their potential applications in biological imaging as fluorescent labels.

The Thresholds of Survival for Systems of Two Competitive Species Under Pulse Input of Toxin in a Polluted Environment

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ABSTRACT

There has been a fair amount of previous work on models of persistence and extinction for two species in a polluted environment under the assumption that the input of toxicant was continuous and that the limit of exogenous input of toxicant exists (see, for example, [1-3]). It is observed that the toxicants are often emitted to the environment with regular pulse.

In the present work we consider a impulsive differential system of the form

$$
\begin{array}{ll}
\frac{dx_1(t)}{dt} = x_1(t)\Big(r_{10} - r_{11}C_0(t) - a_{11}x_1(t) - a_{12}x_2(t)\Big) & \\
\frac{dx_2(t)}{dt} = x_2(t)\Big(r_{20} - r_{21}C_0(t) - a_{21}x_1(t) - a_{22}x_2(t)\Big), & t \neq n\tau, \\
\frac{dC_0(t)}{dt} = kC_e(t) - gC_0(t) - mC_0(t), & n = 1, 2, \cdots \\
\frac{dC_e(t)}{dt} = -hC_e(t) & \\
\triangle x_i(t) = 0 (i = 1, 2, 3), \triangle C_0(t) = 0, & t = n\tau, \\
\triangle C_e(t) = b, & n = 1, 2, \cdots \\
0 \leq C_e(t) \leq 1, 0 \leq C_0(t) \leq 1. &
\end{array}
\tag{1}
$$

Here τ is the period of the impulsive effect about the exogenous input of toxicant; x_i is the density of the ith species; C_e is the concentration of toxicant in the environment; C_0 is the concentration of toxicant in the organism, supposing that the concentration of toxicant contained in each species at time t is the same; the coefficients are positive constant.The exogenous rate of input of toxicant into the environment is represented by u, which is restricted by $0 \leq u_t < +\infty$for $0 \leq t < +\infty$.

Our purpose is to discuss dynamics properties of the model (1), and obtain the threshold of existence and extinguishment for each population under pulse input of toxin in a polluted environment.

References:

[1] Ma.Zhien, Mathematical Modeling and Research on Synecology, Anhui Education Press, 1996.
[2] H.Liu and Z.Ma, The threshold of survival for systems of two species in polluted environment, *J. Math.Biol.*
30(1991), 49–61.
[3] Shukla JB, Agarwal AK, Dubey B, Sinha P,Existence and survival of two competing species in a polluted environment: a mathematical model, *Journal of Biological Systems*, 9(2001), 1–15.

Developments of Fabricating Nanostructure

Coatings by

Cold Gas Dynamic Spraying

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ABSTRACT

Cold gas dynamic spraying (CGDS) is one kind of novel surface engineering technologies, depositing diversified metal, alloy and composite coatings by high-speed gas current under room temperature or with a little heated. Due to its peculiar characteristics such as low spraying temperature, nonoxidation, low stress among coating layers, compactification, as well as high utilization rate, especially the technical advantages on fabricating nanostructure coatings, the CGDS process has attracted great attention. The paper reviews the current situation of researches on the CGDS technology, and summaries its development in fabricating pure metal, alloy as well as composite nanostructure coatings, mainly including their microstructures, properties, characteristics and applications.

Study on Curing Process and Conductive Performance of UV Curable Conductive Inkjet Printing

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ABSTRACT

A UV curable conductive ink containing silver (Ag) nanoparticles was developed so as to satisfy the requirement of the ultra-fine PCB manufacturing presently, and the effects of Ag nanoparticles on dual-curing process and electrical conductivity were studied. The ink was prepared by uniformly dispersed Ag nanopartilces in organic solvent mixing with UV curable polymer, photoinitiator and thermal initiator. The curing process of the ink included UV curing and thermal curing and therefore it was a dual-curing process. The Ag nanoparticles had an average diameter of around 50 nm and melting point of around 125°C. The dual-curing process of the ink was studied by FTIR. The curing time significantly decreased with the increasing of Ag nanoparticles content in the ink. From SEM imagine, the Ag nanoparticles were coated with a layer of polymers and the nanoparticles shape did not change before heat treatment. However, the morphology of nanoparticles changed dramatically after heat treatment. The Ag nanoparticles were melted to form conductive fillers in the ink after heat treatment at temperature above

125°C. Both Ag nanoparticles content and heat treatment conditions affected electrical resistivity. Electrical resistivity of the ink decreased to as low as $5\times10^{-6}\Omega\cdot$cm by using 70% silver nanoparticles and heat treat at 200°C for 5 min

Study on Curing Process and Conductive Performance of UV Curable Conductive Inkjet Printing

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ABSTRACT

A UV curable conductive ink containing silver (Ag) nanoparticles was developed so as to satisfy the requirement of the ultra-fine PCB manufacturing presently, and the effects of Ag nanoparticles on dual-curing process and electrical conductivity were studied. The ink was prepared by uniformly dispersed Ag nanopartilces in organic solvent mixing with UV curable polymer, photoinitiator and thermal initiator. The curing process of the ink included UV curing and thermal curing and therefore it was a dual-curing process. The Ag nanoparticles had an average diameter of around 50 nm and melting point of around 125°C. The dual-curing process of the ink was studied by FTIR. The curing time significantly decreased with the increasing of Ag nanoparticles content in the ink. From SEM imagine, the Ag nanoparticles were coated with a layer of polymers and the nanoparticles shape did not change before heat treatment. However, the morphology of nanoparticles changed dramatically after heat treatment. The Ag nanoparticles were melted to form conductive fillers in the ink after heat treatment at temperature above 125°C. Both Ag nanoparticles content and heat treatment conditions affected electrical resistivity. Electrical resistivity of the ink decreased to as low as $5\times10^{-6}\Omega\cdot$cm by using 70% silver nanoparticles and heat treat at 200°C for 5 min

A New Versatile High Speed Pattern Generator for Nanolithography

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ABSTRACT

A new versatile high speed pattern generator for nanolevel structure research and applications has been designed and developed. The digital signal processor (DSP) is employed in the pattern generator, so coordinates of exposure points inside the primitive shapes can be calculated with a very high speed. The beam scanning of scanning electron microscope (SEM) is controlled by two sets of 16 bit digital-to-analog converters (DACs). Meanwhile the hardware can acquire SEM images, transfer data and control laser stage. Users can design various patterns and import common industrial layouts such as CIF/GDSII format files by the software package. The powerful display, drawing, and editing capabilities of the software package can accomplish different user necessities for pattern design. The experiments indicate the resolution can approach nanometer, and the field stitching accuracy better than 0.2μm.

Keywords: Nanolithography, Nanofabrication, Pattern generator, Electron beam lithography, Pattern design.

Layout Design of Multi-Finger Power SiGe HBTs for Thermal Stability Improvement

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ABSTRACT

This paper proposes the layout design of multi-finger power SiGe HBTs with non-uniform finger spacing to improve the thermal stability. Two types of 20-finger SiGe HBTs with uniform and non-uniform finger spacing are fabricated. Experimental results shown that, for the HBT with non-uniform finger spacing, the power level for thermal regression is 22.8% higher than that of the uniform one, which contributes to the improvement of the maximum temperature and the non-uniformity of the temperature profile in the device. Therefore, the temperature profiles of HBTs are simulated to directly show thermal stability and verified by the experiment result. Basing on the verified simulation, a further optimum layout design of HBT with non-uniform spacing is proposed. It is shown that the maximum temperature difference is improved by 79.28% for the further optimum HBT, when compared with that of HBT with uniform finger spacing. These results indicate that optimizing the layout of HBTs with non-uniform finger spacing is very useful for improving the thermal properties of power HBTs.

Bioactivity of Plasma-Treated Nanostructured Biomaterials

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ABSTRACT

The surface biological properties of biomaterials are influenced by their micro- and nano-structures and can be improved by plasma processing and surface treatment. Nano-structured TiO_2 and ZrO_2 coatings have been fabrucated using nano-particle plasma spraying and plasma immersion ion implantation. The structure is evaluated by various techniques and their bioactivity and biocompatibility are assessed using simulated body fluid soaking and cell culturing tests. The nanostructured surfaces treated with the proper plasma processes are found to possess excellent bioactivity and biocompatibility. The bioactivity of the films depends on a nanostructured surface composed of enough small particles, as reflected by the ability of the nano films to induce bone-like apatite formation on their surfaces after immersion in a simulated body fluid. The plasma treatment provides the nanostructured surface with a high density of negative charges that influence the adsorption of molecules and ions from the simulated body fluids.

Keywords: Bioactivity, nanostructure, plasma processing.

ZnO Thin Film Grown on Glass by Metal-Organic Chemical Vapor Deposition

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ABSTRACT

ZnO thin film was deposited on the substrate of Corning glass by metal-organic chemical vapor deposition (MOCVD)[1,2,3] with a buffer layer of SiNx grown by plasma enhanced chemical vapor deposition. The quality of ZnO film was studied by X-ray diffraction and photoluminescence measurement. We found strong diffraction (0 0 2) peak at 34.50°, indicating that the ZnO film was strongly C-oriented. The full-width at half maximum of (0 0 2) peak was 0.179°.

Keywords - ZnO; XRD; Thin film; MOCVD

Aqueous Synthesis Towards Vertically-Aligned and Selective Pattern of ZnO Nanostructures Arrays

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ABSTRACT

For any future cost-effective applications of inorganic nanostructures in particular hybrid photovoltaic cell, solution processable and selective printable of inorganic nanomaterials is essential. The patterning and growth of highly ordered arrays of crystalline ZnO inorganic nanostructures use simple soft lithography technique and mild reaction conditions; both low in temperature and free from harmful organic additives. Variable yet controllable anisotropic growth of ZnO nanowires has been demonstrated on the transferred patterns of ZnO nanocystals.

Visible Light-Active Nano-Sized Fe-doped TiO_2 Photocatalysts and their Characterization

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ABSTRACT

Nano-sized Fe-doped TiO_2 samples with different amounts of iron dopant (1.0-10.0 at.%) were synthesized from titanium tetraisopropoxide (TTIP) in absolute ethanol by the modified sol-gel method. The precursor of the iron nitrate ($Fe(NO_3)_3 \cdot 9H_2O$) to be doped was added to an alcoholic solution containing TTIP. This solution was loaded into a pouch type cellophane membrane and placed in a clear solution containing 1:1 (v/v) ratio of absolute ethanol and distilled water with 0.5 1.0 % concentrated ammonia solution for 1h. After the completion of the dialysis process (1h), the suspension was centrifuged (7500 rpm, 10 min), washed with milli-Q water and then dried in an oven at 60°C for 24 h. The powder was finally calcined in a furnace at a temperature of 400°C for 3 h. The use of cellophane membrane offered the advantage of a well-controlled diffusion rate. Phase composition, crystallinity, crystal size and morphology of nano-sized Fe-doped TiO_2 were examined by X-ray diffraction (XRD) and transmission electron microscopy (TEM). The Brunauer, Emmett and Teller (BET) adsorption-desorption of nitrogen gas for specific surface area determination at the temperature of liquid nitrogen was performed on nano-sized Fe-doped TiO_2. The elemental composition and oxidation state of elements were investigated by X-ray photoelectron spectroscopy (XPS). The crystalline size of 2.0 at.% of Fe-doped TiO_2 was found to be in the range of 15-20 nm with BET specific surface area of 109 m^2/g. UV-Vis absorption studies showed significantly enhanced red-shift in UV-Vis absorption spectra with an increased amount of iron. The complexation of Fe-oxalate was determined by using Fourier transform infrared spectrophotometry (FT-IR). The photocatalytic activity of nano-sized Fe-doped TiO_2 was examined by studying the mineralization of oxalic acid under visible light irradiation. It was found that 2.0 at.% of Fe-doped TiO_2 showed the highest activity. All nano-sized Fe-doped TiO_2 showed higher activity than Degussa P25 and bare TiO_2.

Keywords: Characterization, Fe-doped TiO_2, Nano-sized, Photocatalysts, Visible light.

Preparation and Characterization of Metal Fe Nanowires with Graded Diameter

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ABSTRACT

Based on the porous anodic aluminum oxide templates with a graded pore diameter, Fe nanowires were achieved using alternating current electrochemical deposition. SEM and TEM results show that Fe nanowires have obviously graded diameters along the nanowire's direction with gradient ranging from about 12 to 31 nm. High-resolution TEM analysis indicates that the gradient Fe nanowires have a preferential growth along <111> direction. Melting-behavior suggests that diameter-graded Fe nanowires have a graded melting point along one-dimensional direction, which will be of great fundamental and practical interests. It is expected that the ability to fabricate the gradient nanowires could open up new opportnities for fundamental studies and the application of nanostructures.

Surfactant-Assisted Growth of Multipod $In(OH)_3$ Microcrystals Via Facile Hydrothermal Process

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ABSTRACT

Multipod structures $In(OH)_3$, even more than four rod-like pods unit at the same junction, have been successfully synthesized in high yields in the presence of cetyltrimethyl-ammonium bromide (CTAB) as a surfactant via a simple hydrothermal process. The diameter of each pod of these multipod structures is quite uniform along its length, and the typical diameters of the pods range from 200 nm to 250 nm. The products were characterized by X-ray powder diffraction (XRPD), field emission scanning electron microscopy (FE-SEM) and diffused reflectance spectroscopy (DRS) spectra. It has been found that CTAB plays important roles in the formation of $In(OH)_3$ multipod structures. A possible growth mechanism is discussed.

Quantum Size Effect on the Zeeman Splitting in Polar Semiconductor Quantum Dot

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ABSTRACT

First, the subject of quantum dots together with the associated length and energy scales, the nature of the confining potential and some basic concepts like Coulomb blockade, charge quantization etc. will be introduced to emphasize the quantum nature of the problem. Then the effect of electron-phonon interactions in quantum dots and the consequent formation of polarons will be discussed. Finally, it will be shown that the Zeeman effect is suppressed in a semiconductor quantum dot in the presence of polaronic interaction and this suppression becomes strongly size dependent below a few nanometers and can be manipulated by tuning the confining potential and the gate voltage. It will also be shown that although the energy levels are split because of the spin-field interaction, the cyclotron frequencies and the Zeeman lines are independent of the spin in the dipole transition. The suppression of the Zeeman splitting due to the polaronic effect is an interesting theoretical observation which is a clear manifestation of the quantum size effect. This size-dependent Zeeman suppression should be observable through infra-red magneto-optical experiments and would give an unambiguous evidence for existence or otherwise of polarons in quantum dots. This phenomenon can also be usefully exploited to have any desired resonant absorption and may have some interesting implications in quantum dot lasers as well.

Preparation and Characterization of $CaCO_3$ Nanoparticles in a Copolymer Hydrogel Matrix

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ABSTRACT

Recently intense research efforts have been focused on the design and fabrication of the important inorganic nanoparticles. $CaCO_3$ is one such important material. We are

reporting a new and simple method for the preparation of $CaCO_3$ nanoparticles. A fairly monodispersed nanoparticles of $CaCO_3$ was obtained by using a co-polymer hydrogel matrix as the template to resist particle clustering is described. Vinyl acetate and acrylic acid have been used to form the polymer gel matrix. The nanoparticles are formed from a reaction between calcium nitrate and sodium carbonate in the gel during the polymerization process. The nanoparticles have been characterized by the XRD, AFM, SEM and TEM. The particle size of $CaCO_3$ from the powder diffractometry was found to lie between 4 and 6 nm. A systematic application of Hall-Williamson method is used here for the estimation of crystallites size of $CaCO_3$ nanoparticles and its comparison with Scherer equation that does not take into account the peak broadening due to strain. With Williamson-Hall plot the particle size was found to be 16.5 nm.

Thin-Film Packaging of High-Power LEDs by Magnetron Sputtering

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ABSTRACT

LED is called the fourth generation of lighting or green lighting. The total thermal resistance of high-power LEDs is mainly composed of the thermal resistance of the materials and the interfaces. Inefficient heat release will directly influence on the performance and life of LEDs. Thus, the issue of heat release has become the biggest obstacle to the industrialization of high-power LEDs. To solve these problems, we proposed a new thin-film packaging for high-power LEDs. We produced samples by magnetron sputtering and measured its thermal resistance with the method of dynamic electrical method. Through the simulation and experiments we found that packaging thin-film packaging has the following advantages compared with the current PCB packaging: the heat-release performance is much better than PCB packaging, and it is more applicable with simple process and lower price.

Analysis of Mechanical Performance of Silver Inkjet-Printed Structures

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ABSTRACT

We report the mechanical performance of the structure of sintered silver ink used in inkjet printing, having a particle size of 3-7 nm. Tensile adhesion pulloff testing together with the optimized related ISO and ASTM industrial standards were used. Adhesion testing of samples was performed at room temperature and in 50% relative humidity. Sintered silver ink adhesion patterns were inkjet-printed onto several substrates, i.e. PEN (Polyethylene Naphthalate), PI (Polyimide), and LCP (Liquid Crystal Polymer). To control the ink spreading surface treatment material was used and its effect on adhesion performance was investigated. To determine the effect of various sintering processes on adhesion performance, two different sintering procedures, at 250°C for 30 minutes and at 220°C for 60 minutes, were used. After the results from the initial adhesion tests had been recorded, new adhesion test samples were prepared and placed in the humidity chamber to subject them to moisture, during which the JEDEC Standard JESD22-A101-B Steady State Temperature Humidity Bias Life Test was used with a temperature of 85°C in 85% relative humidity. After this soaking, the mechanical performance of the test samples was investigated by adhesion pull-off testing and the findings noted. In addition, the test samples were subjected to tension tests using a DMA (Dynamic Mechanical Analysis) device in order to analyze the effect of the dynamic mechanical stress on them. The DMA tension tests were performed at a temperature continuously increasing from -60°C to 100°C. This testing was done on various inkjet-printed silver patterns. In this paper, the results of adhesion pull-off and of DMA testing are presented separately and the effect of each parameter on the mechanical performance of the inkjetprinted silver patterns is discussed.

Keywords: Inkjet printing, nanomaterials, printable electronics, adhesion, pull-of strength, tensile test, humidity test.

Fabrication of Nano-Structured VO_x Film by Low Temperature Ion Beam Sputtering and Reductive Annealing

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ABSTRACT

VO_x thin films have been fabricated by low temperature ion beam sputtering and post reductive annealing process. Semiconductor-metal phase transition is observed for the film annealed at 400°C for 2 hours. The film also shows a polycrystal structure with grain size from 50 nm to 150 nm. The VO_x thin films fabricated by this process have a TCR up to -2.7% at room temperature. Our results indicate a promising fabrication method of the nano-structured VO_x film with relatively high TCR and semiconductor-metal phase transition.

A Simple Method to Fabricate Silicon Nanowires Arrays by a Catalytic Electrochemical Etching Process

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ABSTRACT

We present a simple method to fabricate large area of silicon nanowires array with low-cost and throughput by a catalytic electrochemical etching process. In our experiment, a thin layer of polyelectrolyte (PAH) was used to absorb negatively charged PS sphere. Using the PS sphere as mask, the silicon nanowires arrays were fabricated by a silver catalytic electrochemical etching process. By SEM and Raman spectrum, the structure and properties of silicon nanowires arrays were also studied.

New High Charge Density Polymers for Printable Electronics,
Sensors, Batteries, and Fuel Cells

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ABSTRACT

Bulk and solution polymerization of reactive ionic liquid surfactants (RILSs) yield easily engineered advanced polymers that can be tailored for diverse applications. Introductory results based upon an RILS composed of an amphiphilic imidazolium acrylate (IL) and a 2-acryloamido-2-methyl-propylsulfonate (AMPS) are illustrated for humidity sensitive preparations suitable for chemFETs, for proton conducting polymer electrolyte membranes (PEM) suitable for fuel cell fabrication, for lithium ion and silver ion conducting membranes suitable for fast ionic conducting batteries, and for high-k dielectrics based on in situ reduction of incorporated ionic silver.

Characterization and Photocatalytic Activity of Pd-doped ZnO Nanoparticles Synthesized by Flame Spray Pyrolysis

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ABSTRACT

Flame spray pyrolysis (FSP) was employed to synthesize the pure ZnO and palladium (Pd)-doped ZnO nanoparticles containing 0.25, 0.50, 0.75 and 1.0 mol% Pd. Pd is one of the most versatile and most widely applied as catalytic metal. Precursor solutions of zinc naphthenate and palladium (II) acetylacetonate were sprayed and combusted, resulting in crystalline and nanostructured particles. The crystalline phase, morphology and size of the nanoparticles were characterized by X-ray diffraction (XRD) and transmission electron microscopy (TEM). The specific surface area of the nanoparticles was measured by nitrogen adsorption (BET analysis). The ZnO nanoparticles were observed as particles having the clear spheroidal, hexagonal and rod-like morphologies. The accurate sizes of these nanoparticles were in the range of 5-25 nm. The elements dispersion was determined by a mapping mode of scanning-transmission electron microscopy (STEM). The photocatalytic activity of ZnO samples were investigated by UV-induced degradation of methanol, glucose and sucrose in aqueous solutions in a photocatalytic reactor. The results showed that the photocatalytic activity of all Pd-doped ZnO nanoparticles were better than that of pure ZnO nanoparticles. In addition, 0.5 mol%Pd-doped ZnO nanoparticles showed the fastest response to the degradation of methanol, glucose and sucrose.

Keywords: Characterization; Flame Spray Pyrolysis; Nanoparticles; Pd-doped ZnO; Photocatalytic Activity.

Raman Spectroscopy in Aluminum-Doped Zinc Oxide Nanorods

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ABSTRACT

Aluminum-doped zinc oxide nanorods are deposited on glass by solution chemical for the first time. The as-grown samples are characterized by scanning electron microscopy (SEM), X-ray diffraction (XRD), UV-Vis spectroscopy and Raman spectroscopy. We observe that Raman spectroscopy of aluminum-doped zinc oxide nanorods is different from un-doped zinc oxide nanorods. The intensity of Raman peak at 437 cm^{-1} is decreased for aluminum-doped zinc oxide nanorods sample while peak at 750 cm^{-1} appears. X-ray diffraction (XRD) shows aluminum-doped zinc oxide nanorods grown in

the (002) orientation. UV-Vis spectroscopy shows no difference in the aluminum-doped zinc oxide nanorods than undoped zinc oxide nanorods.

Effect of Ion Beam Irradiation on Palladium (II) Acetyl Acetonate Dispersed in Polymer Matrix

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ABSTRACT

Composites with organometallic filler and insulating polymer matrix have been prepared by vigorous mixing of Palladium (II) acetylacetonate [Pd(acac)] and Polymethyl methacrylate (PMMA). PMMA was prepared by solution polymerization technique. Different concentration (viz 10 and 30%) of organometallic compound [Pd(acac)] was dispersed in PMMA. The composites were irradiated with 120 MeV Ni^{10+} beam at different fluences i.e. 1×10^{11} and 1×10^{12} ions/cm^2 to study ion induced effects on dielectric, structural properties and surface morphology of the composites. AC electrical properties of these samples have been studied in the frequency range of 100 Hz to 10 MHz. The results show that the conductivity increases with the increase of metal concentration as well as with the ion fluence. The dielectric permittivity/loss shows frequency dependant behavior and it obeys the Universal law of dielectric (i.e. $\Sigma \alpha f^{n-1}$) for pristine and irradiated samples at high frequency. The value of the dielectric permittivity is observed to increase with fluence and also with metal compound concentration. The crystalline size of metal compound was studied by X-ray diffraction (XRD). It is observed that crystalline size decreases from 24 nm to 19.9 nm and 24.8 nm to 20.6 nm for 10% and 30%Pd respectively and after irradiation. Surface morphology was studied by scanning electron microscopy (SEM). It is observed that average surface roughness changes with filler concentration and irradiation.

Initial Growth of Conducting Island-Like Structure on Insulating Polymer Substrate

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ABSTRACT

Using ultrasharp conductive tip atomic force microscopy (c-AFM), we have measured the current voltage (I-V) characteristics of titanium ions implanted into polystyrene thin film spin coated onto silicon substrate. The surface morphology and the electric current between the tip and sample have been obtained simultaneously on the nanometer scale. Initial island-like growths structures were observed and are comparable with implantation time while surface energy and thermodynamics theory allowing the initial stages of film growth to be explained. Our conductivity measurements showed that there are conducting channels, forming of conducting island-like structures surrounded by the pool of insulator polystyrene. The conducting channel or island-like structures on polymer substrate can be a good candidate for the future of nano-plastic-electronics devices.

Controlled Synthesis, Characterization and Magnetic Properties of Magnetite (Fe_3O_4) Nanoparticles without Surfactant Under N_2 Gas at Room Temperature

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ABSTRACT

In this study, synthesis of monodispersed magnetite (Fe_3O_4) nanoparticles was conducted by chemical solution technique under N_2 gas at ambient temperature. Controlled co-precipitation technique was used to prevent undesirable critical oxidation of Fe^{+2}. The powder samples were characterized by the commonly used bulk techniques of scanning electron microscope (SEM), transmission electron microscope (TEM), Fourier transform infra-red (FTIR), X-ray diffraction (XRD), vibrating sample magnetometer (VSM) and BET analyses. SEM was used to observe agglomeration state of the powder. Size and morphology of the precipitated crystallites were examined with TEM. The functional groups present in the synthesized powder were ascertained by FTIR investigations. The pure magnetite and other phases according to processing parameters were observed by XRD analysis. The magnetic properties of Fe_3O_4 nanoparticles were examined with VSM. Finally, the specific surface area of nanoparticles was measured by BET technique. The results indicated that smaller particles can be synthesized by increasing velocity and decreasing the NaOH concentration, which in our case this corresponded to ~40 nm using 0.9 M NaOH at 750 rpm. The vibrating sample magnetometer (VSM) tests showed a saturation magnetization range of (82–96 emu/g) and coercivity of (161–206 Oe) for particles between (35–96 nm) respectively. Also, the highest specific area of 41 m^2/g was obtained at 0.9 M NaOH at 750 rpm and the smallest value of 15 m^2/g at 1.5 M of NaOH at 450 rpm using BET tests.

Nanostructured Materials: Recent Developments of Materials Science

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ABSTRACT

Nanocrystalline materials are three-dimensional solids composed of nanometer sized grains or crystallites. Because of their unique structure, which is characterized by ultra fine grains and a rather high density of crystal lattice defects, these materials have extra ordinary fundamental properties that could be exploited to make '*next-generation super strong materials*'. Strength and ductility are the central mechanical properties of any material. They are determined by the physical nature of plastic deformation, which in conventional, coarse-grained metals is mainly carried by dislocations-line defects of regular crystal lattice-within individual grains. Study suggest, however, that the mechanism of plastic deformation in nanocrystalline materials may be different and so may lead to novel mechanical properties.

The Influence of Operating Temperature on the Barrier Height of ZnO Gas Sensors

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ABSTRACT

Pt/ZnO contact has been fabricated by RF reactive sputtering of Zn metal for gas sensing applications. The current-voltage characteristics of the device was studied as a function of operating temperature in the range of room temperature to 400°C. The operating temperature was found to enhance the output current of the device resulting in the

maximum output current at operating temperature of 400°C. The value of ideality factor was decreased with operating temperature from 3.28 to 2.18. The estimated barrier height of the contact was increased from 0.66 eV to 1.53 eV as the operating temperature increased in the operating temperature range of 22°C to 400°C. The calculated Richardson constant was found to be much lower than that of the theoretical value.

Evaluation of the Toxicity of CdSe and CdSe/CdS Quantum Dots Aqueously Synthesized by Ultrasound-Assisted Method

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ABSTRACT

We have aqueously synthesized Water-soluble, stable, and small-size CdSe and CdSe/CdS quantum dots (QDs) by ultrasound-assisted method. The photoluminescence quantum yields of CdSe/CdS core-shell quantum dots were up to 30%, larger than the original CdSe by around 3 times. The nano size of CdSe/CdS QDs was about 5.0 nm. The cytotoxicity of as-prepared CdSe and CdSe/CdS QDs was evaluated in several cell models (including HL-7702,Bel-7404,Bel-7402,786-O, Hela and C6) by MTT viability assay. From 50μg/ml to 200 μg/ml, the CdSe QDs have no cytotoxicity on HL-7702,Bel-7402,Bel-7404, the death ratios of CdSe QDs on Hela and 786-o were below 30%, the cytotoxicity of it on C6 cells was in evidence, the LC_{50} (median lethal concentration) was 108.96μg/ml. The cytotoxicity of the CdSe/CdS QDs was obviously higher than CdSe QDs on all 6 cell lines, the LC_{50} was from 20.09(C6) to 112.50(Bel-7402) μg/ml. The flow cytometry, AO staining and the fluorescence images showed that they may be cytotoxic by their influence in S phase and G2 phase in cell cycles. The RBC hemolysis assay showed that CdSe QDs and CdSe/CdS QDs had no hemolytic toxicity from 100μg/ml to 500μg/ml. The LD_{50}(median lethal dose) of acute toxicity of CdSe/CdS QDs in mice was 15.91 mg/kg bw, and the 95% creditable region of LD_{50} was 14.81-17.01 mg/kg bw. The intoxication symptoms and fluorescent images of the organs showed that the target organs may be the lung and the heart. After 14d, the CdSe/CdS QDs could be almost discharged.

A Novel Ultrasound-Assisted Method for the Aqueous Synthesis of Highly Fluorescent CdSe and CdSe/CdS Quantum Dots

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ABSTRACT

A novel method for the synthesis of water-soluble small-size CdSe and CdSe/CdS quantum dots (QDs) under high-intensity ultrasonic irradiation has been reported. In this study CdSe nanoparticles capped by CdS were synthesized in the aqueous solution under an atmosphere of N_2 where ultrasound can activate the reaction among sodium sulfite and selenium and cadmium source, and later favor formation of a CdS shell on each CdSe core. Optical absorption and fluorescence emission spectra were used to probe the effect of CdS passivation on the electronic structure of the quantum dots. The photoluminescence quantum yields of CdSe/CdS core-shell quantum dots were up to 30%, larger than the original CdSe by around 3 times. The result showed that the products were well formed which have been characterized by X-ray powder diffraction (XRD) and high-resolution transmission electronmicroscopy (HRTEM). The results also revealed that as-prepared CdSe/CdS QDs were about 5.0 nm with narrow size distribution. We also performed cell viability assay to determine the difference in cell damage depending on the concentration of the QDs and the cell types and found that there is a range of concentration of QDs where the cell viability decreased and the viability decrease varied according to different cells.

Preparation and Characterization of Iodine-Doped TiO_2

Nanoparticles and Evaluation of Their Photocatalytic Activities

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ABSTRACT

Iodine-doped TiO_2 nanoparticles were synthesized by sol-gel method. The prepared samples were characterized by XRD, UV-visible spectroscopy, Raman, BET, XPS and electrochemistry analyses. It is evident from BET analysis that after doping with iodine, the surface area of TiO_2 increases dramatically. Raman analysis that amount of surface oxygen deficiency in the samples varied with calcined temperature. The photocatalytic activities were evaluated by the photodegradation of methyl orange under visible irradiation and showed that the iodine-doped TiO_2 samples have higher photocatalytic activity than pure TiO_2. By investigation the crystal structures, optical properties, surface structure and photocatalytic activity of various samples, we presume the surface oxygen vacancies and large effective surface area contributed to the visible light activity.

Preparation and Characterization of Magnetic Carboxymethyl Chitosan/Fe_3O_4 Composite Nanoparticles

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ABSTRACT

Monodisperse carboxymethyl chitosan-bound Fe_3O_4 magnetic nanoparticles can be potentially used as drug delivery carrier and a novel magnetic nano-adsorbent for the removal of pollutants from aqueous solutions. In this paper, the magnetic chitosan nanoparticles of about 20 nm were prepared by the carboxymethylation of chitosan and the followed binding on the surface of Fe_3O_4 nanoparticles which were prepared using a coprecipitation method. The images of transmission electron microscope showed that the magnetic iron oxide particles were encapsulated by the spherical chitosan nanoparticles. XRD indicated that the magnetic component of the composite nanoparticles were

validated as Fe_3O_4. FTIR spectra confirmed the carboxymethyl reaction of chitosan and the binding of carboxylmethyl chitosan on Fe_3O_4. The saturated magnetization of composite nanoparticles could reach 25.7 emu/g. Meanwhile, the nanoparticles showed the characteristics of superparamagnetism.

Photon-in/Photon-out Soft-X-Ray Spectroscopy in Characterization of Self-Assembled Nanocrystals

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ABSTRACT

The ability to control the particle size and morphology of nanoparticles is of crucial importance nowadays both from a fundamental and industrial point of view considering the tremendous amount of high-tech applications of nanostructured *3d* metal compounds in the applications of solar photovoltaic and photoelectrochemical cells, chemical, gas and biosensors, supercapacitors etc. Controlling the crystallographic structure and the arrangement of atoms along the surface of nanostructured material will determine most of its physical properties.

In general, electronic structure ultimately determines the properties of matter. In the soft X-ray region, the question tends to be, what are the electrons doing as they migrated between the atoms? Soft-X-ray absorption spectroscopy (XAS) and emission spectroscopy (XES) have some basic features that are important to consider [1,2]. X-ray is originating from an electronic transition between a localized core state and a valence state. As a core state is involved, elemental selectivity is obtained because the core levels of different elements are well separated in energy, meaning that the involvement of the inner level makes this probe localized to one specific atomic site around which the electronic structure is reflected as a partial density-of-states contribution. The participation of valence electrons gives the method chemical state sensitivity and further, the dipole nature of the transitions gives particular symmetry information.

The new generation synchrotron radiation sources producing intensive tunable monochromatized soft-X-ray beams have opened up new possibilities for soft-X-ray spectroscopy. The possibility to select the energy of the excitation has created an extra degree of freedom. The high-resolution selectively excitation has opened a new field of study by disclosing many new possibilities of soft-X-ray resonant inelastic scattering (RIXS). In this presentation, some recent findings regarding XAS, XES, and RIXS studies of various nanostructured systems are presented [3–5]. The results reveal the electronic structure of the *3d* metal compounds of TiO_2, Fe_2O_3, and ZnO in their pure form and their variations upon doping. Also, in-situ characterization of Co nanocrystal suspensions

demonstrated the way for real-time studies of nanomaterial growth and chemical reactions [6–8].

References:

[1] J.-H. Guo, "Synchrotron radiation, soft-X-ray spectroscopy and nanomaterials", Int. J. Nanotechnology, vol. 1–2, pp. 193–225 (2004).
[2] J.-H. Guo, chapter 9 "X-ray Absorption and Emission Spectroscopy in Nanoscience and Lifescience", in *"Nanosystem Characterization Tools in the Life Sciences",* Challa S. S. R. Kumar (ed.), Wiley-VCH, (2006).
[3] A. Augustsson, A. Henningsson, S. M. Butorin, H. Siegbahn, J. Nordgren, and J.-H. Guo, "Lithium ion insertion in nanoporous anatase TiO_2 studied with RIXS", J. Chem. Phys. 119, 3983 (2003).
[4] C. L. Dong, C. Persson, L. Vayssieres, A. Augustsson, T. Schmitt, M. Mattesini, R. Ahuja, C. L. Chang, and J.-H. Guo, "Electronic structure of nanostructued ZnO from x-ray absorption and emission spectroscopy and local density approximation", Phys. Rev. B *70*, 195325 (2004).
[5] L. Vayssieres, C. Såthe, S. M. Butorin, D. K. Shuh, J. Nordgren, and J.-H. Guo, "One-Dimensional Quantum Confinement Effect in α-Fe_2O_3 Ultrafine Nanorod Arrays", Adv. Mater. *17*, 2320 (2005).
[6] J.-H. Guo, Y. Luo, A. Augustsson, J.-E. Rubensson, C. Såthe, H. Ågren, H. Siegbahn, and J. Nordgren, "X-ray Emission Spectroscopy of Hydrogen Bonding and Electronic Structure of Liquid Water", Phys. Rev. Lett. 89, 137402 (2002).
[7] J.-H. Guo, Y. Luo, A. Augustsson, S. Kashtanov, J.-E. Rubensson, D. K. Shuh, H. Agren, and J. Nordgren, "The molecular structure of alcohol-water mixtures", Phys. Rev. Lett. 91, 157401 (2003).
[8] H. J. Liu, J.-H. Guo, Y. D. Yin, A. Augustsson, C. L. Dong, J. Nordgren, C. L. Chang, P. Alivisatos, G. Thornton, D. F. Ogletree, F. G. Requejo, F. de Groot, and M. Salmeron, "Electronic Structure of Cobalt Nanocrystals Suspended in Liquid", Nano Lett. 7 (7), 1919 (2007).

Ion Beam Irradiation of High-Temperature Superconductors: From Nano-Size Defects to the Fabrication of Nanodevices

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ABSTRACT

Ion-beam irradiation of high-temperature superconductors creates different types of defects depending on ion mass, energy and dose. Computer simulations reveal the diversity of the ion-target interactions with $YBa_2Cu_3O_7$ and are compared to previous experimental results from transmission electron microscopy and electrical transport properties. While protons have a very low efficiency to create defects in $YBa_2Cu_3O_7$, significantly heavier ions produce defect clusters and inhomogeneous damage in the target material. On the other hand, He^+ ions with energy of about 75 keV do not implant into 100-nm thick films of YBa2Cu3O7 but primarily create point defects by displacement of the oxygen atoms. Such defects are very small and distributed homogeneously in $YBa_2Cu_3O_7$. The small lateral straggle of the collision cascades allow for the patterning of nanostructures by directing a lowdivergence beam of He^+ ions onto a thin film of $YBa_2Cu_3O_7$ through a mask. Features with about 60 nm size have been produced and observed by transmission electron microscopy.

Preparation, Characteristic and Effect of Annealing Temperature of Low Voltage ZnO Film Varistor

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ABSTRACT

ZnO thin films were deposited by means of gas discharge active reaction evaporation through at relatively lower temperatures. XRD and AFM patterns showed that the film with average size of crystal grains about 50 nm was highly c-axis oriented. The mechanism behind the effect of annealing temperature on varistor characteristics of ZnO thin films was also discussed.

Keywords - Low voltage; ZnO thin film varistor; structure; nonlinear coefficient;

Ball Milled MgH_2+ 5%wt. M (M=Fe and FeF_3) Nanocomposites for Improving Hydrogen Storage

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ABSTRACT

Magnesium hydride ball milled nanocomposites was prepared separately using vibratory and planetary ball milling devices under argon atmosphere, mixing with 5%wt. Fe and FeF_3 to improve the kinetics of H-sorption without reducing the high hydrogen storage capacity. Morphology, structural and thermal characterization of the MgH_2 composites was performed using XRD, SEM and simultaneous TG and DSC techniques. The X-ray diffraction patterns reveal the presence of mainly tetragonal β-MgH_2, Fe, FeF_3 and some peaks of meta-stable γ-MgH_2. The peaks intensity of the γ-MgH_2 phase increases and the peak intensities of Fe and FeF_3 decrease when increasing milling time, indicates physical and chemical transformations of MgH_2 and the catalysts during the milling process. The magnesium hydride milled with the catalyst release hydrogen in two stages, which occurs in different temperatures, depending on the catalysts, type of milling devices and duration of milling. MgH_2 develops uniform distribution and similar microstructures when it mixes with the catalyst during the vibratory milling process. The catalyst powders are broken up to the fine particles during the planetary milling and are well distributed over the MgH_2 matrix. Electrochemical study of hydrogen charge-discharge process in MgH_2 provides distinct information on thermodynamic and kinetics of the MgH_2-catalyst system. The potentials of the absorption and desorption were showed a good reversibility, indicating the product was significantly activated due to the catalytic effects.

Correlation Between Functional Group and Dielectric Properties of Structure-Polarized Nanohybrids

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ABSTRACT

Three hybrid nanomaterials (MST, VST and GST) based on (3-methacryloxypropyl)-silsesquioxane (MS), Vinyl- silsesquioxane (VS), (3-glycidoxypropyl)-silsesquioxane (GS) and modified with tetraethoxysilicate (TEOS) were prepared using hydrolytic condensation. The dielectric constant (ε_r) testing profiles of MST, VST and GST with 0, 5, 10, 15, 20 and 25 wt-% TEOS can be divided into three frequency ranges (0.10-21.54, 21.54-100.00 and 100.00-1000.00 KHz). MST has the lowest ε_r due to the larger-sized methacryloxy groups and GST has the highest ε_r due to the ring-opening of the epoxy groups. The influence of the TEOS fractions of MST, GST and VST on the ε_r values and surface morphology was also analyzed.

Research of Mechanical Properties of a Cu Micro/Nano Rod Material Based on the Shape of *Nocadia*

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ABSTRACT

The functional groups and mechanical properties of *Nocadia* before and after metallization are determined by fourier transform infrared spectroscopy (FT-IR) and nanoindentation technology. *Nocadia* is a kind of rod-shaped bacteria with submicrometer in diameter and 3-10 mm in length. The group-COOH exists on surface of *Nocadia* before metallization and the function groups of *Nocadia* decreases after metallization. The elastic modulus of metallized *Nocadia*, *Nocadia* and resin is 42.583GPa, 9.501GPa and 5.723GPa, respectively. The hardness is 1.940GPa, 0.265GPa and 0.301GPa, respectively. There is a great improvement in elastic modulus and hardness compared with those of bare *Nocadia*. This is due to a powerful mechanical foundation supplied by the Cu metallization layer.

Keywords: Metallized *Nocadia*, Mechanical properties, FR-IR, Nanoindentation

Rational Design of Molecular Self-Assemblies: A Platform for NanoTechnology

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ABSTRACT

In order to create surface patterns, planar molecules with extended π-conjugated systems have found particularly wide use because they tend to bond in a flat-lying geometry, which allows functional groups at the molecule periphery to approach each other easily and to engage into noncovalent interactions, predominantly hydrogen bonds [1]. In this work, we developed an original approach, based on a new molecular unit designed both in order to act as a functional group used as a 'clip' between neighboring molecules, and to pattern 2D supra-molecular architectures into specific arrangements. The opportunity to reach multiple and tunable topologies is evidenced by using scanning tunneling microscopy (STM). All these results allow to establish molecularengineering rules for designing new nanostructures, opening interesting perspectives for applications in various domains of nanotechnology such as nanoelectronics.

Carbon Nanotube/Nanosphere Composite

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ABSTRACT

Outstanding and different properties of carbon nanotubes (CNT) and amorphous carbon (a-c) motivates the investigation on CNT/DLC composites. In this research, we investigate on synthesis, characterization and hydrophobic properties of CNT/a-c nanosphere composites. Filtered Cathodic vacuum arc (FCVA) technique was used to deposit the a-c nanospheres on the CNT films which were deposited onto a silicon substrate by plasma enhanced chemical vapor deposition (PECVD). X-ray photoelectron spectroscopy (XPS), was used to measure SP^2/SP^3 ratio of amorphous carbon nanospheres. Results show that the SP^2/SP^3 ratio can be controlled by controlling the deposition parameters. Static contact angle measurement reveals that this new carbon nanostructure exhibit controllable superhydrophobic properties. This is mainly due to unique structure of the material which combines the Wenzel and Cassie model which results in a superhydrophobic surface. Moreover, controlling the geometry of the structures controls the Wenzel to Cassie transformation and a unique Cassie superphobic structure is achieved.

Temperature Characteristics of Polysilicon Piezoresistive Nanofilm Depending on Film Structure

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ABSTRACT

The influence of film structure on temperature characteristics of polysilicon nanofilms (PSNFs) was reported in this paper. Samples were deposited by LPCVD with different film thickness and deposition temperature. The microstructure of films was characterized by SEM, TEM and XRD. By measuring the resistivity and the gauge factor of samples at different temperatures, temperature coefficients of the resistance and the gauge factor (TCR and TCGF) were investigated. Based on the analysis of tunneling piezoresistive effect, the results indicated that PSNFs of ultrahigh doping concentration (around $3\times10^{20}cm^{-3}$) have better piezoresistive temperature characteristics than single crystal silicon. By controlling the process parameters like deposition temperature and film thickness, film structure was optimized to obtain a very low resistance temperature coefficient (about $\pm10^{-4}$/°C. Moreover, TCGF was negative and almost not affected by deposition temperature and film thickness. These conclusions are useful for temperature compensation of polysilicon pressure sensors.

Comparison of the Structure and Properties Between the *Cladophora* and *Spirogyra* Filamentous Macroalga

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ABSTRACT

Algae is well known as a food source, and in recent years has been derivatized for a variety of biochemical applications. Algae can grow as single cells or as filaments. They may attach to any number or substrates. Algae may contain significant amounts of crystalline cellulose as a structural component on the cell walls. The cellulosic algal filaments may be useful as a replacement for existing synthetic fibers used for the production of composites. Both *Cladophora* genus and *Spirogyra* genus are green filamentous macroalga, are widely distributed in many parts of world. In this paper, the green algae obtained from freshwater rivers have been characterized. The structure of the algal fibers has been examined through optical and scanning electron microscopy. In this contribution, the structure properties of the 2 genuses filamentous macroalga have been investigated and compared.

Synthesis of Nano-Sized Powders of Transparent Conductive Aluminum-Doped Zinc Oxide by Electrolysis-Modified Co-Precipitation Method

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ABSTRACT

Nano-sized powders of transparent conductive aluminum-doped zinc oxide (AZO) have been successfully prepared by electrolysis-modified co-precipitation method. By adding ammonium hydroxide into the precursor solution prepared by electrolytic dissolution of zinc metal in a buffered electrolyte solution of nitric acid and ammonium nitrate with adequate addition of aluminum nitrate, co-precipitate precursors of AZO with particle size between 30 to 60 nm were produced. After washing, filtering, and drying of the co-precipitates, nano-powders of AZO with wurtzite structure were produced when the dried co-precipitate precursors were calcined at temperature above 800°C. By aging at pH = 5 and co-precipitating at pH = 8.0, the atomic ratio of Al/Zn of the nano-powders could be maintained throughout the synthesis. After calcining at 1000°C in air for 2 hours, nano-sized powders of AZO with ZnO wurtzite structure and particle size between 200 to 500 nm were synthesized. Finally, it was found that both the particle sizes of

co-precipitate precursors and calcined nano-powders of AZO could be decreased by increasing the pH of the electrolyte solution for electrolytic dissolution.

Low Temperature Deposited Nano-Structured Vanadium Oxide Thin Films for Uncooled Infrared Detectors

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ABSTRACT

A novel process of room temperature ion beam sputtering deposition of vanadium oxide films and low temperature post annealing for uncooled infrared detectors was proposed in this work. VO_x thin films with relatively low square resistance (70 KΩ/□) and large temperature coefficient of resistance (more than 3%/K) at room temperature were fabricated using this low temperature process which was very compatible with the process of uncooled infrared detectors based on micromachined technology. Furthermore, chemical composition and film surface have been characterized using X-ray photoelectron spectroscopy (XPS) and scanning electron microscopy (SEM) respectively. The results showed that the main composition of the processed thin films was V_2O_5 and the thin films were in the process of crystallization.

Al Nanocluster Arrays on *Si(111)-7×7* Surfaces: Formation

Process and Interactions Between Nanoclusters

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ABSTRACT

Due to potential applications in nanocatalysis, optical and electronic devices, and quantum computing and cryptography, fabricating large-scaled and highly-ordered metal nanocluster arrays on solid surfaces has been an intensively attractive topic. Recently, identically-sized metal cluster arrays have been fabricated on technically important *Si(111)* surfaces. Especially for the case of *Al[1,2]*, nanoclusters occupy both faulted half unit cells *(FHUC)* and unfaulted half unit cells *(UFHUC)* of the *Si(111)-7×7* surface and form large-scaled 2D honeycomb lattices with few defects, so-called nanocluster crystals, which can be possibly used as a perfect artificial interface or template for fabricating functionalized large-scaled metal cluster arrays or single molecule arrays. The atomic structure model of such metal nanoclusters has been proposed theoretically based on scanning tunneling microscopy *(STM)* observations. Each *Al* nanocluster consists of six *Al* adatoms and three *Si* edge adatoms which are displaced toward the center of the Si *(111)-7×7* half unit cells. However, the underlying growth mechanism of such metal nanocluster arrays remains unclear as yet.

Fabrication of a ZnO nanocrystals/Polyimide

Hybrid Material

and Investigation of its Memory Effect

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ABSTRACT

ZnO nanocrystals (NCs)/Polyimide (PI) hybrid material was fabricated by chemically decomposition of the complex formed between Zn and the PI precursor, polyamic acid (PAA). The memory effect of this hybrid material was also investigated based on results of Capacitance-voltage (C-V) measurements.

A 10 nm thick Zn film was sputtered onto a Si substrate by DC magnetron sputtering, and then the Zn-PAA complex was formed by spin coating of a p-phenylene biphenyltetracarboximide (BPDA-PDA) type PAA in N-methyl-2-pyrrolidone (NMP) solution. The Zn-PAA complex was decomposed by immersing the specimen into a chemical curing agent formed by a dehydration agent and a catalyst, ZnO NCs were formed accompanying by the transformation of PAA into PI.

Transmission electron microscopy (TEM) observation showed that the size of the ZnO NCs embedded in the PI film is about 4 nm in diameter. However, the selected area electron diffraction (SAD) pattern is not so sharp, indicating the ZnO nanocrystals were not well crystallized. For this reason, thermal treatment (TT) of the hybrid material was performed in an nitrogen ambient at 150°C for 1 hour, subsequent TEM and SAD characterization showed that the size of the NCs increased to about 6 nm in diameter accompanying by the increasing of NCs density; at the same time, the SAD pattern became sharper due to improvement of the ZnO crystallization.

An Al/ZnO NCs/PI/p-Si structure was fabricated by evaporation of Al onto the hybrid material obtained before. Room temperature C-V measurement of this structure showed a clear hysteresis, indicating the existence of sites occupied by electrons and the presence of these sites due to the quantum-confinement effect of ZnO NCs embedded in the PI film. The magnitude of the voltage shift increased when the applied voltage increased from the range of −5V~+5V to −15V~15V, and the voltage shift seem to become saturated when the applied voltage was continuously increased. At the same time, the Al/ZnO NCs/PI/p-Si structure with thermal treatment showed a bigger voltage shift compared with that one without thermal treatment, one explanation for this is that thermal treatment affected the size, density and crystallization of ZnO NCs embedded in the PI film.

These results showed that the ZnO NCs/PI hybrid material has a memory effect and hold a promising application in nonvolatile flash memories area.

Acknowledgement

This research was supported by a grant(code #: 07K1501-02510) from 'Center for Nanostructured Materials Technology' under '21st Century Frontier R&D Programs' of the Ministry of Science and Technology, Korea

References

[1] J.H. Jung, J.Y Jin., I. Lee, T.W. Kim, H.G. Roh, Y.H. Kim, Appl. Phys. Lett, 88 (2006) 112107.
[2] J.H. Jung, J.H. Kim, T.W. Kim, M.S. Song, Y.H. Kim, Appl. Phys. Lett. 89 (2006) 122110
[3] S.K. Lim, C.S. Yoon, C.K. Kim, Y.H. Kim, J. Phys. Chem. B 2004, 108, 18179-18184

Fabrication and Characterization of Tin-Oxide Nanoplates and Nanodiskettes in a Thermal Chemical Vapor Deposition Process

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ABSTRACT

Functionality low-dimensional metal-oxide nanostructures have attracted great attentions due to their unique applications in electronic/optoelectronic devices. Recently, one-dimensional (1D) and two-dimensional (2D) semiconducting metal-oxide nanomaterials such as ZnO, SnO_2 and In_2O_3 based nanowires, nanorods, nanosheets and nanowalls have been extensively investigated. In contrast, compared to 1D nanostructures, two-dimensional (2D) nanostructures of metal-oxide semiconductors have been relatively little explored and require further investigation due to difficulty in controlling the nucleation and growth. Recently, 2D nanostructures such as nanosheets, nanoplates, and nanowalls have become a new and interesting focus in nanoscience and nanotechnology research communities. Due to the high surface-to-volume ratio of 2D nanostructures, the potential for applications in sensors for chemical and biological species, energy-storage devices, and photovoltaic devices is high.

In this paper SnO-based 2D nanostructures such as nanoplates and nanodiskettes were successfully synthesized on ITO-coated glass and SiO_2/Si (001) substrates in a thermal chemical vapor deposition method. SnO nanoplates and nanodiskettes were synthesized on ITO-coated glass and SiO_2/Si (001) substrates using a pure tin oxide (99.99% SnO) powder via a vapor-solid mechanism at low temperature of 400 ~ 500°C was realized. We could confirm that the SnO nanoplates with no planar defects and structural uniformity are of ±(110) and ±(110) preferred growth direction as well as a single-crystalline tetragonal structure with HRTEM and FFT studies. In addition, we were confirmed that the gas sensing properties of SnO nanoplates have high sensitivity.

Low Dielectric Constant and Hydrophobic Nanoporous Silica Films

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ABSTRACT

A novel route to prepare low-dielectric constant mesoporous SiO_2 films is reported in this paper. Silicate sols are prepared with the precursor TEOS and template CTAB catalyzed by hydrochloric acid. The films are prepared by dip-coating process. FTIR, XRD and AFM are used to characterize the films. The dielectric constants are measured by impedance analysis apparatus. The films with dielectric constants smaller than 2.2 can be acquired by adjusting the concentration of CTAB and aging time.

Keywords: low dielectric constant; films; hydrophobic.

Effect of Pressure on Nanocrystalline Diamond Films Deposition by Hot Filament CVD Technique from $CH_4/H_2/Ar$ Gas Mixture

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ABSTRACT

The effect of pressure on the deposition of nanocrystalline diamond (NCD) films in a hot filament chemical vapor deposition (HFCVD) system was investigated using $CH_4/H_2/Ar$ gas mixture. The reactor pressure was found to have the strongest influence on nucleation of nanocrystalline diamond films. The range of Ar concentration in the $CH_4/H_2/Ar$ mixture that permits the deposition of nanocrystalline diamond (NCD) film at 40 torr is 90%, while the Ar concentration needed for the transition into nanocrystalline diamond phase is 50% at 5 torr. Such pressure dependence of the nanocrystalline diamond film growth is suggested to result from two competing effects of pressure on the concentration of reactive species near the film growth surface, and the C_2 density at lower pressure (5 torr) is higher than that at high pressure (40 torr) at the same Ar concentration.

Nanostructured Silicon Thin Films Prepared by Layer-by-layer Deposition Technique

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ABSTRACT

Nanostructured silicon thin films prepared by layer-by-layer deposition technique were studied. The films were grown at different deposition conditions such as radio-frequency (rf) power, hydrogen to silane flow-rate ratio and substrate temperature. The effect of these deposition conditions on the surface morphology, hydrogen bonding property and

crystallinity of the films were studied. These properties were investigated using field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM), Fourier transform infrared spectroscopy (FTIR), micro-Raman spectroscopy and X-ray diffraction (XRD). The results showed various morphological features of nanostructured silicon thin films which consist of clusters of nanocrystallites surrounded by grain boundaries. Raman results showed the presence of crystalline phase in these films which was contributed by the nanocrystallites. FTIR results demonstrated presence of $Si\text{-}H_2$ bonds which we believe were present in the grain boundaries separating the nanocrystallites from each other in the clusters and also Si-H bonds which were present in the amorphous phase separating the clusters.

Fabrication of CNT Interconnect Structures and Active Devices Using Laser Beam Manipulation and Deposition

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ABSTRACT

A maskless and non-invasive technique based on optical trapping is used for the direct writing of CNT patterns on Si wafers. Interconnections and active transistor devices are fabricated at room temperatures using this technique.

Fabrication of SWNT Device by Self-Assembly Technology

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ABSTRACT

The single-walled carbon nanotubes (SWNTs) were randomly deposited on pre-treated silicon substrate by a self-assembling method. By this method, the SWNTs film with uniform distribution and random structure were formed and the density of SWNTs could be controlled by the concentration of the SWNTs suspension and the assembling time. Also, Cr interdigitated electrodes were patterned on the assembled SWNTs by traditional lift-off process. The results show that SWNTs films made by self-assembly can adhere firmly to the substrate.

Multi-Walled Carbon Nanotubes Under N Ion Beam Irradiation

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ABSTRACT

The multi-walled carbon nanotubes (MWCNTs) irradiated by N ion beams at different temperatures were investigated. At the irradiation dose of 1×10^{17} ions/cm^2, the MWCNTs completely became amorphous at room temperature. The amorphous carbon of the N ion irradiated MWCNTs could be evaporated by 5 KeV focused electron beam irradiation. That is, the irradiated MWCNTs could be modified by the low energy electron beam irradiation. Nevertheless, with increasing the temperature, the radiation damage in MWCNTs that could destroy the structure was minimized. Moreover, at the temperature of 800 K, the interconnection of adjacent parallel MWCNTs could be realized at the irradiation dose of 1.5×10^{17} ions/cm^2. This interconnection was ascribed to the fact that two adjacent MWCNTs shared a common graphene.

Rapidly Dispersion and Loading of Pt Nanoparticles on CNTs for DMFC Electrodes

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ABSTRACT

In this article, platinum nanoparticles with uniform diameter (about 4.3 nm) were efficiently dispersed on multi-walled carbon nanotubes (MWCNTs) with temperature controlled, microwave assisted polyol method. Temperature is an important factor that affects the reduction rate of Pt particles from chloroplatinic acid. In a microwave system, chloroplatinic acid is rapidly dissociated and reduced. Pt catalyst particles are then deposited on the MWCNTs. An addition of sodium dodecyl sulfate (SDS) and poly-vinyl pyrrolidone (PVP) in chloroplatinic acid/ ethylene glycol (EG) solution can efficiently disperse the catalyst particles homogenously on MWCNT, enhance the adsorption of platinum particles, and reduce the residue of platinum particles. The results indicate that the optimal temperature range from 140 to 160°C, and that the loading amount of Pt/CNTs can achieve more than 50 wt% for only 90 seconds of processing time. The significant improvement in dispersion and loading is due to the ability of SDS, which wraps the PVP-stabilized Pt nanoparticles around the surface of carbon nanotubes. The characterization analyses are conducted by using SEM, TEM, XRD, XPS, and TGA.

Preparation of Carbon Nanotube/Silica Composite for Optical Limiting

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ABSTRACT

Introduction

Nowadays, laser sources are widely used in areas of industry, medicine, biological and military. The development of laser has brought us many benefits, but it also brought a potential hazard for human eyes and optical sensors. So there have been increasing interests in materials that exhibit strong optical limiting properties. Different kinds of materials, such as fullerenes, organometallics, carbon black suspensions (CBS), semiconductors and liquid crystals, have been investigated and selected as candidates for good optical limiters in the visible domain for short laser pulse.

Carbon nanotubes (CNTs), since their discovery by Iijima in 1991 [1], have been the object of extensive physical studies concerning essentially their fascinating electronic and mechanical properties [2]. Theoretical calculations [3] have shown that CNTs with large second hyperpolarizabilities γ (also called third-order optical nonlinear coefficient) correlated with the high optical limiting properties. Furthermore, many researchers have observed strong and broad-band optical limiting in single-walled and multi-walled nanotube suspensions [4, 5], as well as in solid films [5]. However, most of the investigations were carried out in suspension or solution, which were not suitable for practical use. Considering of this reason, we try to introduce CNTs into solid matrix to make it more practicality for optical limiter.

On the other hand, an ideal optical limiter must have a high linear transmittance at low input fluence (at least of 70%), which ensure the acceptance of signals for eyes and optical sensors. Silica (SiO_2) is a widely used optical material with a high transmittance (more than 90%), which is suitable to be the matrix of optical limiter. In addition, SiO_2 composites with varied contents of CNTs have been made and the results show that the composites have improved mechanical properties [6, 7] and excellent microwave attenuation properties [8]. But the optical limiting properties of the composite haven't been studied yet.

In the paper, we described the preparation of CNTs / SiO_2 powder and bulk composite, and then discussed the microstructure and property of the composite.

Experimental

The multi-walled carbon nanotubes (MWCNTs) provided by Shenzhen NANO Tech. Port. Co. Ltd. of China were fabricated by catalytic pyrolysis of hydrocarbon. Nano SiO_2 powder was prepared by a sol-gel method. The experiments were as follows. In order to achieve better performance of the composites, a sol-gel method has been used to coat MWCNTs with SiO_2 (SiO_2@MWCNTs) [9]. The detailed technical process was described in Refs.9. Then the powders of SiO_2@MWCNTs and nano SiO_2 were mixed with absolute alcohol and ball-milled for 12 h using agate balls as the grinding media. After drying and sieved through a 200 mesh screen, the CNTs / SiO_2 powder was obtained.

Finally, the CNTs / SiO_2 powder was added into a graphite die and hot-pressed at 1300°C under an applied stress of 30MPa in N2 atmosphere for 0.5h.

Results and Discussion

Fig.1 is the transmission electron microscopy (TEM) image of MWCNTs coated with SiO_2 (SiO_2@MWCNTs). As seen from the image, there is a uniform SiO_2 layer coating on MWCNTs.

Fig. 2 is the photo of the CNTs/SiO_2 composite prepared in this paper. The content of CNTs was 0.05wt%. From the photo, we can see the sample is not very transparent. Because it is not easy to disperse the CNTs well to the SiO_2 matrix. The black dots in the sample maybe some impurities, which entered in the process of hot-press. XRD and SEM will be used to ascertain the composition of the impurities, and the sintering process need to be improved in the following work.

Conclusion

CNTs/SiO_2 composite was prepared in this paper, the content of CNTs was 0.05wt%. CNTs have strong and broad-band optical limiting behavior, while SiO_2 have a high linear transmittance. These properties made them ideal as protective materials for eyes and optical sensors. The following job is to measure the optical limiting properties use Z-scan technique. CNTs/SiO_2 composite may has potential application for optical limiting.

References

[1] S. Iijima, nature 354 (1991) 56.
[2] R.Saito, G. Dresselhaus, M.S.Dresselhaus, Academic Press, London, 1996, p. 791.
[3] R.H. Xie, J. Jiang, Appl. Phys. Lett. 71 (1997) 1029.
[4] L. Vivien, E. Anglaret, D. Riehl, F. Bacou, C. Jurnet, C. Goze, M.Andrieux, M. Brunet, F. Lafonta, P. Bernier, F. Hache, Chem.Phys. Lett. 307 (1999) 317
[5] X. Sun, R.Q. Yu, G.Q. Xu, T.S.A. Hor, W. Ji, Appl. Phys. Lett. 73(1998) 3632.
[6] J. W. Ning, J. J. Zhang, Y. B. Pan, and J. K. Guo, Mater. Sci. Eng. A 357, 392 (2003).
[7] J. W. Ning, J. J. Zhang, Y. B. Pan, and J. K. Guo, J. Mater. Sci. Lett. 22, 1019 (2003).
[8] ChangShu Xiang, Yubai Pan, Xuejian Liu, Xingwei Sun, Xiaomei. Shi, and Jingkun Guo, Appl. Phys. Lett. 87, 123103(2005)
[9] Yong Zhu, Yubai Pan, Heng Xu, Changshu Xiang, chemistry letters Vol. 36(2007), No.9P.1098.

Electropolymerized Polyaniline Enzyme Immobilized Carbon Nanotube Electrode for Electrochemical Detection of Cholesterol

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ABSTRACT

Electrochemical detection is a promising technique for bio-analytes sensing because of rapid analysis, good selectivity, reusability, thermal stability, linearity and relatively low cost. There have been consistent efforts to improve the performance of the electrochemical biosensors which include functionalization of the working electrode surface by polymer or nanomaterials. In this work, a cholesterol sensor is developed based on carbon nanotube electrode with electrochemical polymerized enzyme immobilization. First, CNTs are selectively grown on 1 mm^2 window of gold coated SiO_2/Si substrate by thermal chemical vapor deposition (CVD) with water-assisted etching. CNTs are then simultaneously functionalized and enzyme immobilized by electrochemical polymerization of polyaniline and cholesterol enzymes. Scanning electron microscopic characterization reveals polymer-enzyme nanoparticle coating on CNT surface. Fourier transform infrared spectroscopy is then used to confirm that the coated nanoparticles are polyaniline-cholesterol enzyme composite. The fabricated sensors have been characterized for cholesterol detection in the concentration range between 0 to 300 mg/dl by standard cyclic voltammogram measurement. CV curves show the oxidation and reduction peaks centered around 450 and -220 mV, respectively. In addition, the peaks become clearly pronounced and shifted toward lower voltage as the cholesterol concentration increases. An almost linear relationship between the cholesterol concentration and the response current could be observed in the concentration range of 100-300 mg/dl with good sensitivity. Thus, the fabricated bioprobe is effective for cholesterol detection in normal range of cholesterol concentration in human blood.

Carbon Nanotubes Thick Layers for Electronic Applications

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ABSTRACT

Massive samples of well packed, vertically aligned and very long multiwall carbon nanotubes (MWCNTs) were synthesized by a very efficient thermal Chemical Vapor Deposition (CVD) process. The average diameter of the single nanotubes is ranging between 10 and 100 nm, while their length exceeds 3 mm, forming a uniform massive carpet. The deposition involves the co-evaporation of camphor and ferrocene in a

nitrogen atmosphere and subsequently the pyrolysis of the precursors at 850°C. With an appropriate control of the growth parameters, the deposition of such kind of material has been successfully performed on several uncoated substrates ordinary employed in electrical devices: silicon, heavily-doped silicon, silicon oxide, silicon carbide, and oxide catalyst coatings on steel.

The morphology and physical properties of the nanotube forest were characterized by electron microscopy (FESEM, HR-TEM), spectroscopy techniques (XRD, micro-Raman) and mechanical tests. Thermal properties were investigated by thermo-gravimetric analysis (TGA) and thermal conductivity tests. Electrical properties of the single nanotubes were analyzed by scanning tunnel spectroscopy (STS), whereas the bulk resistivity with respect to the temperature was studied down to 4 K by a four point-probe technique.

Since CNT thick carpets exhibited a very high-thermal conductivity, the deposition on the reported substrates can offer a solution in integrated circuit manufacturing as heat sinks. On the other hand, because of the electrical properties of our CNTs - which show a resistivity linear with the square root of temperature in the range from 4 to 300 K - a new perspective is perhaps opened in the field of temperature sensors.

Reference

[1] S. Musso *et al*, Carbon 45 (5), 1133–1136 (2007)

Carbon Nitride Nanotubes Synthesized by High-Frequency Induction Heating Quickly and their Field-Emission Properties

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ABSTRACT

Carbon nitride nanotubes have been rapidly synthesized using high-frequency induction heating equipment in less than 3 minutes. The diameter of synthesized carbon nitride nanotubes is about 1.5–2nm. Both X-ray photoelectron spectra and EDX analysis give its formula of CN nanotube. The carbon nitride nanotubes grown under this condition have better field-emission characteristics with low turn-on and threshold fields of 1.1 and 3.8

V/μm, respectively. The reason could be that carbon nitride nanotubes synthesized by high-frequency inducting heating with high heating rate have more "bamboo-like" structure with many open ends and high purity.

Humidity Sensor Utilizing Multiwalled Carbon Nanotubes Coated Quartz Crystal Microbalance

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ABSTRACT

Carbon nanotube (CNT) is a promising material for humidity sensing due to its high specific surface area and large water absorption. In this work, multiwall CNTs are coated on quartz crystal microbalance (QCM) for humidity sensing at room temperature. The MWCNTs were then synthesized by chemical vapor deposition (CVD) with iron catalyst powders. The deposition is conducted under hydrogen, acetylene and argon gases at atmospheric pressure and deposition temperature of 700°C. The obtained CNTs were ground to obtain small CNT fragments and purified by etching with nitric acid. The purified MWCNTs were then separated by sonication in methanol. Finally, the CNTs are coated on QCM by drop coating of CNTs in 5% polyethyleneimine-methanol solution. From scanning electron microscope (SEM) characterization, small clusters of MWCNTs were found to uniformly scatter over QCM electrode. The size and density of CNT clusters on QCM can be varied by adjusting the CNT concentration. With optimum CNT concentration, the humidity sensitivity of CNT coated QCM sensor is increased by more than two orders of magnitude compared to uncoated QCM sensor. In addition, the CNT based QCM sensor has fast humidity detection with short response and recovery times. Thus, the proposed CNTs deposition on the QCM electrode is an effective way to improve humidity-sensing characteristic of QCM sensor.

The Influence of the Temperature in the Organic Modification of Single Walled Carbon Nanotubes

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ABSTRACT

In this paper, a simple method to modify single walled carbon nanotubes (SWNTs) with ODA is introduced and the effect of reaction temperature is mainly researched. The FTIR spectrum and XRD were used to investigate the organic functional groups and crystal structure of carbon nanotube before and after modification. The mole percentages of ODA decorated on SWNTs to carbon atoms in SWNTs are calculated by weighing method. The results show that the temperature plays an important role in the modification process. The amount of organic functional group on the surface of SWNTs is increase with the temperature and the mole percentage of ODA/carbon atom is in range of 2.12 to 8.64%.

The absorption spectrum of the commercially procured SWNTs dispersed in 2 wt % aqueous solution of Sodium cholate and also in 1 wt % of Sodium dodecyl sulfate was studied in the wavelength range 240-2400 nm. Two distinct bands each containing three peaks in the nIR range were observed for both the suspensions. These two bands were interpreted to be due to transitions between van Hove singularities E_{11} and E_{22}, which are symmetrically located at the opposite sides of the Fermi level in the density of states of the semiconducting SWNTs. These observed peaks were compared with the empirical Kataura plot in order to estimate the diameters and chiralities of the nanotubes. The diameters of the nanotubes were also calculated theoretically using tight binding approximation. It was found that the values of diameters estimated theoretically are lower as compared to those calculated from the experimentally observed E_{11} and E_{22} peaks using Kataura plot. This discrepancy is found to be higher for E_{11} peaks than for E_{22} peaks. It has been suggested that the reason for this is that E_{11} peaks are blue shifted due to coulomb interactions and exciton formation and these effects becomes weaker as we move towards higher order singularities. The excitons thus play a significant role in determining the band properties of nanotubes. The intensity of E_{11} peaks is also found to be higher than that of E_{22} peaks and this is attributed to the lifetime of the excitons in the transitions. The excitons have a very low lifetime for V_2-C_2 transition as compared to those associated with V_1-C_1 transitions causing electron and hole pair to relax very quickly for the second order van Hove singularity. The TEM images of the sample were also recorded and the tubes were found to be present in a bundle of size 50-100 nm in diameter. Due to bundling intertube coupling occurs causing a red shift in the transition energies. Therefore the peaks suffer from blue shift and red shift both but effect of blue shift is found to be more predominant.

Study of Photoluminescence Quenching and DC Conductivity Measurements in Polymer-SWNT Composite Films for Various SWNT Concentrations

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ABSTRACT

Conducting polymer-SWNT composite films have a high potential in the area of Photovoltaic devices and Light emitting diodes. SWNTs have high electron affinity and high mobility for electrons. As a result of this, the separation of photoinduced charges in the solar cell is very fast and efficient. For LEDs, the polymer-SWNT composite films act as efficient electron transporting layer (ETL). In general the mobility for electrons in conducting polymers is much lower than that for holes due to efficient trapping of electrons by the impurities and traps in the polymers. Due to high mobility of electrons in SWNTs, using polymer-SWNT composite film as ETL is a good alternative. In the present work composite solutions of P3HT and SWNTs were prepared in 1,2-dichlorobenzene with nanotube to polymer mass ratios varied from 0 to 30%. To disperse the nanotube powder the solution was ultrasonically agitated for ~ 5 minutes. The solutions were left undisturbed for ~ 48 hrs to sediment out the present impurities. The upper half of the solution was decanted to obtain impurity free solution. The films from this solution were spin coated on a glass substrate with the help of spinner. The thickness of the film was measured with the help of Talystep and was ~ 100 ± 10 nm. The photoluminescence (PL) of the film was observed with the help of Shimadzu spectrophotometer. It was found that the PL intensity decreases by ~ 90% as the concentration of the SWNT is increased from 0 to 30%. This decrease is due to transfer of electrons from P3HT to SWNTs before the exciton in the polymer can decay radiatively to emit PL. For measuring dc conductivity the composite films were spin coated on a glass substrate having Al coating. Six Al contacts having an area of 0.25 cm^2 were deposited on the upper surface of the film and conductivity was measured with the help of Keithley sourcemeter in sandwiched structures. It was found that conductivity increases by more than five orders of magnitude

with the increase of SWNT concentration. The composite films can therefore act as good electron transporter for LEDs and efficient electron acceptor for solar cells.

Process Integration of Carbon Nanotubes on Different Substrates with Diamond-Like amorphous Carbon films

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ABSTRACT

We investigate the growth of carbon nanotubes on 3 different surfaces, Si, SiO_2/Si and DL-aC/Si using Fe as the main catalyst. The carbon nanotubes were deposited using a PECVD system while the Diamond-like amorphous Carbon (DL-aC) films were deposited using a KrF pulsed laser deposition system. Very densed and well-aligned Carbon nanotubes were observed to be on both Si and SiO_2/Si substrates while little or to no carbon nanotubes were observed on the DL-aC substrates. One interesting observation was the height of the carbon nanotubes on Si has an average height of 8.8μm as compared to 6.2μm on SiO_2/Si when deposited simultaneously at the same conditions. High-resolution TEM confirmed that the carbon nanotubes grown were multi-walled. Diamond-like amorphous carbon films of varying thickness were deposited on the top of the densed carbon nanotubes forest at room temperature with no post-deposition process performed. SEM images showed that the carbon nanotubes had a thicker diameter after a very thin diamond-like amorphous carbon layer was deposited. In addition, small "lumpy" clusters were observed. When thicker diamond-like amorphous carbon films were deposited, the films started to form closely knited ball-like clusters, The electron emission results from the diamond-like amorphous carbon coated carbon nanotubes were also tested and discussed.

CNTs/Cu Composite Thin Films Fabricated by Electrophoresis and Electroplating Techniques

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ABSTRACT

The CNTs (carbon nanotubes)/Cu composite thin films were fabricated by a method combined electrophoresis and electroplating techniques. Uniform composite films with CNTs content from 0 to 32.68% were prepared. Relationship between sample resistivity and CNTs content is also studied. It shows that the resistivity of composite film is even lower than that of copper. Special mechanisms of copper grain growth and the time of electroplating were investigated with different CNTs content.

Research on EVA-Inorganic Nanocomposites

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ABSTRACT

In recent years, polymer/inorganic nanocomposites have already attracted the interests. In this paper, EVA/inorganic nanocomposites of direct-dispersed, one-step and two-step were prepared by melt blending. The preparation, morphological Structure and mechanical properties of these composites were systematically investigated, which laid the foundations for the further experimental. The dispersibility of nanoparticles in EVA matrix was characterized by FESEM and FT-IR. In all the composite systems, one-step improves the mechanical properties more than direct dispersed and two-step methods; Proper filling of nanoparticles by one-step may decrease the apparent viscosity of the systems; There has a interface bonding layer between EVA and nanoparticles by Vinyl Triethoxyl Silane coupling agent, adjusting the bonding structure between phasesnanocomposites have nano-scale dispersions

Keywords: nanocomposites; ethylene/vinyl acetate (EVA); preparation method; mechanical properties; dispersion morphology

A New Antisolvent Approach for Modification of Multiwalled Carbon Nanotubes Using Supercritical Carbon Dioxide

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ABSTRACT

Modification of multiwalled carbon nanotubes (MWCNTs) was investigated from solution of high density polyethylene (HDPE) in conventional organic solvent p-xylene using antisolvent deposition with supercritical (SC) CO_2. The technique was conducted in SC CO_2 under 9 MPa at 110°C and under 12 MPa, 15 MPa at 120°C. A field emission scanning electron microscopy (FESEM) and high-resolution transmission electron microscopy (HRTEM) was used to study the morphology, crystallization behavior of the resulting products. PE lamellar crystals are perpendicular or oblique to the MWCNTs axis, forming a "lamellae staggered structure." MWCNTs are wrapped and modified with layers of PE lamellae. The effect of PE concentrations was investigated and SEM has demonstrated that the size of lamella is due to the competing result of SC CO_2 antisolvent action and PE concentration. We anticipate that this work could be attributed to the further development of polymer/CNTs nanocomposites.

A High Performances Glucose Sensor Based on Double Layer Nano-Materials

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ABSTRACT

A highly stable glucose sensor based on the synergic action of multi well carbon nanotube (MWCNTs) and ZnO nanoparticles has been developed. Glucose oxidase (GOx) is firmly immobilized on the ZnO nanoparticles surface due to their large difference in the isoelectric point (IEP), while the ZnO nanoparticles were deposited on the negatively charged MWCNTs layer. A cationic polydiallyldimethylammonium chloride

(PDDA) layer was coated on the GOx layer. The unique sandwich-like layer structure (PDDA/GOx/ZnO/MWCNTs) formed by self-assembling provides a favorable microenvironment to keep the bioactivity of GOx and to prevent enzyme molecule leakage. The excellent electrocatalytic activity toward H_2O_2 of the fabricated electrode indicated that the polyelectrolyte-protein multilayer and ZnO nanoparticles do not affect the electrocatalytic properties of MWCNTs, enabling sensitive determination of glucose. Amperometric detection of glucose is carried out at 100 mV (vs. Ag/AgCl) in 0.01 M (mol/L) phosphate buffer solution (PBS, pH 7.4) with a wide linear response range of 50 μM to 6.0 mM, a sensitivity of 50.2 mA $cm^{-2}M^{-1}$ and a detection limit of 17 μM (3σ). The PDDA/GOx/ZnO/MWCNTs/GC biosensor showed excellent properties for the sensitive determination of glucose with good reproducibility, remarkable long-term stability, and freedom of interference from other co-existing electroactive species. The sensor has been applied to the assay of real samples with good precision and accuracy.

Nanostructured Biosensors Built by Layer-by-Layer Assembly of Multiwall Carbon Nanotubes and Zn-Salen

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ABSTRACT

Carbon nanotubes have a high electrochemically accessible area of porous tubes, good electronic conductance and strong mechanical property. These properties essentially suggest that CNTs are attractive materials for the construction of nanoscaled biosensors. Ligand frameworks such as the schiff base containing salen ligand, that can be sterically and electronically modified with ease, are very attractive[2]. The use of the salen ligand framework in catalytic reactions has been receiving increasing interest because of its success in many newly discovered processes. In this paper, MWCNTs and Zn-salen were alternative deposited onto the surface of glassy carbon electrode via layer-by-layer assembly technology. We find that $(MWCNTs/Zn\text{-}salen)_n$ multilayer films have excellent electrocatalytic activity for L-tyrosine and NO_2^-. Hence, a nanostructured electrochemical sensor for simultaneous detection L-tyrosine and NO_2^- was developed successfully.

Growth of Nancrystalline Si for TFT and Solar Cell Applications

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ABSTRACT

We report the growth of nanocrystalline (nc-) Si for device application by plasma enhanced chemical vapor deposition. We optimized the growth of nc-Si by changing the dilution gas such as H2, He and Ar. The addition of Cl2 and H2 to the silane plasma changes the deposition chemistry such that crystalline volume fraction increases under some growth conditions. The nc-Si with a high crystalline volume fraction up to 88% was grown on glass substrate and applied to make thin-film devices We made a series of p-i-n devices for solar cell and medical sensors for X-ray detection. The leakage currents of the a-Si:H pin can be reduced down to 40 pA/cm^2, which leads to detect a very low intensity light signal. The diode quality factors of pin cells are in the range of 1.2 to 1.9 depending on the dilution ratio and RF power to make a silane plasma. The effect of gas dilution to the silane plasma on the performance of pin diode will be presented. The image sensors and solar cells based on a-Si:H and nc-Si will be presented at the conference.

Barrier Height Engineering through Alloy Deposition in Depletion Type Schottky Contacts

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ABSTRACT

The barrier height of Schottky contacts is engineered by coating thin layers of different metals on top of each other. It is found that the barrier height will change when the weight percent of metals in the overall metallic layer is changed. Also the thermal stability of the barrier height of these alloyed Schottky contacts is investigated, and it is found that the barrier height of the alloyed Schottky contacts shows better thermal stability compared to the pure metal Schottky contacts.

NASICs: A Nanoscale Fabric for Nanoscale Microprocessors

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ABSTRACT

The rapid progress of manufacturing nanoscale devices is pushing researchers to explore appropriate nanoscale computing architectures for high density beyond the physical limitations of conventional lithography. However, manufacturing and layout constraints, as well as high defect/fault rates expected in nanoscale fabrics, could make most device density lost when integrated into computing systems. Therefore, a nanoscale architecture that can deal with those constraints and tolerate defects/faults at expected rates, while still retaining the density advantage, is highly desirable. In this paper, we describe a novel nanoscale architecture based on semiconductor nanowires: NASICs (Nanoscale Application Specific ICs). NASIC is a tile-based fabric built on 2-D nanowire grids and NW FETs. WISP-0 (Wire Streaming Processor) is a processor design built on NASIC fabric where NASIC design principles and optimizations are applied. Built-in fault tolerance techniques are applied on NASICs designs to tolerate defects/faults on-the-fly. Evaluations show that compared with the equivalent CMOS design with 18 nm process (the most advanced technology expected in 2018), WISP-0 with combined built-in redundancy could be still 2~3X denser. Its yield would be 98% if the defect rate of transistors is 5%, and 77% for 10% defective transistors.

Investigations of NBTI by Conventional and New Measurement Methods for p-MOSFETs

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ABSTRACT

The conventional and the fast pulsed IV measurements are carried out for the extraction of the threshold voltage shift for p-MOSFETs under stress. In addition, the on-the-fly interface trap (OFIT) measurement technique recently developed by our group is applied to the characterization of interface trap generation and recovery. The OFIT data are compared with those obtained using conventional charge pumping and direct-current current-voltage measurements. It is shown that the time delay during various measurements affects the measured characteristics of NBTI, which may mislead the understanding of NBTI mechanism. It is found that the interface trap generation plays a more important role in NBTI than that of oxide charges in the long time, especially for 10 years lifetime prediction. The results on the interface trap generation suggest a dispersive transport process, which indicates that the classical reaction-diffusion model should be reconsidered carefully.

Comparison of Analog and Digital Nanosystems: Issues for the Nano-Architect

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ABSTRACT

Improvements in manufacturing and assembly of novel devices such as the carbon nanotube (CNT) and semiconductor nanowires has led to the exploration of new nano-architectures utilizing such devices for applications such as general purpose computing, image processing etc. This paper discusses different possible nanoscale implementations of Cellular Neural Networks (CNN). It is seen that while an analog nanoscale implementation of the CNN may be difficult with self-assembly based approaches given the requirements for customization of devices and arbitrary routing, a digital equivalent may be realizable in the near term. One such digital CNN design based on the NASIC nanoscale fabric is shown. A specialized architecture for CNN with Resonant Tunneling Diodes (RTD) is also discussed.

Novel Nanowire Integration Schemes for Massively Parallel and Manufacturable Nanoscale Electronics and Photonics

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ABSTRACT

In the last decade, the nanotechnology has made significant progress in the synthesis and demonstration of novel devices with semiconductor nanowires. However, interfacing and integrating nanowires in devices and circuits has remained a formidable challenge since they were first envisioned as building blocks of future electronics, photonics and sensing systems. We demonstrated an epitaxial bridging technique for interfacing nanowires that allows individual electrical access to a large number of nanowire devices without recourse to nanoprobes or tedious and expensive serial interfacing procedures. Two opposing electrically isolated semiconductor surfaces are fabricated using coarse optical lithography, along with wet and dry etching. Lateral nanowires are then grown from one surface and epitaxially connected to the other, forming electrically continuous and robust "nano-bridges". By forming the structure on a silicon-on-insulator (SOI) substrate, electrical isolation is achieved. The nanowire devices fabricated using the bridging interfacing technique exhibit more than two orders of magnitude lower contact resistance and three orders of magnitude lower noise level than any other reported works. We extended our nano-bridging method and demonstrated heterogeneous bridged InP nanowires between Si surfaces. Interesting properties such as space charge limited current and a discernable level of persistent photocurrent were observed. The nano-bridging technique was expanded to fabricate high performance nanowire device on any type of substrates such as amorphous materials or even metals. Based on this new approach, a semiconductor nano-bridge based photodetector was designed and fabricated on a quartz substrate and an impressive bandwidth >30 GHz was measured. These results demonstrate that it is now possible to design and manufacture nanowire based semiconductor devices without using expensive single crystal substrates. Exciting opportunities for novel high performance electronics and photonics on ultra-low cost surfaces such as quartz, plastic, FR4, metal etc. are likely to becoming a commercial realty.

Effect of Decoupled Plasma Nitridation Power on Interface

Trap and Oxide Charge Trap in Deep Sub-Micron

Gate Oxide

Under Negative Bias Temperature Instability

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ABSTRACT

Negative bias temperature instability (NBTI) in PMOS has emerged as one of the critical reliability concerns in deep sub-micron devices. Nitrogen concentration and profile in gate oxide is believed to be one of the key factors impact NBTI performance. In this paper, the NBTI behavior of thin gate oxide nitrided by decoupled plasma nitridation (DPN) under various DPN power is investigated. The interface trap and oxide charge trap generation under NBTI stressing is monitored by different device characteristics, including the midgap voltage (Vmg) shift, the sub-threshold swing (S) shift, and the linear drain current (Idlin) shift. It is found that the interface/oxide traps extracted from different methods are consistent with each other. It is also seen that, with the DPN power increase, the interface/oxide charge trap does not increase monotonically, but showing a peak value at certain power. Detailed analysis from device physics point of view is given to correlate the interface/oxide charge traps to the DPN power and the NBTI performance as well. This investigation provides an insight on NBTI improvement through optimizing the DPN process.

Read Stability and Write Ability Analysis of Dual -Vt Configurations of a single Cell of an SRAM Array-Effect of Process-Induced Intra-Die Vt Variations

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ABSTRACT

This paper studies read stability and write ability of various dual-Vt configurations of an SRAM cell in an array considering the process-induced intra-die threshold voltage Vt variations using N-curve metrics. The effects of process induced intra-die Vt variations in 11 different dual-Vt cell combinations are evaluated and compared. In this work, N-curve metrics are adopted for the analysis as information about read stability and write ability

can be obtained using a single curve. The statistical parameters like mean, standard deviation, average deviation for each of the metrics is found for all the 11 dual -Vt configurations using Monte-Carlo simulations. The effects of intra-die variations are considered as they are prominent at nanometer technologies. The comparisons are made with the help of power noise margins which are obtained by finding the product of mean of voltage noise margins and mean of current noise margins. The variances and percentage variances from the mean, of voltage and current margins for all combinations are tabulated and analyzed. Comparisons are also made based on five different yield values. Thus given a range of a metric and the yield value one can choose the type of configuration of SRAM cell.

Resistive Switching Devices Based on Cu_2S Electrolyte

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ABSTRACT

The Cu_2S electrolyte films have been deposited on $Pt/TiO_2/SiO_2/Si(111)$ and conductive Si(111) substrates by using pulsed laser deposition(PLD) technique with a specially designed temperature program, which matches the 'lift-off' technology of semiconductor industry. The structures of the Cu_2S films were characterized by using X-ray diffractions, and their surface morphology was studied by using atom force microscopy(AFM) and scanning electron microscopy(SEM). With the fused ion beam(FIB) technique, the Cu_2S circular memory units of 300 nm diameter with sandwich structures $Cu/Cu_2S/Pt$ and $Cu/Cu_2S/Si(111)$ were fabricated, and their electric switching properties were investigated. The resistance ratio between the 'OFF' state and the 'ON' state reaches 1×10^7 for the memory unit $Cu/Cu_2S/Pt$, and 3.3×10^3 for the memory unit $Cu/Cu_2S/Si(111)$, which matches the requirements of the non-volatile memory devices of next generation.

A Novel Nonvolatile Memory Device Based on Solid Electrolyte

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ABSTRACT

A novel nonvolatile memory device with $Ag/(AgI)_{0.5}$ $(AgPO_3)_{0.5}/Pt$ structure was proposed in this letter. The intermediate amorphous $(AgI)_{0.5}(AgPO_3)_{0.5}$ films was prepared by pulsed laser deposition(PLD). Two devices with same structure but different effective areas were prepared. They can store information in two states, high conductance state and low conductance state. The previous device with effect diameter of 1um can be written and erased more than 10^5 times with pulse of 200 us. The latter device with effect diameter of 300nm can be written and erased more than 10^6 times with pulse of 10 us. The mechanism of the switch of the conductance is analyzed in the letter.

Performance Improvement of Metal Nanocrystal Memory with High-*k* Tunneling Dielectric

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ABSTRACT

MIS capacitor structure with Au nanocrystals (NCs) embedded in gate dielectrics is fabricated, with SiO_2 and high-*k* ZrO_2 as tunneling dielectric. The charge storage characteristics and retention performances are investigated. The memory effects are confirmed through C-V measurement. Transient capacitance versus time test is carried out to research the charge retention performance. It is found that with the same physical thickness, the sample with tunneling SiO_2 shows better retention performance, while with the same equivalent oxide thickness (EOT), the sample utilizing ZrO_2 as tunneling dielectric exhibits improved retention performance. The physical mechanisms are proposed and discussed. The results show that the high-*k* ZrO_2 is promising to be used as tunneling dielectric in nanocrystal memory devices.

Synthesis and Characterization of Magnetic-Fluorescent Composite Colloidal Nanostructures

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ABSTRACT

In this communication, we report fluorescent and magnetic bifunctional structures in the nanoscale range. The synthesis and characterisation of various colloidal nanostructures as $Y_3Fe_{5-x}Al_xO_{12}$-TRITC, γ-Fe_2O_3-$Cs_2Mo_6Br_{14}$@SiO_2 and Fe_2O_3-QDs will be presented.
At the outset, the first synthesis of aluminium substituted YAIG ($Y_3Fe_{5-x}Al_xO_{12}$) by the citrate gel process and its surface modification by TRITC through grafting of 3-aminopropyltrimethoxysilane (g-APS) for biology-related labelling will be reported. Secondly, the synthesis of nanoparticles under restricted environments offered by water-in-oil microemulsions provides excellent control over particle size and shape and interparticle spacing. These environments have been used in the synthesis of silica nanoparticles (50 nm) with magnetic nanocrystals core surrounded by optically active nanoclusters. Finally, we will describe the preparation of composite magnetic QD bioconjugable micelles by simultaneous encapsulation of hydrophobic CdSe/ZnS QDs (2-4 nm) and magnetic γ-Fe_2O_3 nanoparticles (3-4 nm) into micelles of synthetic functional PEG amphiphiles bearing a bioactivable terminal group.

Enhancement of High-Frequency Permeability of FeCoHf Films by Surface Oxidation

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ABSTRACT

Nanocrystalline FeCoHf films with crystal size about 10 nm were prepared by radio-frequency magnetron sputtering method at room temperature. The films were annealed at 400°C for 1 h in the presence of magnetic field of 2 kG. Then the films were cooled in vacuum or floating Ar/O mixed gas (referred to as AV and AO, respectively). Bright-argentine and light-brown surfaces were observed for AV and AO, respectively. The average O composition of samples AV and AO was 5.3 and 14.6 at%, respectively. Comparing with sample AV, evidently enhanced anisotropy field, resistivity and ferromagnetic resonance frequency over 3 GHz were achieved in AO. It is revealed that the surface oxidation is an effective way to increase the resonance frequency of high-frequency ferromagnetic films.

Spin-Dependent Transport Characteristics Across Magnetic Nanoscale Junctions through Doped IV and III/V Semiconductors

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ABSTRACT

We have studied spin-dependent transport across magnetic metallic strips deposited on doped Si and GaAs in a wide range of temperatures up to the ambient temperature, and found strong evidence of coherent spin transport through the magnetic metal into the semiconductors at the elevated temperatures. First, spin transport through Si doped GaAs was studied between two cobalt strips separated by a 100 μm. It was found that there was well-defined field modulated resistance variation in low magnetic field range (<100 Oersted) at T = 300 K. A moderate variation of 3% was observed in samples with light doping (~1014/cm^3), which exhibited non-ohmic contact behavior demonstrating two oppositely polarized Schottky barriers for the two Co strips. The field modulation was found to be dependent on the current, and the temperature dependence of resistance with excitation energy was close to that of the Si dopant. Further, tunneling characteristics were measured on e-beam lithographically patterned spin-dependent tunneling (SDT) lines on n-doped Si, to study ballistic transport from ferromagnetic nano-lines via AlOx barrier into group IV semiconductor. The measurement was done using dual lock-in amplifiers, multi-channel voltmeter, in adder circuit with low noise operational amplifiers. Nano-scaled 100 nm STD junction lines closely spaced (100 nm)

were fabricated on P doped Si as injection contacts. The measured I-V characteristics and the differential conductance (dI/dV) versus the bias voltage (V) versus temperature, from 84 to 300 K, through a STD junction showed weak temperature dependences. For example, from 84 to 250 K in the measured dI/dV at low bias range was found to be independent of T, which demonstrated clearly ballistic transport from ferromagnetic nano-contacts into the semiconductor.

High-Coercivity $SmCo_5$ Thin Films Deposited on MgO and Glass Substrates

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ABSTRACT

In this work, both $SmCo_5$ thin films with a (1120) texture on single crystal MgO (100) and glass substrates, respectively, have shown high in-plane coercivity and in-plane anisotropy after deposition at a relatively low substrate temperature of 400°C. An epitaxial growth was achieved on the MgO (100) single crystal, while polycrystalline and nearly isotropic Cr underlayer was found on the glass substrate. A comparison study showed different coercivity mechanisms of the two $SmCo_5$ films.

Extraordinary Hall-Effect Sensor in Split-Current Design for Readout of Magnetic Field-Coupled Logic Devices

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ABSTRACT

This work demonstrates a novel extraordinary Hall-effect sensor which is designed to probe the magnetization state of micron-scale Co/Pt dots. The applied split-current geometry is well-suited for the electrical readout of field-coupled computing structures realized by focused ion (FIB) techniques. The electrically measured hysteresis loop is in good agreement with SQUID measured hysteresis curves of identical layer stacks. Full reversal in a perpendicular field causes an approximately 0.1 percent change in the Hall-resistivity of the film. We argue that this sensor is scalable all the way down to probe single domain Co/Pt dots with lateral dimensions of 200 nm · 200 nm.

The Structure and Magnetic Properties of NiO with Different Sizes

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ABSTRACT

NiO was prepared by co-precipitation followed by an annealing. The fabricated powers showed cluster structures when the annealing temperature was 170°C and the powders showed a dominant ferromagnetic coupling with a magnetization of 105 emu/g. When the annealing temperature was higher than 170°C, the powders showed a nanocrystalline structure composed of surface spins and antiferromagnetic core. Exchange bias was observed after field cooling in these powders. Spin glass and superparamagnetism behaviors were found in the cluster NiO and nanocrystalline NiO, respectively.

New Opportunities and Challenges of Spintronic Devices and Magnetic Nanoparticles

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ABSTRACT

Nanomagnetism and spintronics is an exciting field of research combining two traditional branches of physics: magnetism and electronics. Distinguishing and manipulating the

up-spin and down-spin through nano-scale structuring of magnetic materials and devices is expected to add new dimensions to the practice of quantum electronics. This talk will report recent advances made in author's group on spintronic devices and magnetic nanoparticles and a discussion of research opportunities and challenges of this field.

Magnetic tunneling junction (MTJ)/ giant magnetoresistance (GMR) based memory devices and programmable logic devices with perpendicular anisotropy have been proposed and demonstrated for future solid state memory and reconfigurable and nonvolatile computation. Spin Torque Transfer (STT) or so-called current-induced magnetization switching (CIMS) has advantages in the device scaling compared to the field-switching mechanism. However, so far, high switching current density is still needed for the STT devices in order to meet criteria of thermal stability. A new spintronic device structures will be reported to address this key issue, which is to use a hybrid (or so-called composite) magnetic free layer integrated with a nano-current-channel (NCC) layer. The implementation of multi-logic functions including AND, OR, NAND, and NOR will be reported by using a single MTJ/GMR device using STT switching mechanism. A STT based spintronic full adder for future processors will be presented. Challenges for the spin-torque-transfer devices will be laid out and discussed for future Spin-RAM, Spin-Logic and Spin-Oscillator.

Heterostructured magnetic/spintronic nanoparticles, with multiple functions and enhanced properties arising from the interaction of individual components within the single particle, have been designed and fabricated by a novel micro/nano-electronic compatible vacuum process. Several interesting and emerging biomedical applications of these novel magnetic particles will be introduced. Magnetic-particle-based spintronic devices will be presented.

By end of the talk, new research opportunities and challenges of nanomagnetism and spintronics will be discussed.

Growth and Magnetic Properties of Ferromagnetic Co Nanorods Filled Inside Carbon Nanotubes towards Nanoscale Spintronics

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ABSTRACT

We synthesize Co nanorod filled inside multi-walled CNTs (MWCNTs) by microwave plasma enhanced chemical vapor deposition (MPECVD) and utilize off-axis electron holography to observe the remanent states of the filled metal nanorod inside MWCNTs at room. The MWCNTs grew up to 100–110 nm in diameter and 1.5–1.7 μm in length. The typical bright-field transmission electron microscope (TEM) images revealed both Co/Pd multisegment nanorod and Co nanorod filled inside MWCNTs on the same substrate. We have also performed energy-dispersive X-ray spectrometer (EDS) measurements to characterize the composition of metal filled inside MWCNTs. Based on high-resolution TEM measurements, we observed the face-centered-cubic (fcc) Co filled inside MWCNT. The component of magnetic induction was then measured to be 1.2 ± 0.1 T, which is lower than the expected saturation magnetization of fcc Co of 1.7 T. The partial oxidation of the ferromagnetic metal during the process and the magnetization direction may play an important role in the determination of the quality of the remanent states.

Effect of Process Conditions and NiO on Magnetoresistance of La-(Ca,Ba)-Mn-O Composites

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ABSTRACT

$La_{2/3}(Ca_{0.6}Ba_{0.4})_{1/3}MnO_3$/xNiO heterogenous composites have been synthesized by modified sol-gel method. Resistivity versus temperature in difference magnetic fields for the samples, as well as magnetoresistance (MR) versus magnetic in room temperature, have been measured. It is indicated that the addition of NiO results to the increase in resistivity and the weakeness in magnetization. Enhanced MR has been obtained in

NiO-doped composites. The temperature dependence of magenetoresistance for NiO-doped composites in low magnetic field may be explained by the model of spin-polarized tunneling. The vary trend of MR in MR-T curve is similar to the result obtained by Monte Carlo simulation. MR in high magnetic field may be explained by spin polarization inside ferromagnetic grains.

Preparation and Magnetic Properties of Size-Monodispersed Fe-Co Alloy Nanoclusters

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ABSTRACT

$Fe_{70}Co_{30}$ alloy clusters were prepared by a plasma-gas-condensation-type cluster deposition technique. By adjusting the deposition parameters, size-monodispersed $Fe_{70}Co_{30}$ alloy clusters were obtained and their average sizes can be changed from 8.6 to 14.3 nm. The structural and magnetic properties of these alloy nanoclusters were studied. The as-obtained $Fe_{70}Co_{30}$ clusters have a body-centered-cubic α-(Fe, Co) structure although a very weak oxide phase ($(Fe,Co)_3O_4$ or γ-$(Fe,Co)_2O_3$) was also detected because the cluster assemblies have to be exposed to the ambient atmosphere for transmission electron microscopy (TEM) observation and magnetic measurement. Based upon the magnetic measurement results, we compared and discussed the magnetic differences between $Fe_{70}Co_{30}$ alloy clusters and pure Fe and Co clusters.

Observation of Photogalvanic Current for Interband Absorption in InN Films at Room Temperature

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ABSTRACT

The linear and circular photogalvanic effects have been observed in undoped InN films for the interband transition by irradiation of 1060 nm laser at room temperature. The spin polarized photocurrent depends on the degree of polarization, and changes its sign when the radiation helicity changes from left-handed to right-handed. This result indicates the sizeable spin-orbit interaction in the InN epitaxial layer and provides an effective method to generate spin polarized photocurrent and to detect spin-splitting effect in semiconductors with promising applications on spintronics.

Magneto-Optical Investigation of Fe/Zr and Fe/Zr/Fe Thin-Film Systems

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ABSTRACT

Results on the investigation of magnetic and magneto-optical properties nanocrystalline Fe/Zr and Fe/Zr/Fe thin film systems are presented. The examined samples were prepared by DC magnetron sputtering technique under a base pressure of less than 10^{-8} Torr and an argon gas pressure of 1×10^{-3} Torr. The structural investigations of the samples were performed by X-ray diffraction analysis. The hysteresis loops and spectral dependencies of the transverse Kerr effect (TKE) for the 1.4–4.5 eV incident light energy range were measured employing the magneto-optical magnetometer and the magneto-optical spectrometer, respectively. The influence of the Zr layer thickness on the magnetic properties of the Fe/Zr samples was discovered. It was found that in the trilayers, the saturation field, H_S, along the easy axis of the magnetization oscillates as a function of t_{Zr}. This result was explained by the presence of the exchange coupling between ferromagnetic layers through the Zr spacer and its oscillatory behavior with changing t_{Zr}. The TKE spectra, obtained for all samples, were revealed to be identical but the values of TKE depend on the thickness of both the magnetic and nonmagnetic layers.

Nanoparticle-Based Strategies for High-Performance Biodetection

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ABSTRACT

The use of gold nanoparticles (AuNPs) has a long history in biology, which dates back to the application of "immunogold" in biological imaging in the 1970's. Based one the unique optical and electronic properties of AuNPs, a series of methods for ultrasensitive detection of DNA and proteins by using AuNPs have been developed. This has motivated worldwide interest to develop AuNPs-based biodetection. Here I will present several examples from our group, demonstrating enhanced biodetection performance by exploiting nanoparticle-biomolecules interactions.

1. Nanoparticle-PCR

We developed a highly selective NP-PCR strategy by employing gold NPs. We have demonstrated that in the presence of appropriate concentrations of gold NPs, PCR amplification can be optimized in both yields and specificity. Thus the use of these highly stable, commercially available and inexpensive inorganic nanomaterials open new opportunities for improving PCR, the most important standard methods in molecular biology. We also note that, in addition to the two-round PCR employed here, gold NPs might also be applicable to many other PCR reactions requiring either high specificity or high yields, such as single-molecular PCR, multiplex PCR and long distance PCR.

2. Aptamer detection

Gold nanoparticles can effectively differentiate unstructured and folded DNA, thus providing a novel approach to probe nucleic acid structures. In the presence of unstructured DNA aptamers for K+, gold nanoparticles are stabilized by adsorbed DNA and show great resistance to high ionic strength, thus exhibiting the red color characteristic of dispersed gold nanoparticles. In contrast, gold nanoparticles do not have sufficient affinity to folded aptamers (G-quartets) that are bound to the ligand K+. As a result, gold nanoparticles get aggregated by the added salt and turn to the purple color arising due to the shift of the surface plasmon resonance. Based on such red-to-purple color change, we demonstrate that gold nanoparticles are a sensitive and selective probe for K+-induced structural variation of the aptamer.

Acknowledgement:

We greatly appreciate the financial support from NSFC and Shanghai Municipal Commission for Science and Technology (0652nm016).

Conjugated Polymers as Novel Electrochemical and Optical DNA Sensors

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ABSTRACT

A range of novel gene sensing methodologies based on intrinsically conducting polymers composed of modified polypyrroles and polythiophenes that were synthesized in the authors' laboratory are outlined and discussed. These sensors are based on the electrochemical transduction of the hybridization event by conducting polymer thin films. Optical gene detection schemes have also been developed based on cationic conjugated polymer and quantum dots homogeneous assays. The electrochemical and optical readout modalities are compared and discussed.

Interaction of Nanomaterials with Biological Molecules : Manganese and Dopamine

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ABSTRACT

We present here the results of first principles study on the interaction of a Mn_{13} cluster with a dopamine molecule, an important biomolecule functioning as a neurotransmitter or a neurohormone in the living body. It is found that the dopamine strongly binds to the Mn cluster through co-ordinated covalent bond. This finding confirms the observation of dopamine depletion in the presence of Mn nanoparticles.

Interaction of Size Expanded DNA Bases with Small Neutral Gold Nanoclusters

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ABSTRACT

Binding of yDNA bases with gold nanoclusters is studied using density functional theory. We find that gold complexes interact asymmetrically with y-bases. The binding energies in these complexes are found to lie between -29.1 and -77.1 Kcal/mol. The binding is contributed by direct Au-N or Au-O anchor bonds, as well as non conventional Au...H-N type of hydrogen bonding

Cytotoxicity of Polystyrene Nanospheres Internalization in Mouse Fibroblast Cells

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ABSTRACT

With development of nanotechnology application, industry and government regulators notice that nanomaterials, especially nanoparticles, have some potential intimidation for human health and environmental safety. In this work, the cytotoxicity of 20 nm and 200 nm polystyrene nanospheres was investigated in cultured L929 fibroblast cells. There was an obvious difference of cytotoxicity between 20 and 200 nm polystyrene nanospheres because of their size effect. With increase concentration of 20 nm polystyrene nanospheres, L929 cells became round, even shrinkage in shape, whereas cells cultured with 200 nm polystyrene nanospheres were well spreading at these concentrations. With exposure to 20 nm polystyrene nanospheres, TEM image showed that lysosomes were enhanced and cytoplasm organelles were damaged. There was a significant increase exceeding oxidative stress for different concentration of 20 nm polystyrene nanospheres, with increasing of lactate dehydrogenase (LDH) and decreasing of methyl tetrazolium cytotoxicity (MTT). Possible mechanisms involved in the cytotoxicity of polystyrene nanospheres were also discussed.

Keywords: Cytotoxicity, polystyrene nanospheres, cell morphology, cell cycle, oxidative stress

Vertically-Aligned-Carbon-Nanotube-Based Microelectrode Arrays for Neural Interfacing

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ABSTRACT

Mciroelectrode arrays (MEAs) have been adopted to establish the interface between biological neural tissue and electrical devices. A few recent studies have demonstrated that this neural interfacing can be enhanced by exploring the rapid development of nanotechnologies, especially using vertically aligned carbon nanotubes (VACNT). This paper thus attempts to firstly survey the recent advances of VACNT-based MEAs and their intriguing electrochemical, biological, mechanical, and chemical properties for neural interfacing. VACNT can be fabricated with plasma enhanced chemical vapor deposition (PECVD) on metal catalyst, and they can be integrated with MEAs by coating CNF bundles on individually addressed micoelectrode sites. Due to the larger "effective" area of CNT, the capacitive charge injection between electrode and tissue can be improved significantly. The impedance of CNT MEAs, however, can yet be kept small and it exhibits weak frequency dependence. Moreover, the electro-cell coupling and biocompatibility of VACNT-based MEAs are much better than the currently used MEAs. Due to the development of the fabrication technologies and the encouraging properties of VACNT, the integration of VACNT with MEAs holds a great promise in the applications related to neural interfacing. The last section of the paper thus is dedicated to address these key applications along with a few pointers for future application oriented research.

Keywords : Microelectrode arrays, carbon nanotube, neural interface, electro-chemical properties.

Titanate Nanotubes: Synthesis, Properties and Loading with Silver-Nanoparticles for Photochromic Application

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ABSTRACT

High aspect ratio titanate nanotubes with large surface area and good uniformity were produced by alkaline hydrothermal treatment of grounded TiO_2 aerogels and further by applied freeze-drying. Not only the crystal phase and diameter but also morphology of the starting materials impact on the aspect ratio and transformation efficiency of obtained nanotubes. Other parameters, such as the pH value during neutralization process and drying method for the final products, are important on control over the length and dispersion of the tubes. The high quality nanotubes with good crystallinity and uniform dispersion became a good supporter for Ag nanoparticles to exhibit multicolor photochromism behavior, which has great potential application on electronic device.

Local Structural Properties and Growth Mechanism of ZnO Nanostrcutures

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ABSTRACT

We investigated the growth mechanism of ZnO nanorods using *in-situ* extended x-ray absorption fine structure (EXAFS). ZnO nanorods were synthesized with a solution method and the structural properties around zinc atoms were measured by the *in-situ* EXAFS at every process. The synthesis was started with the solution of $ZnNO_3$ powder and H_2O. The solution was added with an amino acid complex and then heated up to 80°C. The EXAFS revealed that the zinc atoms of the solution had only two oxygen atoms without any second neighboring atoms, implying that $ZnNO_3$ is amorphous. When the complex was applied to the solution, the second neighboring Zn atoms appeared, although there was a substantial amount of structural disorders existing in the Zn-Zn pairs. This result suggests that the nitrogen ions in the complex play a role in clustering ZnO. At 80°C, ZnO was rapidly crystallized and the structural disorders disappeared. The in-situ EXAFS measurements provided the critical information of ZnO crystallization in the solution.

Optical Response of Carbon Nanotube Field Effect Transistor with Optical Sensitive Protein

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ABSTRACT

The optical sensitive protein "bacteriorhodpsin (BR)" can be applied to a detection part of a high-speed recognition sensor for the moving body. We fabricated the CNTFET on which the BR is directly functionalized by biotin-avidin method. For the BR- CNTFET device, optical response is observed at start point and end point of irradiation of white light. It is due to the structural relaxation of BR and the movement of proton in BR on the CNTFET.

Metal Oxide Nanowires: Growth, Applications and Devices

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ABSTRACT

We have developed a generic approach for the size-selective and site-specific growth of nanowires by combining vapor-liquid-solid (VLS) approach with the chemical influence of molecular precursors.

The synthesis of nanowires (NWs) is based on the decomposition of discrete molecular species in the liquefied Au-Si alloy, which allows growing nanowires at low-temperatures with a precise control over their diameter and length. The precursor chemistry can be tuned to facilitate the stripping of organic ligands and to achieve complete decomposition that is critical for maintaining the gas phase super-saturation necessary for 1D growth. High-yield synthesis of NWs of tin, vanadium and iron oxides was performed by the chemical vapor deposition of appropriate metal-organic precursors. Axial and radial dimensions of the NWs were varied in the ranges 50-1500 nm and 25-40 μm and the device potential of these building blocks as photo- and gas sensors was tested. For instance, illuminating tin oxide NWs with UV photons triggers interesting photo-conductance with applications in UV detectors or optical switches. In addition, tin oxide NWs were grown on sensor platforms and their response towards carbon monoxide (CO) was compared with nanostructured tin oxide films.

Directly Assembly and Electrical Transport Measurement of Nanowires by Nano-Manipulator Probes

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ABSTRACT

One of the important features to the success of 1D nanotechnology is the ability to manipulate nanostructures physically. Nanostructure assembly is challenging because the pertinent length scales prohibit direct locating and tinkering. So far, fluidic assembly schemes offer sufficient control to fabricate simple networks and dictate the macroscopic patterning of 1D nanostructures but not with the precision, pattern density, or complexity needed for many applications. The alignment of 1D nanostructures via electric or magnetic forces suffers the additional frustration of fringing fields that make the construction of dense or complex architectures impractical. In this work, the directly assembling of the 1D nanowire by using the manipulator machine has been developed to provide a much controllable and accurate strategy in nanowire device fabrication and functional characterization of nanowires structure. The key advantage of this technique is

the ability to precisely move the nano-materials by physically handling it which resulting in no chemical contamination. Through the micrometer-scale probe controlled by the manipulator poisoner, the individual building block such as ZnO, Si nanowires were able to be assembled into the patterned substrate. The electric static force and the electron beam deposition technique under SEM were used to anchor the nanowire to the substrate. After the individual nanowire has been localized to the target position, the in-situ IV measurement by the nanomanipulator was able to be carried out.

Determination of Contact and Intrinsic Nanowire Resistivity in Two-Contact ZnO Nanowire Devices

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ABSTRACT

Cylindrical ZnO nanowires were synthesized to fabricate two-contact ZnO nanowire devices with the same separation distance between the two contact electrodes. Electrical properties including temperature dependence of resistance and *I-V* curves were recorded. According to distinct electrical behaviors and room-temperature resistance, ZnO nanowire devices can be categorized into three different types exhibiting either contact or intrinsic NW attributes.

Fabrication and Magnetic Properties of Metal Nanowires via AAO Templates

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ABSTRACT

Metals (Ni, Co, Cu and Fe) nanowires were fabricated by electro deposition onto anodic aluminum oxide (AAO) template. In this work, we have studied the effect of the electrode potential on the microstructure and magnetic properties of nanowires. TEM results showed that Cu, Co and Ni nanowires were single crystal. Cu and Ni nanowires had the same orientation along the [220] direction, while Co had a preferred orientation along [100] direction. The growth mechanisms are probably due to the competition growth of the adjacent grains and the confinement of growth in the nano-sized hole of the AAO template. Single crystal Fe nanowires could not be formed by the application of different potentials. Ni, Co and Fe showed good magnetic properties. The coercivities up to 1.3 kOe and 1.6 kOe were obtained in Co and Fe nanowires with high remanence ratios 79.7% and 84.8% for Co and Fe, respectively. The remanence ratio of Ni was 97.9%.

The High-Field Drift Velocity in Degenerately-Doped Silicon Nanowires

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ABSTRACT

The nanowires and nanotubes are being considered as the best candidates for high-speed applications. The mobility and saturation velocity are the two important parameters that control the charge transport in any conducting channel. It is shown that the high mobility does not always lead to higher carrier velocity. The ultimate drift velocity due to the high-electric-field streaming are based on the asymmetrical distribution function that converts randomness in zero-field to streamlined one in a very high electric field. The limited drift velocity is found to be appropriate thermal velocity for a non-degenerately doped sample of silicon, increasing with the temperature, but independent of carrier concentration. However, the limited drift velocity is the Fermi velocity for a degenerately doped silicon nanowire, increasing with carrier concentration but independent of temperature. The results obtained are applied to the modeling of a nanowire transistor.

In-situ TEM Electrical and Mechanical Properties Measurements of One-Dimensional Inorganic Nanomaterials

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ABSTRACT

The unique possibilities of Current-Voltage (I-V) and Force-Displacement (F-D) curve recordings from individual 1D-nanostructures inside high-resolution transmission electron microscopes are demonstrated. The examples include Ga-filled MgO, In-filled SiO_2 and pure multi-walled BN nanotubes.

1/f Noise Analysis of ZnO Nanowire and Thin Film

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ABSTRACT

1/f noise spectral are obtained on ZnO nanowires thin films and ZnO hybrid materials at different concentration. Various 1/f noise models are used to analysis the results, the parameters such as: mobility, trap level and density, activation energy are extracted from the models. The results show that 1/f noise is a useful tool to monitor thin film and nanowires quality, as well as interface properties. By applying the models, the important parameters can be derived which is difficult to measure by other scientific instruments.

P-I-N junction in Silicon Nanowires

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ABSTRACT

P-i-n junctions were fabricated along silicon nanowires of about 8 nm in cross-sectional dimension via the conventional top-down approach. Rectifying electrical characteristics have been observed and the ideality factor is estimated to be 3.8, attributed to trapped charges in the encapsulating silicon dioxide layer. Dopants diffusion along the nanowires reduces the effective length of the intrinsic region. The reverse bias breakdown exhibiting a negative temperature coefficient could be attributed to tunneling effect. The p-i-n junctions respond well to illumination despite their small capture area and preliminary results on photoresponse will be presented.

Direct Electrochemistry of Horseradish Peroxidase in Layer-by-Layer Nanotubes Synthesized on Template

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ABSTRACT

Horseradish peroxidase (HRP) and phthalic diglycol diacrylate (PDDA) was successfully immobilized on anodic aluminum oxide (AAO) template modified glassy carbon (GC) electrode using electric field directed layer-by-layer assembly (EFDLA) synthesis. The materials were characterized by scanning electric microscopy (SEM), transmission electric microscopy (TEM), UV-vis spectroscopy (UV-vis) and electrochemical impedance spectroscopy (EIS). A pair of redox peaks resulted from the redox reaction of HRP were observed with the formal potential of 0.012V (v.s. SCE) in 0.2 mol/L pH = 7.0 phosphate buffer solution (PBS). The number of transference electron was 1.05 and the direct electron transfer (eT) constant (k_s) was 0.59 s^{-1}.

Applying One-Dimensional ZnO in Dye-Sensitized Solar Cells and Electronic Papers

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ABSTRACT

We report here two applications of one-dimensional ZnO nanostructures, i.e. dye-sensitized solar cell (DDSC) and electrochromic type electronic paper making use of hydrothermally grown ZnO nanostructure array electrodes including nanorods and nanoflowers.

In DSSC application, the performance of ZnO nanoflower and nanorod arrays was compared. The dye used was *cis*-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato)-ruthenium(II) bis-tetrabutylammonium (N-719). At AM 1.5G irradiation with 100 mW/cm^2 light intensity, the DSSC based on ZnO-nanoflower film showed an energy conversion efficiency of 1.9%, which is much higher compared to that (1.0%) of the control device constructed using a photoanode of up-standing ZnO-nanorod array fabricated by hydrothermal method as well. The better performance of ZnO-nanoflower DSSC was due to a better dye-loading and light harvesting of the ZnO nanoflower film. The results demonstrate potential application of ZnO nanoflower array for efficient dye-sensitized solar-cells.

In the electrochromic type electronic paper applications, we employed a commercially available electrolyte and with the ZnO nanorod array made by hydrothermal method.The device showed a much improved response time of 80 ms and 30 ms of coloring and bleaching respectively compared to traditional devices which require seconds to change. Detail device characteristics will be reported.

三 Spectrum Analysis and its Application of Tunneling Current in Scanning Tunneling Microscopy

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ABSTRACT

By spectra analysis of tunneling current, a novel technique for the simultaneous measurement of tip-sample force interactions in Scanning tunneling microscopy (STM) is developed. Frequency spectra of the tunneling current of Highly Oriented Pyrolitic

Graphite (HOPG) is measured in air with a mechanically cut probe from a wire of Pt-Ir alloy. A frequency peak at about 40 kHz presented to the spectra, which is demonstrated to relavant to the vibration mode perpendicular to the length direction of the STM probe and to its eigenfrequency under tip-sample force interactions. The characteristics of the eigenfrequency for various experimental conditions are also presented. Quantative relationship between the eigenfrequency and the force gradient of tip-sample interactions is acquired. The spectrum analysis technique provides a novel method for simultaneous measurement of force interactions under true STM conditions.

Enabling Nanometrology for Trench and Hole Structures with Carbon Nanotube AFM Probes

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ABSTRACT

Atomic force microscopy (AFM) and carbon nanotube (CNT) are two cornerstones in the emerging field of nanoscience and nanotechnology. This paper discusses recent progress in combining CNT probes with the industrial AFM metrology tool to measure depth, sidewall angle, and pitch for narrow and deep features in nanoscale integrated circuit manufacturing processes. As the technology roadmap advances to the 45 nm node and below, the narrow space features with high aspect ratio (trench or hole) pose a difficult challenge for optical, e-Beam, or even conventional AFM dimension metrology. Results in this paper demonstrated that AFM with CNT tips shows a great potential to provide a gauge capable metrology solution for STI etch, contact etch, metal trench etch, and via etch for logic, DRAM, or flash memory microelectronic devices. CNT probes have small geometry, excellent mechanical property, and very long lifetime. The inline etch depth metrology by AFM is critical for production inline process monitoring, engineering process experiments, or calibrating CD SEM/scatterometry simulation models. CNT probes equally apply for metrology needs in other similar nanoelectronic manufacturing such as photomask and magnetic thin film head.

3-Dimensional XPS Imaging of Surface Nano-Structures; A New Technique

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ABSTRACT

XPS energy spectra vary characteristically with the depth distribution of electron emitting atoms on the nano-scale. This is the basis for the by now well known and widely used method[1] to non-destructively determine atomic depth distributions with nano-meter resolution by analysis of the inelastically scattered electrons associated with the XPS peak.

A new algorithm which is suitable for automation was suggested recently[2]. For each XPS signal, this algorithm determines the total amount of the corresponding atoms within the outermost ~ 10 nm and it also determines their depth distribution. The validity of the algorithm was demonstrated experimentally by comparison to more elaborate quantification methods[2]. In addition, software that can automatically analyze several thousand spectra corresponding to the situation in XPS imaging is developed. The software produces nondestructively a 3-D image of the surface with nanometer depth resolution. The practical applicability for XPS imaging was recently demonstrated[3].

As an example we demonstrate a *quantitative* test[4] of the algorithms ability to produce images of Ag taken from a series of samples with increasing thicknesses of plasma patterned Octadiene (2, 4, 6 and 8 nm) on Ag substrates. The obtained images of the amount of silver atoms in the outermost few nano-meters of the samples were in good agreement with the nominal thicknesses. For a given sample, different sectioning of depth distributions of atoms were made which clearly prove the ability of the method for quantitative and nondestructive 3-D characterization of nano-structures.

References

[1] S. Tougaard Surf. Interf. Anal. 26, 249 (1998)
[2] S. Tougaard, J. Vac. Sci. Technol. A23, 741 (2005)
[3] S. Hajati, S. Coultas, C Blomfield and S. Tougaard, Surf. Sci. 600, 3015 (2006)
[4] S. Hajati, S. Coultas, C Blomfield and S. Tougaard, Surf. Interf. Anal. (in press)

The Exposure Process Study of 100KV JBX-6300LS Electron-Beam Nanolithograph System

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ABSTRACT

We report on a series results of the performance of a Jeol model JBX-6300LS electron-beam nanolithography system operating at 100KV. The exposure conditions are optimized to fabricate dense lines with 1:1 L/S and with the line-widths down to 30 nm for resist ZEP520A and PMMA. The lines show a very good uniformity within an area as large as 2 mm×2 mm. We obtained isolated metal lines with 22 nm widths through lift-off process based on 170 nm thick PMMA. Exposure studies were also performed for double layer resists to get a good under-cut cross section profile.

The Nano-Pillar Fabrication by Self-Assembled Nanoparticle Monolayer

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ABSTRACT

The fabrication of the periodic nanostructure has been an extremely active area such as electronics, sensors and microelectro-mechanical machines. A large-area nano-pillar fabrication method by nanoparticle monolayer as an etch mask was displayed, which can be used in kinds of nano thin film fabrication. The uniform gold nano-particle monolayer was formed on silicon substrate by self-assembled method using coupling agents. The silicon nano-pillar arrays were fabricated using gold nano-particles as etching mask by Reactive Ion Etching. The influence of different parameters in etch process, such as gas ratio, etch power and etch time, on silicon nano-pillar arrays were investigated in detail. A large-area Si nano-pillar arrays with pillar size of < 20 nm and aspect ratio > 10:1 can be obtained on Si substrate by controlling the suitable etch parameters. The results show that this method can be applied to pattern a wide variety of thin film materials into pillar arrays. The approach reported here offers a possibility to produce large-area nano-pillar, which is especially important for developing micro-electro-mechanical machines.

Fabrication and Characterization of Traveling Wave Dielectrophoretic (twDEP) Microfluidic Devices

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ABSTRACT

In this work, we present a microfluidic device with 16 parallel electrodes array and microchamber for cell manipulation by traveling wave dielectophoretic force. Polystyrene microspheres suspensions in water were used as the tested cells. Cells respond to the electric field in various mechanisms depending on the frequency of applied AC signals. When the frequency of applied AC fields is in the range where dielectrophoresis (DEP) is negative, cells experience twDEP force in such a way that they were repelled from the electrode rather than being trapped by positive DEP. As the frequency of the applied signals is in the range of 50-700 kHz, cells were move under the influent of twDEP force. As the frequency of the applied signals is more than 700 kHz, cells started moving out of the center between electrodes. These results are consistent with the theory. Because of the fact that twDEP force depends on the effective polarizability and size of particle, it gives us a chance to make the device for cells fraction and separation which can be further applied in biological and medical application such as motion control and cell selectivity.

Electric Field Assisted Fabrication on Si and HOPG Surfaces by AFM

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ABSTRACT

In this paper, we present two different results of oxidation using the same electric field assisted nano-fabrication method by atomic force microscope (AFM). Experiments were performed on silicon (Si) and highly oriented pyrolytic graphite (HOPG) surfaces

respectively. Raised oxide lines were formed on Si surface, whereas sunken etch grooves were got on HOPG surface after the fabrication. We conclude that different materials may form different oxide structures in the oxidation fabrication: positive structure (raised oxide line) or negative structure (etch groove). By utilizing these oxide structures reasonably we may fabricate novel nano patterns and devices.

On-Line Displacement Measurement using a High Stability Multiplexed Optical Fiber Interferometer System

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ABSTRACT

A multiplexed optical fiber Michelson interferometers system for measurement displacement is presented. This system employs fiber Bragg gratings (FBGs) and wavelength-division-multiplexing technique to multiplex two optical fiber interferometers together which share the same optical path of the main part of the optical system. When the Michelson interferometer which uses FBGs as reflective mirrors is stabilized by an electric feedback loop, the other interferometer which does the measurement work is also stabilized. An active phase tracking technique is applied for signal processing to achieve high resolution.

A Fully Coupled Analysis and Simulation of Capacitively Coupled Radio Frequency Glow Discharges, Application to PECVD System

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ABSTRACT

Plasma enhanced chemical vapor deposition process is simulated by combined analysis for the glow discharge, fluid flow, and chemical reactions. The main goal is to achieve an optimized design for the plasma glow discharge reactors. Argon plasma is assumed in this simulation. The approach used is based on fully theoretical partial differential equation models, and no empirical approximation of the critical data is used. Owing to the fact that the relevant equations are highly nonlinear, the discretization method is of a great importance. Finite Boxes Method is used to solve the mentioned partial differential equations (PDEs), and Scharfetter-Gummel method is used to discretize the electron and ion flux terms.

Influence of Annealing Temperature on Preparation of Nanosize Lead Titanate Powder

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ABSTRACT

This article introduces the process that mainly contains the precursor preparation and crystallization for the preparation of the nanosize lead titanate powder. The nanosize powder is obtained by annealing at 800°C. With the X-ray diffraction pattern, the product is the lead titanate powder, of which the space group is P4 mm and the a and c is 3.882 Å and 4.132 Å respectively. The SEM image shows that the average size of the particles is about 500 nm.

A Nanoindentation Study on Magnetron Sputtering Deposited Cu/Ta Thin Films

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ABSTRACT

Ta layers (50 nm) and Cu layers varied in thickness (100 nm, 200 nm, 300 nm, 400 nm and 500 nm) were deposited by magnetron sputtering process on thermal oxidized Si substrate. Nanoindentation was adopted to investigate the compound hardness and elastic modulus of $Cu/Ta/SiO_2/Si$ multilayer thin film system, which is a typical structure widely used in the manufacture of integrated circuit below 130 nm technology. The calculation of hardness and elastic modulus of the thin films under different normal loads was based on Oliver and Pharr method. The results indicate that the hardness of the films shows an apparent dependence on the film thickness and decreases with the increase of film thickness, whereas the elastic modulus does not. The cross-sections of the thin films were observed with SEM before the nanoindentation experiments, and the residual indents after. In order to reveal further information, a trench through the center of a residual indent was created by FIB. In some residual indent centers, a crack was found in the copper layer, suggesting a weak mechanical property in copper layer under a relatively large load.

Keywords: copper; tantalum; nanoindentation; hardness; elastic modulus.

Synthesis of Nanoporous Carbon Spheres and Their Application in Dispersing Noble Metal Nanoparticles

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ABSTRACT

Monodisperse carbon spheres were synthesized in large quantities via a facile hydrothermal method. Transmission electron microscopy (TEM) and high resolution transmission electron microscopy (HRTEM) observation results indicate that the surfaces of as-prepared carbon spheres are incompact and distributed with countless pores of about 0.2 nm in diameter. The effects of several reaction parameters such as temperature, the reaction time, the fill rate and the cooling-down mode on size, monodispersity, and surface roughness of carbon spheres were investigated. Taking the carbon spheres as substrates, noble-metals such as silver was deposited onto their surfaces by an one-step ultrasonic electrodeposition procedure to synthesize Ag/C nanocomposites. Under appropriate conditions, silver nanoparticles (NPs) of 5-6 nm in diameter were dispersed homogeneously on the surfaces of the nanoporous carbon substrates. This study offers a simple, efficient and easily controllable approach to fabricate noble-metal/carbon nanocomposites.

Keywords: Nanoporous carbon spheres; Ultrasonic electrodeposition; Metal/C nanocomposite.

New Challenges in MOS Compact Modeling for Future Generation CMOS

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ABSTRACT

As bulk-MOS technology is approaching its fundamental limit, non-classical devices such as multiple-gate (MG) and silicon-nanowire (SiNW) transistors emerge as promising candidates for future generation device building blocks. This trend poses new challenges to developing a compact model suitable for these new device structures and requires a paradigm shift in the core model structure. Conventional bulk-MOS models are based on *four*-terminal *unipolar* conduction in a *doped* channel with ideal *symmetrical* PN-junction source/drain contacts. In MG/NW MOSFETs, however, the device becomes *three*-terminal with *undoped* channel and possible *bipolar* conduction, and source/drain contacts become an integral part of intrinsic channel. Source/drain asymmetry, either intentional or unintentional, in a theoretically symmetric MOSFET also becomes important to be captured in a compact model, which is nontrivial in a model that depends on terminal source/drain swapping at the circuit level. This paper discusses these new challenges and demonstrates solutions based on the unified regional modeling (URM) approach.

Fully Ballistic Field-Effect Transistor: Theoretical and Experimental Evidence

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ABSTRACT

It has long been the hope of devising a FET (field-effect transistor) operating in the fully ballistic regime. Since a ballistic FET – a perfect FET – has no defects, kinks or obstacles other than a connection at each end to allow current to flow through an external circuit. Consequently, significant performance improvements are expected. Thanks to remarkable theoretical and experimental progress in mesoscopic physics, ballistic field-effect devices are routinely achievable. Among them, the most investigated mesoscopic device is a nearly perfect 1D quantum ballistic conductor which is realised by split-gate constrictions also called quantum point contacts (QPC), on a high mobility two-dimensional electron gas (2DEG). This device has allowed discoveries of conductance quantisation and numerous exceptional electronic properties in the fully ballistic regime. However, to the best of our knowledge no transistor effect has been demonstrated in any ballistic device. Indeed, a transistor is a device having gain, i.e., the ability to amplify electrical signals. The amplification ability of a FET is assessed by the voltage gain, defined as the ratio of the variation of the output drain-source voltage V_{DS} over that of the input gate-source voltage V_{GS} ($\Delta V_{DS}/\Delta V_{GS}$), which must be higher than 1. By using two main FET parameters, i.e., transconductance $g_m = \partial I_{DS}/\partial V_{GS}$ (I_{DS}: drain-source current) and output conductance $g_d = \partial I_{DS}/\partial V_{DS}$, the voltage gain can be expressed as g_m/g_d. This work shows that by the Landauer-Buttiker formalism and an appropriately designed QPC device, 1D sub-bands can be used to obtain the voltage gain exceeding one in the fully ballistic regime.

Methodologies for Size, and Temperature Dependent Change of Materials Properties

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ABSTRACT

With the miniaturization of a solid down to nanometers scale, the mechanical and optical properties of such nanomaterials are different from that of their corresponding bulk materials. A systematic understanding of the atomic origin of the unusual behavior of mechanical and optical properties of a nanosolid is presented here towards the predictions for design and controllable growth of nanosctructured materials. The Local

Bond Average (LBA) approximation and bond-order-length-strength (BOLS) correlation mechanism in size, temperature and pressure domain has been developed, which enables the tunability of various measurable properties, such as elastic constants, optical phonon frequency shift. Agreement between predictions and observations reveal that the shortened and strengthened surface bonds are responsible for the observed size dependent change of material properties, while the temperature induced bond expansion and weakening are the physical origin for the temperature dependent change of measurable material properties.

Width Effects in Ballistic Graphene Nanoribbon FETs

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ABSTRACT

Graphene related materials have drawn a lot attention from the device engineering community due to their unique electronic properties such as high carrier mobility, which makes them potential candidates for novel transistor channel devices. Carbon nanotube (CNT) FETs have been widely considered in this area, whereas the fabrication challenges on the chirality control of CNTs is a big drawback for their potential application in a realistic system. Recent experimental studies [1,2] show the possibility to fabricate graphene nano-ribbons (GNR) transistors, and the potential of CNRs as an alternative method to bypass the CNT chirality challenge while still retaining the excellent electronic properties of graphene sheets, such as high electron/hole mobility [3], which appear in the CNTs as well. Furthermore, the graphene sheet itself is a semi-metal and can be employed as the metal contacts. Similar to the CNT cases, the electronic structure of GNRs such as the bandgap (E_G), is a sensitive function of their width [4]. In addition, quantum effects such as quantum tunneling dominate the I_{OFF} of the device and strongly depend on the E_G, i.e., the GNR width. Therefore, the dependence of the device behavior on the width needs to be properly investigated for a rigorous treatment of the I_{OFF} of the device.

In this work, we utilize a full real-space quantum transport simulator using Non-equilibrium Green's Function (NEGF) approach self-consistently coupled to a 3D Poisson's solver for treating the electrostatics as shown in Fig. 1. [5] Using this model, the ballistic performance of double-gate armchair GNR MOSFETs and armchair GNR SB FETs with different types of the contacts and the regular metal with the constant density of states is evaluated. The details of the device structure are shown in Fig.2. The width dependence of these different types of armchair GNR FETs on the device performance, in terms of the subthreshold swing (SS), the drain-induced-barrier-lowering (DIBL),

ON-current, the device delay (t), and power-delay-product (PDP), are investigated. Our simulation results show that the device performance is limited by the tunneling currents which depend on $E_G$delay, controlled by the GNR width. As shown in Fig. 3 and Fig. 4, among these different transistor types, GNR MOSFETs (infinite semiconducting conducts) always have the best performance.

Off-State Leakage Current in Nano-Scale MOSFET with Hf-Based Gate Dielectrics

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ABSTRACT

The off-state gate current, drain current and substrate current were simulated, exhibiting that the edge direct tunneling current (I_{EDT}) from the gate overlap to the source and drain extension prevails over conventional gate induced drain leakage current (I_{GIDL}), subthreshold leakage current (I_{SUB}), band-to-band tunneling current (I_{BTBT}) and I_{EDT} dominates off-state leakage current. The I_d-V_g characteristics for the 50 and 90 nm MOSFETs were investigated, it was observed that a large increase in off-state leakage current (I_{off}) occurs for smaller devices due to increase in edge direct tunneling current at high V_{dd}. I_{EDT} with various gate dielectrics including SiO_2, Si_3N_4 and HfO_2 were compared, which indicates that I_{off} decreases because of reducing I_{EDT} by increasing gate dielectrics permittivity K. The I_d-V_g characteristics for various gate dielectrics were studied, we found that off-state leakage current arises because of fringing induced barrier lowering when K > 25. This paper also examined HfSiON and HfLaO gate dielectrics and the I_{EDT} with them is 2-5 orders of magnitude lower than that of SiO_2 and FIBL is small. Moreover, HfLaO and HfSiON have superior thermal stability, they are promising gate dielectrics

Real- and Mode-Space Simulation of Electron Transport in Metallic Carbon Nanotubes using NEGF

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ABSTRACT

Electron and potential distributions in metallic carbon nanotubes (CNTs) under applied voltages are simulated with fully self-consistent real and mode space non-equilibrium Green's function (NEGF) and tight-binding (TB) method. I-V characteristics are also obtained. It is shown that mode-space method is a good approximation to real-space method and could significantly reduce computational cost. A rough relation is given to determine whether to include a specific mode in simulation or not. Conductance of small-diameter CNTs is found to coincide with theoretically calculated conductance of a nano-scaled conductor in ballistic limit. Computed conductance of large-diameter CNTs is large than $4e^2/h$ due to contribution of upper subbands.