



Strasbourg (France)

E-MRS Spring Meeting 2004
May 24-28, 2004

SYMPOSIUM G

Current trends in nanoscience – from materials
to applications

Symposium Organizers:

Marshall Stoneham, University College, London, U.K.

Hermann Grimmeiss, University of Lund, Sweden

Giovanni Marletta, University of Catania, Italy

George Jeronimidis, University of Reading, U.K.

Papers will be published in Materials Science and Engineering C

E-MRS 2004 SPRING MEETING

SYMPOSIUM G

Tuesday, May 25, 2004

Morning

Session I

G-I.01 09:10

THE GROWTH AND ELECTRICAL PROPERTIES OF SELF-ORGANIZED METAL-OXIDE NANOSTRUCTURES FORMED BY ANODIC OXIDATION OF SPUTTER-DEPOSITED Ta-Al BILAYERS

A. Mozaley, G. Gorokh, Department of Microelectronics, Belarusian State University of Informatics and Radioelectronics, 6, Brovka Str., Minsk 220013, Belarus and M. Sakairi, H. Takahashi, Interface Micro-Structure Analysis Laboratory, Graduate School of Engineering, Hokkaido University, N-13,W-8, Sapporo 060-8628, Japan

Experimental samples were Ta films, 8 to 20 nm thick, and Al films, 500 nm thick, sequentially sputter-deposited onto dielectric substrates and anodized in 0.2 M oxalic acid solution at 53V. After selective removal of the overlying porous alumina, the films were examined by SEM, TEM, AES, XPS, and EIS. The behaviors of sheet resistance (SR) and temperature resistance coefficient (TRC) of the films were determined in a wide temperature and frequency range.

It was found that the films are composed of multiplied oxide hillocks, 90 nm in size, closely adjusted to, but separated from, each other by unanodized Ta metal, which is self-organized in the nano-sized metallic network (mesh). A single built element in the mesh (tantalum nanowire) is about 5-10 nm thick. The oxide hillocks have a mixed composition of tantalum pentoxide, sub-oxides, alumina and electrolyte-derived species. The co-operative transport mechanism for Ta and Al ions during anodizing of the Ta-Al bilayers was further advanced in this work. It appeared that the net-like structure and nanoscale topography of the conductive Ta mesh result in a very high SR value (up to 150 kOhm/sq). Simultaneously, the films were found to possess a very low TCRs (70...10 ppm). This extraordinary combination of two mutually exclusive parameters can be explained by considering the films as periodical heterogeneous two-phase (metal-insulator) systems, having impurity depth and width profiles, and by existence in the films of specific quantum-size effects, with no counterpart in the initially deposited metallic films. Possible electron conducting mechanisms in the metal-oxide films will be discussed in the paper. New findings are valuable for fabricating integral micro-resistors with significantly improved performances.

G-I.02 09:25

OPTIMIZING THE GROWTH OF 1300 NM INAS/GAAS QUANTUM DOTS WITH INGAAS AND INALAS LAYER

H.Y. Liu(a), I.R. Sellers(b), K.M. Groom(a), M. Hopkinson(a), T.J. Badcock(b), D.J. Mowbray(b) and M. S. Skolnick(b), (a)Department of Electronic & Electrical Engineering, University of Sheffield, Sheffield S1 3JD, U.K., (b)Department of Physics & Astronomy, University of Sheffield, Sheffield S3 7RH, U.K.

Recently, the development of 1300-nm InAs/GaAs QD lasers has progressed rapidly. However, the performance of these lasers appears to be limited by gain saturation and poor temperature stability around room temperature (RT), due to a low dot density and a small energy separation between the QD ground and first-excited states. In order to improve device performance, we have increased both the QD density and energy separation by the incorporation of InGaAs and InAlAs layers.

Initially, the structural and optical properties of GaAs-based 1300 nm InAs/InGaAs dots-in-a-well (DWELL) structures have been optimized by using different In compositions, x, for the InGaAs well. We found that the optimum In composition is 15%. Optimised devices exhibit excellent characteristics with a room temperature Jth of 33Acm⁻² at 1310 nm, with lasing via the ground state up to 85°C and negligible variation of the external slope efficiency across this temperature range. To the best of our knowledge this represents the best reported Jth for a >1300nm QD laser with uncoated facets. The use of InGaAs potential barriers in the InAs/InGaAs DWELL structures results in a reduction of the energy separation between the discrete QD energy levels. To increase this separation, a combined InAlAs-GaAs buffer layer and InAlAs-InGaAs strain-reducing layer were introduced into the structure. This modification results in an increase of the energy separation from 84 to 93 meV for optimum thickness of GaAs in the InAlAs-GaAs SBL, due to the increased confinement potential of the Al containing ternary. Based on these results, 1300-nm InAs/GaAs QD lasers containing InAlAs cap layers have been successfully operated at room temperature and show promise for improved high temperature operation.

- G-I.03** 09:40 -Invited- ELECTRONIC CONFINEMENT AND C-AXIS CONDUCTIVITY IN LAYERED PEROVSKITE MANGANITES
Ch. Renner(a), H.M. Roennow(b) and G. Aeppli(a), (a)London Centre for Nanotechnology, UCL, London, U.K., (b)Paul Scherrer Institute, Villigen, Switzerland
 One property common to most layered transition metal perovskite oxides is their highly anisotropic transport properties. The in-plane resistivity is metallic, whereas electron transport perpendicular to the layers is characteristic of a semiconductor. We present vacuum tunneling spectroscopy on cleaved $\text{La}_{1.4}\text{Sr}_{1.6}\text{Mn}_2\text{O}_7$ single crystals using a scanning tunneling microscope (STM) in ultrahigh vacuum. We find a gap E_g that is associated with the room temperature c-axis conductivity, but remarkably does not vanish when the temperature is lowered through the metal-insulator transition. This striking result suggests that the intrinsic electron transport between adjacent perovskite layers is thermally activated at all temperatures, with a characteristic activation energy E_g . We further find no evidence of electronic phase separation, as E_g is spatially homogeneous at all temperatures. We shall discuss these spectroscopy data and atomically resolved STM micrographs in the context of colossal magnetoresistance (CMR), and their contribution to our understanding of CMR perovskites.
- G-I.04** 10:15 NANOFABRICATION OF COILS FOR BIOSENSOR APPLICATIONS BY FOCUSED ION BEAM (FIB)
A. Vilà, F. Hernández, A. Romano-Rodríguez, S. Martínez, C. Serre, A. Pérez-Rodríguez, J.R. Morante, EME-CerMAE, Department of Electronics, Physics Faculty, University of Barcelona, Martí i Franqués 1, 08028-Barcelona, Spain
 Magnetic biosensors often require optimum coils to achieve good selectivity and specificity. Numerical calculations indicate that the best coil design should include a limited external dimension and a narrow separation between tracks. In particular, for micrometer-sized coils, the distance between tracks would be in the nanometre range, which is difficult to achieve via standard microelectronic processes. A good way to accomplish these design rules is using a Focused Ion Beam (FIB), which is a direct-write technique that uses an accelerated Ga⁺ beam.
 The main goal of this work is to describe different methods to fabricate such microcoils for biosensor applications, using the FIB located at our nanotechnology platform. One is based on patterning the coil on a metal/insulating/semiconductor substrate, followed by the realisation of the electrical contacts inside the FIB machine. Results will be presented and discussed. Other alternatives using FIB will also be considered.
- G-I.05** 10:30 NANO-SCALE STRUCTURES BASED ON PHOTOCHROMIC ORGANIC COMPOUNDS
Valery A. Barachevsky, Photochemistry Center, Russian Academy of Sciences, 7a Novatorov Street, Moscow 119421, Russia
 The analysis of the results obtained during an investigation of the technology development as well as the study of the photochromic and optical properties for the polymolecular films and molecular aggregates based on the certain photochromic compounds is presented. This study is connected with making nano-structured systems acceptable for manufacturing the recording media used in one- and three-dimensional operative optical memory with the high information capacity, photocontrolled frequency converters of laser radiation, and chemical as well as biological sensors. It was showed that the photochromic compounds manifesting valence isomerization (quinones, diarylethenes, fulgides) are more acceptable for optical memory. Polymolecular layers and J-aggregate-containing films prepared with the use of photochromic spirocompounds exhibiting photoinduced photodissociation and thermal cis-trans isomerization provide a useful application for making of other two above mention devices.
- 10:45 **BREAK**

Session II

G-II.01 11:10 -Invited-

ADVANCES IN SCANNING PROBE MICROSCOPY FOR NANOTECHNOLOGY

Mervyn Miles, Andy Humphris, Jamie Hobbs, Massimo Antognozzi, Andy Round, James Vicary, Loren Picco and Terry McMaster, H.H. Wills Physics Laboratory & Interdisciplinary Research Centre for Nanotechnology, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, U.K.

One of the main techniques for the characterisation of nanoscale structures is scanning probe microscopy (SPM). This technique also has potential for the fabrication of structures on the nanoscale. In this presentation, recent advances in our laboratory for increasing the force sensitivity of atomic force microscopy (AFM) in order to reduce distortion of delicate structures and increase AFM resolution will be described. Although SPM has many major advantages over other forms of microscopy, it has, in general, the one serious disadvantage of slowness in imaging. Very low frame rates not only prevent the technique from following processes occurring on shorter timescales, but also prevent rapid inspection of large areas of the specimen. Of particular importance to the fabrication of nanoscale structures using SPM technology is the serial nature of the SPM scanning process. In order to address a large area and create nanoscale structures on a viable timescale through the interaction of the SPM probe with the surface, much higher imaging speeds are required. Active resonance control to increase or decrease the effective quality factor (Q) of the probe will be described and examples of its use to reduce the imaging force and increase the resolution of images recorded in liquid environments will be given. This technique can also be used in dynamic force spectroscopy in liquid, allowing the measurement of the complex mechanical properties of single molecules. Active resonance control has also been used to increase the sensitivity of biosensors based on micro cantilevers. The TDFM is a true non-contact microscope that can also operate in liquid environments. The interaction of the probe with the specimen is mediated by a few layers of water molecules, and the technique can be used to study the local structure of water on surfaces. Imaging with this technique is inherently slow, but use of the active resonance controller can increase the maximum speed by about a factor of three. Perhaps surprisingly, the resulting images are also of higher resolution and have higher signal-to-noise content, for example, combined TDFM and active resonance can routinely produce the highest resolution images of DNA molecules. In another application, TDFM has also been used to map magnetic field vectors over the surface of a hard disk. Perhaps the greatest challenge has been to increase the scanning rate of SPM into the realm of a frame in milliseconds. Here the recent development has been resonant scanning microscopy (RSM). This provides a new platform for imaging and data collection. Examples will be described in which RSM has been applied to (i) scanning near-field optical microscopy (SNOM) where the imaging rate has been increased by a few orders of magnitude compared to current SNOM instruments and (ii) atomic force microscopy (AFM).

G-II.02 11:45

SUB-MICROMETER ADHESION MODULATION ON POLYMER SURFACES CONTAINING GRATINGS PRODUCED BY TWO-BEAM INTERFERENCE

M. Csete, Cs. Vass, N. Kresz, K. Osvay and Zs. Bor, Department of Optics and Quantum Electronics, University of Szeged, Dóm tér 9, 6720 Szeged, Hungary, S. Hild, O. Marti, Department of Experimental Physics, University of Ulm, Albert Einstein Allee 11, 89069 Ulm, Germany

Grating-like structures having a period of 416 nm were produced on the surface of poly-carbonate films by two-beam interference realized by the fourth harmonic of Nd:Yag laser. The period of the structures was half of the applied master grating, the ratio of the width of the ablated valleys to the period was tuned by the intensity, the depth of the modulation was increased by the number of laser pulses. Pulsed force mode atomic force microscopy was applied to study the topography and the adhesion on structured surfaces with sub-micrometer resolution. The adhesion modulation caused by the topography was calculated along different line cross-sections taking into account the tip and surface geometry. The separation of the effects of the topography and the laser induced material changes proved that the adhesion is increased at the areas illuminated by laser beam having a fluence above the ablation threshold. It was shown that very adhesive randomly distributed grains also appear on the surface above the damage threshold. Poly-carbonate films having sub-micrometer periodic adhesion modulation were applied to attach biological objects.

G-II.03 12:00

LIGHT-INDUCED RANDOM WALK MOTION OF AN AZOBENZENE-CONTAINING POLYMER

Boris Bellini, Jorg Ackermann, Hubert Klein, Philippe Dumas, CRMN – UPR 7251, Faculté des Sciences de Luminy, Université Aix-Marseille II et III, Marseille, France

Thin films of azobenzene-containing polymers (PMMA DR1) undergo topographic deformations when exposed to green light, at an intensity ($\mu\text{W per cm}^2$) far under the one necessary to increase the film temperature or perform ablation.

We illuminate spin-coated azopolymer films with an interference pattern of micronic step and simultaneously study the evolution of the topography with an Atomic Force Microscope in semi-contact mode. Light-induced deformations appear as a surface grating of periodicity equal to the one of the interference pattern. Data indicate a massive molecular motion. It is understood that this motion occurs from highly exposed areas to darker ones and that it is triggered by the photo-isomerization cycles of the azo-chromophores. But questions about the process remain. A fundamental one being: is it a collective or an individual process? We propose a light-driven random walk model that accounts for the observed phenomena. We start with a coarse-grained approach which overlooks the effects of light polarization and which is based on only two hypotheses: - Each isomerization cycle causes a displacement of span l of the chromophore in a random direction. - The isomerization probability is proportional to the local light intensity. We compute the evolution equation of the surface deformation $h(x,t)$ exposed to an interference pattern. The inferred expression of $h(x,t)$ displays a grating formation time and a saturation height. This expression fits well the experimental curve. Discussing the quantitative implications of this first approach lead us to generalise the model. Indeed, two effects can easily be included: the role of the polarisation direction of light and the bleaching process that suppresses the photo-activity of the chromophores.

G-II.04 12:15

SWITCHING OF INDIVIDUAL PHOTOCHROMES

Nicolas Battaglini, Hubert Klein, Philippe Dumas, CRMC, CNRS, Marseille, France

Diarylethene are photochromic molecules that undergo reversible switching between two isomeric conformations when shined with appropriate light. We present a STM study of diarylethene derivatives grafted on a gold surface. We elaborate mixed self assembled monolayers on a gold surface containing both alkylthiols and photochromic moieties. STM imaging of such surfaces show well organized alkylthiol domains containing isolated photochromes.

Such samples allow us to focus on photochromic molecules. Our STM data provide evidence that the individual photochromic molecules reversibly switch between two states. We assign these states to the two isomeric conformations of the diarylethene. These results will be discussed in the light of other experimental data.

12:30

LUNCH

Session III

G-III.01 14:00 -Invited-

GROWTH OF HIGH QUALITY SINGLE WALL CARBON NANOTUBES AND THEIR APPLICATION IN TOP GATE AND SIDE GATE TRANSISTORS

K.B.K. Teo(a), R.G. Lacerda(a), M.H. Yang(a), A.S. Teh(a), L.A.W. Robinson(a), S.H. Dalal(a), N.L. Rupesinghe(a), F. Wyczisk(b), K. Koziol(a), D. Roy(a), M. Chhowalla(a), D.G. Hasko(a), P. Legagneux(b), G.A.J. Amaratunga(a), and W.I. Milne(a), (a)University of Cambridge, U.K., (b)Thales Research and Technology, France

The single wall carbon nanotube (SWNT) is a promising candidate as a building block for future nanoelectronic devices. Today, SWNT field effect transistors and simple logic inverters have been demonstrated, and these exhibit a remarkably high current carrying capability (typical current density $\sim 10^9$ A/cm²), room temperature operation and favourable transistor performance characteristics compared with state of the art silicon CMOS. The successful implementation of SWNT devices relies on large scale integration SWNT, and chemical vapour deposition (CVD) is considered as one of the most promising techniques for the production of SWNT directly on wafers. In our CVD process, a triple layer thin film of Al/Fe/Mo (with Fe as the catalyst) on an oxidised Si substrate is exposed to a single short burst (5s) of acetylene at 1000°C. This process produces a high yield of very well graphitised SWCNT, as confirmed by transmission electron microscopy and Raman spectroscopy. We believe that the high temperature is responsible for the high crystallinity/straightness of the nanotubes, and the rapid growth process allows us to achieve a clean, a-C free deposition which is important for SWCNT device fabrication. The absence of a-C is confirmed by Auger Electron Spectroscopy, Raman spectroscopy and electrical measurements. Depth resolved auger electron spectroscopy is also used to investigate the transformation of the Al/Fe/Mo layers during the growth process and a mechanism for the formation of SWNT is proposed. By patterning the thin film catalyst, selective growth of SWNT on substrates is achieved. The conditions for obtaining single, isolated SWNT (rather than bundles) will be discussed. We also noticed that the 'path' which the SWNT grows along is dictated by topographical features on the substrate. Top gate and double-side gated transistors integrating SWNT were successfully fabricated from the SWNT. The yield and electrical measurements of these transistors at room and low temperature will be discussed.

G-III.02 14:35

OPTICAL MEASUREMENT OF SINGLE WALL CARBON NANOTUBE PROCESSING BY PULSED LASER

F. Nakanishi, K. Sakamoto, T. Ikegami, K. Ebi-hara, Kumamoto University, 2-39-1 Kurokami, Kumamoto, 860-8555, Japan

A pulsed laser ablation (PLA) method is well known to produce single wall carbon nanotubes (SWNTs) with high yield. Usually argon ambient gas has been used in the SWNTs preparation by PLA. Recently, it is reported that a SWNTs production yield in nitrogen ambient gas is higher than that in argon gas. However, detail growth mechanism of SWNTs in nitrogen ambient gas has not been cleared. Therefore we investigated the effects of ambient nitrogen gas on SWNTs formation using optical measurement and compared SWNTs with those of argon ambient gas.

A graphite composite rod containing 1 at.% nickel (Ni) and 1 at.% cobalt (Co) was used as a target. The target set in a quartz glass tube is ablated by a pulsed Nd:YAG laser. A repetition rate, wavelength and energy of the laser are 10 Hz, 532 nm, and 240 mJ/pulse, respectively. Laser fluence at the target surface is about 2 J/cm². The quartz tube is heated to 1000 ˚C by an electric furnace and pure argon or nitrogen gas was introduced into the tube. Laser induced fluorescence method was used to measure relative density of C₂ molecules and Ni atoms in the ablation plasma plume. Spontaneous emission and LIF signal from the plasma plume near the target surface were observed using a spectrograph equipped with an ICCD detector. Optical measurement were done at various time delays after ablation using a delayed pulse. Using spontaneous emission spectra, vibrational temperatures of C₂ molecules were estimated by fitting Swan band spectrum calculated theoretically. The SWNTs were observed by using FE-SEM and TEM.

G-III.03 14:50

A COMPREHENSIVE STUDY OF THE CVD PROCESSES TO GROW ALIGNED FILMS OF CARBON NANOTUBES AND OTHER CARBON NANOSTRUCTURES

CS Cojocar(a), B. Vigolo(a), O. Ersen(a), P. Parent(b), K. Lafon(b), F. Le Normand(a), (a)IPCMS, UMR 7504 CNRS, Po Box 43, Bat 69, 23 rue du Loess, 67034 Strasbourg Cedex, France, (b)LURE, B. 209D, Centre Universitaire Paris Sud, 91405 Orsay Cedex, France

We have compared many CVD processes, involving classical thermal and activated CVD processes, to grow films of aligned carbon nanotubes and other carbon nanostructures (nanofibers, nanocones, ...) with a high selectivity. Activation of the gas phase was carried out by hot filaments (HF CVD), by a gas discharge (DC CVD) or by the use of both activation pathways (DC HF CCVD). Prior to the CVD growth, a dispersion of Co catalytic particles on SiO₂ (8nm)/Si(100) was in situ performed through an effusive cell in ultra high vacuum directly connected to the CVD reactor. Samples before and after CVD were characterized by SEM, TEM, HRTEM, Raman spectroscopy and in situ XPS, AES, ELS.

It is found that the DC HF CVD process is by far the most efficient process to get aligned nanotubes as it combines the activation of the gas mixture (C₂H₂:H₂) both by a plasma created between two electrodes and by hot filaments. Thus both ions and highly reactive neutral radicals are formed with a high density. Therefore we propose a mechanism of nanotubes nucleation and growth that account for the occurrence of ions and highly reactive radicals. We found also that occurrence of carbon nanotubes, relative to other carbon nanostructures, is highly sensitive to the ratio of the power input into the hot filaments and into the DC discharge, respectively that governs the density of highly reactive neutral and ions, respectively. The alignment of the carbon nanotubes has been quantitatively studied by angular X-ray absorption spectroscopy (XAS) on the C K edge. It is found that the p → p* transition at 285.2 eV is highly sensitive to the mutual orientation of the carbon nanotubes.

G-III.04 15:05 NUCEATION MECHANISM OF Ag NANOCRYSTALS IN SILICATE GLASSES UNDER GAMMA - vs. HEAVY ION - IRRADIATION
R. Espiau de Lamaestre, H.Béa and H. Bernas, CSNSM-CNRS (UMR 8609), Université Paris-Sud, 91405 Orsay, France
It has been known for fifty years that irradiation by energetic electromagnetic radiation (from deep UV to g rays) allows limited control over the nucleation density of noble metal nanocrystals in silicate glasses. However the detailed nucleation mechanism is still unknown. A somewhat analogous control of Cu nanocrystal growth in silicate glasses has recently been shown by heavy ion irradiation [1], for which the mechanism of nucleation is also unclear. Via transmission electron microscopy and optical absorption (OA) experiments, we compare the effects of both types of irradiation on Ag nanocluster formation in Ag-doped sodalime silicate glasses, then combine ESR and OA experiments (in the g ray-irradiation case) to determine the influence of charge exchange on nucleation.
[1] E. Valentin, H. Bernas, C. Ricolleau and F. Creuzet, Phys. Rev. Lett., 86, 99 (2001)

G-III.05 15:20 SINGLE ELECTRON CHARGING MECHANISMS INTO SILICON QUANTUM DOTS REALIZED BY ULTRA LOW ENERGY IMPLANTATION
A. Beaumont(A), P. Normand(B), G. Ben Assayag(C), A. Claverie(C), A. Souifi(a), (a)LPM-INSA, Bât.502, 20 Avenue Albert Einstein, 69621 Villeurbanne cedex, France, (b)IMEL, NCSR "Demokritos", 15310 Aghia Paraskevi, Greece, (c)CEMES-CNRS, 29 rue J. Marvig BP 4347, 31055 Toulouse Cedex 4, France
Embedding silicon nanocrystals in thin insulator layers is an attractive way to build low-voltage, low-consumption and conventional MOS technology compatible EEPROM devices. Among the numerous available techniques developed for the fabrication of silicon quantum dots in thin oxide layers, Ultra Low Energy Ion Beam Synthesis (ULE-IBS) is one of the most promising.
Current and capacitance measurements on MOS-capacitors containing silicon nanocrystals made by ULE-IBS were performed in order to understand which transport mechanisms are related to the charging and where the carriers are stored. TEM pictures show that the nanocrystals plane is close to the middle of the oxide layer, separated from the substrate and the gate by about 5nm. The mean diameter of the nanocrystals is around 2 nm, with a small dispersion in size. The results show that process parameters have a strong influence on the charging. When performing the measurements on samples annealed in oxidizing environment, single-electronic phenomenons are observed at room temperature, contributing partly to the charging. Indeed, it is believed that electrons are trapped into dots via a resonant tunneling mechanism. This charging occurs at low voltage (about 1.5 V) and it is shown that a constant number of carriers is involved in this storage process, whatever the writing signal ramp. The stored carrier density resulting from this charging current was calculated and found consistent with the dots density, what confirms the trapping behaviour of the nanocrystals. Additional charging occurs at higher voltage, via a Fowler-Nordheim tunneling mechanism. In that case, the carriers are supposed to be stored in the remaining implantation defects and in the sub-stoichiometric oxide surrounding the nanocrystals.

15:35

BREAK

Session IV

G-IV.01 16:10 -Invited- RECENT ADVANCES IN THE FABRICATION OF 1-DIMENSIONAL NANOSTRUCTURES
K. Shantha Shankar and A.K. Raychaudhuri, Department of Physics, K. Shantha Shankar Indian Institute of Science, Bangalore 560012, India
Nanowires and nanotubes are now at the forefront of nanoscale materials science because of their unique properties and their potential for application in multifunctional devices. Over the last few years, there has been a tremendous advancement in the growth of 1-D nanostructures of multifunctional oxides. Novel synthesis routes for precision control over the dimension, morphology and phase purity of nanostructures have emerged. We review the recent developments in the synthesis of nanowires with a special emphasis on low cost chemical methods that are suited for high-volume production. We also address the importance of novel methods for the characterization of nanowires. We focus on nanowire properties that differ from those of their parent crystalline bulk materials, with an eye toward possible applications that might emerge from the unique properties of nanowires. We briefly discuss the methods suitable for assembling 1-D nanostructures into functional devices. We would also comment on the future developments of the field.

G-IV.02 16:45 LIGHT INDUCED CHARGE SEPARATION ON MgO AND TiO₂ NANOPARTICLES
O. Diwald, M. Sterrer, T. Berger and E. Knözinger, Institut für Materialchemie, Technical University of Vienna, c/o Veterinärplatz 1/ Trakt GA, 1210 Vienna, Austria
Chemical vapor deposition provides nanometer-sized MgO cubes with characteristic surface defects. On this model system, electron hole centers O⁻, were generated and studied as surface probes by electron paramagnetic resonance spectroscopy. Monochromatic UV light was employed to selectively address surface anions in edge and corner positions of the nanocubes. These excitation processes generate charge separation in terms of surface trapped electrons and holes. A novel energy transfer mechanism across the MgO surface was observed and utilized for H-atom abstraction from molecular hydrogen [1].
While on MgO UV light with energies above 6.2 eV (λ=200nm) activates only surface states, light induced charge separation in TiO₂ nanoparticles is initiated in the bulk. Charge trapping into localized states, holes as O⁻ and electrons as Ti³⁺ states, were investigated by dynamic EPR experiments. It will be shown that during UV excitation of TiO₂ nanoparticles at 77K and under high vacuum conditions, only a limited fraction of electrons are actually localized as Ti³⁺ states. The majority of them enter the conduction band where they remain trapped after stopping photoexcitation. The location of trapped and localized charges will be discussed. [1] M. Sterrer, T. Berger, O. Diwald, E. Knözinger, J. Am. Chem. Soc., 125, 195, (2003)

G-IV.03 17:00

STUDIES ON THE EFFECT OF UV IRRADIATION ON Mn-DOPED ZnS NANOPARTICLES

Almira B. Cruz, Taro Toyoda, Department of Applied Physics and Chemistry, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu City, Tokyo 182-8585, Japan

Since the publication of the high quantum efficiency (~18%) for the synthesized Mn-doped ZnS nanoparticle (ZnS:Mn) by Bhargava et al., subsequent researches have suggested that ZnS:Mn might form a new class of luminescent materials sparking interest in this particular area of research. We have synthesized ZnS:Mn nanoparticles through an inorganic synthesis method and passivated it with acrylic acid (AA). Using the photoacoustic (PA) technique, the optical absorption spectra were obtained, showing a peak at 3.8 eV. This peak may be attributed to the lowest transition energy due to quantum confinement effects. A marked improvement in the intensity of the photoluminescence (PL) spectra was observed upon passivation with AA. Prolonged exposure of the sample to UV showed a decrease in the PA intensity indicating a possible decrease in the nonradiative processes occurring during exposure. A corresponding increase in the radiative processes was also indicated by an increase in the PL intensity after exposure. This increase in the PL intensity for the samples passivated with AA may be attributed to the polymerization of AA, leading to better surface coverage thus a lessening in the surface defects. For the unpassivated samples, the increase in PL intensity can be caused by either photo-oxidation or photo-corrosion. Measurements on the luminescent decay time have also been performed on samples before and after UV irradiation. Preliminary observations have shown that the luminescent decay time increases upon prolonged exposure to UV.

G-IV.04 17:15

ULTRAFAST CARRIER DYNAMICS OF CdSe-SENSITIZED NANOSTRUCTURED TiO2 ELECTRODES USING LENS-FREE HETERODYNE DETECTION TRANSIENT GRATING TECHNIQUE

T. Toyoda, Q. Shen, Department of Applied Physics and Chemistry, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo 182-8585, Japan and K. Katayama, T. Sawada, Graduate School of Frontier Sciences, The University of Tokyo, 7-3-1 Hongo, Bunkyo-ku, Tokyo 113-8656, Japan

Dye-sensitized solar cell (DSSC) based on nanostructured TiO2 electrodes has received much attention in recent years, since it shows high energy conversion efficiency exceeding 10%. Besides organic dyes, narrow band-gap semiconductors can also be used as sensitizers. In this paper, we report the ultrafast carrier dynamics of nanostructured TiO2 electrodes sensitized with CdSe quantum dots (QDs) using lens-free heterodyne detection transient grating (LF-HD-TG) technique. TG method is a powerful technique to measure various kinds of dynamics. The LF-HD-TG method has high sensitivity and its optical alignment is so simple that it can be applied to samples with rough surfaces. The LF-HD-TG measurements were carried out using titanium/sapphire laser with a wavelength of 800 nm, the repetition rate of 1 kHz and the pulse width of 200 fs. The pump pulses were frequency doubled to a wavelength of 400 nm, and the probe pulses were 800 nm. The difference of the responses with and without CdSe QDs can be observed clearly. Three decay processes can be observed with decay times of a few ps, a few tens ps and larger than a few hundred ps, respectively. The carrier relaxation dynamics in CdSe QDs can be considered to relate to the transitions from carrier to shallow levels and/or deep levels, shallow levels to HOMO states and deep levels to HOMO states. Detailed analysis of the response dynamics are in progress. Part of this work was supported by a Grant-in-aid for Scientific Research (Nos. 14750645 and 15510098) and that of Priority Area 417 (No. 15033224) from the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government. Part of this work was carried out under the 21st Century COE program on "Coherent Optical Science".

G-IV.05 17:30

HIERARCHY OF ELECTRON AND HOLE TRAPS AND ENERGY TRANSFER ON OXIDES SURFACES: CASE STUDY OF MgO

P.V. Sushko, A.L. Shluger, Department of Physics & Astronomy, University College London, Gower Street, London, WC1E 6BT, U.K. and M. Sterrer, O. Diwald, E. Knözinger, Institut für Materialchemie, Technische Universität Wien, c/o Veteriärplatz 1/GA, 1210 Wien, Austria

Understanding of the electronic structure of oxide nano-clusters is essential for our understanding of surface charging and photo-catalytic reactions. The electronic and chemical properties of MgO nano-clusters activated by photo-excitation have been studied experimentally and are very different from bulk MgO [1]. We model nano-clusters of MgO and establish a correlation between the local atomic structure of the surface topological features (steps, corners and kinks), their ability to trap electrons and holes and chemical reactivity. The optical excitation energies, electron affinities and ionisation energies of these defects were calculated [2]. We position the defects energy levels with respect to the vacuum and the top of the surface valence band, and provide an energy map of surface defect states. The results demonstrate the existence of a hierarchy of electron traps ranging from deep traps, such as positively charged oxygen vacancies, with electron affinities of 3.5-5 eV to shallow ones with electron affinities of 0.5-1.5 eV. These results open a possibility for selective excitation of surface defect sites and energy transfer along quasi-one dimensional surface features.

1. M. Sterrer, O. Diwald, E. Knözinger, P. V. Sushko, A. L. Shluger, J. Phys. Chem. B, 106, 12478, (2002)

2. P. V. Sushko, J. L. Gavartin, A. L. Shluger, J. Phys. Chem. B, 106, 2269, (2002)

17:50 – 19:00

POSTER SESSION 1

G/PL01

EFFECTS OF METALLIC CONTACTS ON SILICON NANOSTRUCTURES STUDIED QUANTUM MECHANICALLY

C. Summonte and A.M. Mazzone, C.N.R.-Istituto IMM, Sezione di Bologna-Via Gobetti 101, 40129 Bologna, Italy

The purpose of this study is to get insight into the effects of metallic contacts on nanocrystalline silicon material. Therefore the Hartree-Fock formulation at semiempirical level and DFT have been applied to silicon grains coated with aluminum atoms. The semiempirical method is used for routine calculations whereas DFT serves as benchmark for the accuracy of the semiempirical calculations. The calculations describe the effects induced by the presence of the metallic atoms on the grain structure and electronic charge. In fact, the structural and electronic properties of the grains appear perceptibly altered by the metallic overlayer and the strength of bonding is generally lowered in the structures with the contacts. Furthermore the built-in potential across the entire device exhibits a functional dependence on the geometry of the grain and of the contacts which could be usefully applied for the fabrication of unconventional Schottky barriers devices.

- G/PI.02** QUANTUM FIELD THEORY OF NANO-CRYSTALLIZATION OF IONIC CRYSTALS IN THE PRESENCE OF MAGNETIC FIELDS
A.C. Cefalas(a), S. Kobe(b), Z. Kollia(a), E. Sarantopoulou(a), (a)National Hellenic Research Foundation, TPCI, Athens 11635, Greece, (b)Department of Nanostructured Materials, Jozef Stefan Institute, Jamova 39, Ljubljana, Slovenia
 Initial stage of nano-crystallization of corrosive agents drives chemical reactions to a certain direction, and thus could have sound environmental, technological and economical impact [1]. It is effected besides chemical bonding between building and catalyzing atomic blocks, on additional factors, such as the presence of electromagnetic fields (EMF) during initial stage of nucleation and initial state of atoms (energy, momentum, etc). Thus scaling and corrosion in water and fuel flow systems can be prevented provided that the processes which affect nano-nucleation can be well described. By applying ab-initio calculations together with quantum electrodynamics in water flow systems in the presence of EMF, it is found that the initial stage of crystallization depends on the efficiency of the coupling between the magnetic fields, and the atomic and molecular blocks which form the corrosive agents. Theoretical results are in agreement with experimental data of nano-crystallization of CaCO₃ in water flow systems taken by applying Transmission and Scanning Electron Microscopy together with EDXR spectroscopy.
- G/PI.03** THEORETICAL STUDY ON JUNCTION OF METAL PORPHYRIN OLIGOMER FOR MOLECULAR NANOELECTRONICS
Hiroshi Mizuseki, Yoshiyuki Kikuchi, Rodion V. Belosludov, Amir A. Farajian and Yoshiyuki Kawazoe, Institute for Materials Research, Tohoku University, Sendai 980-8577, Japan
 Recently, the molecular nanoelectronics has attracted strong attention as a "post-silicon technology" to realize future nanoscale electronics devices (1). A rectifier could be built by combining these two molecular subunits which have acceptor or donor group (2-3). Porphyrin possesses good electron-donating properties due to its large easily ionized π -electron system, and a long molecular wire of fully conjugated porphyrin polymer was reported by Tsuda and Osuka (4). In this study, we propose that a rectifier diode could be created by combining two metal porphyrin molecules containing different metal atoms. This function would realize an effect similar to a p-n junction in a solid-state device. To estimate the electron transport through this molecule, we have analyzed the spatial extent of the frontier orbitals (HOMO and LUMO), providing a strategy by which the rectifying properties of the porphyrin oligomer can be understood. This study was performed through Special Coordination Funds for Promoting Science and Technology from the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government.
 (1) A. Aviram and M. A. Ratner, Chem. Phys. Lett. Vol. 29 (1974) 277.
 (2) C. Majumder, H. Mizuseki, and Y. Kawazoe, J. Phys. Chem. A, Vol. 105 (2001) 9454.
 (3) H. Mizuseki {Yit et al.}, Sci. Technol. Adv. Mater., Vol. 4 (2003) 377.
 (4) A. Tsuda and A. Osuka, Science Vol. 293 (2001) 79.
- G/PI.04** MANY PARTICLE APPROACH TO EXCITONS IN CRYSTALS AND IN QUANTUM SIZE STRUCTURES
A.M. Yaremko(a), B. Silvi(b), (a)Institute of Semiconductor Physics NASU, 03-028 Kiev, Ukraine, (b)University P&M Curie, 75000, Paris, France
 The optical properties of quantum size structures (QSS): quantum dots (QDs), quantum wells (QWs) etc. are as usual connected with the effect of size quantization. For description of excitons in such structures, effective mass approximation (EMA) is traditionally used. In given communication we show that EMA is insufficient. We show that an exciton problem should be considered in the framework of matrix density approach because in this case there is the transition of electron between two continuities (electron bands) and even small perturbation will result in to intermixing many band's states. The absorption of light is expressed in such case by Fourier component of two-electron Green function (TEGF) poles of which give the spectrum of excitation and its imaginary part describes the spectral dependence of absorption. Obtained expression describes all spectrum: the sharp maximum (exciton) corresponds to "coupled states" and smooth part describes other band-to-band transitions. Both parts of spectrum are strongly connected and all spectrum depends on the density of states (DOS) in valence (V) and conductivity (C) bands. Numerical calculations show that not only local region near extrema points of C,V bands, according to EMA, gives the contribution to exciton but full considered C, V bands. Beside as QD (QW) structures are as rule created by substitution of some atoms in the unit cells, QSS can be considered as perturbed crystal lattice of ideal crystal. It was shown for exciton in QW that Coulomb interaction constant is renormalized and new bands in spectrum can arise.
- G/PI.05** COMPUTER SIMULATION OF ELECTRON TRANSFER IN MOLECULAR ELECTRONIC DEVICES
 Helena M.G. Correia, Marta M. D. Ramos, Departamento de Física, Universidade do Minho, Largo do Paço, 4700-320 Braga, Portugal
 The study of electron transfer through individual molecules bound to metal electrodes has become important due to the potential application in molecular electronic devices. Since the electronic and the atomic motions in these molecules influence each other they need to be treated self-consistently. We have used self-consistent quantum chemistry molecular dynamics calculations to discuss some of the issues relating electron transfer through a spatially symmetric [9,10-Bis((2'-para-mercaptophenyl)-ethinyl)-anthracene] and an asymmetric [1,4-Bis((2'-para-mercaptophenyl)-ethinyl)-2-acetyl-amino-5-nitrobenzene] molecule bound to metal electrodes. Specifically addressed are the effects of voltage inversion on electron transfer between electrodes through both molecules. Our results show a nonlinear behaviour in agreement with experimental current-voltage data. The change in time of electron density and dimerisation at specific atomic sites is also discussed.

- G/PL06** FANO-TYPE RESONANCE IN OPTICAL TRANSITIONS BETWEEN THE ABOVE-BARRIER STATES IN ALGAAS/GAAS COMPOSITE QUANTUM WELL STRUCTURES
 S.J. Xu and Y. Huang, Department of Physics and HKU-CAS Joint Laboratory on New Materials, The University of Hong Kong, Pokfulam Road, Hong Kong, China
 Optical transitions in a composite quantum structure based on Al_{0.35}Ga_{0.65}As/GaAs asymmetric two quantum wells (QWs) were measured with low-temperature photoluminescence technique. Strongly enhanced emission from the radiative transition between the above-barrier states was observed. Furthermore, the distinct asymmetric line shape of the emission peaks was found. Fano-type resonance between the QW discrete state and the above-barrier continuum state is responsible for the observed anomalies of the optical transitions. Simple transfer matrix method was used to calculate the energy levels and envelope wave functions in the wells and above the barriers. According to the energy levels and corresponding wave functions, the oscillator strength of various transitions was estimated. Our results show that Fano-type resonance plays important role in the optical transitions associated with the above-barrier states.
- G/PL07** GIGAHERTZ ACTUATOR OF MULTI-WALL CARBON NANOTUBE ENCAPSULATING METALLIC IONS: MOLECULAR DYNAMICS MODELLING AND SIMULATIONS
Jeong Won Kang(a), Ki Ryang Byun(a), Won Young Choi(a), On Keun Kwon(b) and Ho Jung Hwang(a), (a)Department of Electronic Engineering, Chung-Ang University, 221 HukSuk-Dong, DongJae-Ku, Seoul 156-756, South Korea, (b)Department of eCommerce, Semyung University, Jecheon 390-711, South Korea
 We will show a possibility of gigahertz actuator composition based on multi-wall carbon nanotubes (CNT) encapsulating metallic ions using classical molecular dynamics simulations. Our results for a vacant CNT pendulum were in good agreement with results obtained from the previous experiments, theory, and simulations. Encapsulated potassium ions accelerated by applying external electric field could initialize the gigahertz actuator composed of a 7K+@CNT pendulum. The energetics and the operations of a vacant CNT pendulum were similar with those of the 7K+@CNT pendulum except for the binding energies, the correlated collisions, and the mass increase by the encapsulated ions. Since the total mass of the 7K+@CNT pendulum was slightly higher than that of the vacant CNT one, the frequency of the vacant CNT one was slightly higher than the frequency of the 7K+@CNT one. The correlated collisions between ions or between the CNT and the ions slightly affected on the oscillation dynamics, such as restoring force and frequency.
- G/PL08** ELECTRONIC STRUCTURE CALCULATIONS FOR ZnS_xSe_{1-x}
S. Ben Nasrallah, S. Ben Afia, H. Belmabrouk and M. Said, Unité de Physique des solides, Département de Physique, Faculté des Sciences de Monastir, 5019 Monastir, Tunisie
 Energy band gaps, electron and hole effective masses as well as their composition dependencies are the most critical parameters for band structure calculations of semiconductor alloys. Therefore, an accurate knowledge of these parameters is very important. Unfortunately, there appear to be limited experimental and theoretical information in the literature at present, regarding the electronic band parameters for zinc blende ZnS_xSe_{1-x}. This has incited us to carry out such calculations. For this purpose, we have used the empirical pseudo potential method within the Virtual Crystal Approximation, and treating the effect of compositional disorder as an effective potential. The band gap variation versus sulfur concentration *x* show two different behaviors: clear diminution of gap energy with strong bowing for lower concentrations, and quasi-linear behavior and a small bowing for large values of *x*. Furthermore, the calculated effective mass show that the disorder is not only compositional but also structural. Similar results was also obtained in other compounds. An attempt to explain these results will be presented.
- G/PL09** NUMERICAL STUDY OF ALIGNED CARBON NANOTUBE ARRAYS ON FIELD EMISSION PROPERTIES
Dohyung Kim, Jean-Eric Bourée, Laboratoire de Physique des Interfaces et des Couches Minces, CNRS UMR 7647, Ecole Polytechnique, 91128 Palaiseau Cedex, France
 Numerical investigation of aligned carbon nanotube arrays on field emission properties has been performed in order to get the best field emission. The electron field distribution was calculated by finite difference method using over-relaxation schema. Experimental data from other groups were used for estimating experimental factor of Fowler-Nordheim equation that describes electron tunneling probability from inside metal to vacuum level. Current density was obtained for different given structures of carbon nanotube arrays taking into account as parameters the space between each nanotube, the length, and the diameter of carbon nanotube. Using these data, the most suitable configuration of carbon nanotubes has been proposed for getting the best field emission.
- G/PL10** LINEAR ELECTRONIC RESPONSE OF AN ORGANIC COMPLEX
Mathias Kula, Department of Theoretical Chemistry, Royal Institute of Technology, Sweden, Yi Luo, Department of Theoretical Chemistry, Royal Institute of Technology, Sweden
 We have used an elastic scattering Greens function model to characterize the electronic linear response of a complex of tetracyanoethylene and tetramethyl xlyldithiol adsorbed onto Au(111). The results are then compared to experimental data.
- G/PL11** ENERGY STRUCTURE OF MAGNETIC QUANTUM WIRES
M. Labuz(a), A. Wal(a), M. Kuzma(a), (a) University of Rzeszow, Institute of Physics, Rejtana 16a, 35-959 Rzeszow, Poland
 Recent technology of polymers allows to form short chains of magnetic metal ions (e.g. Cr⁸, Fe⁸, Fe¹⁰, Mn¹², etc.). These structures can be considered as magnetic quantum nanowires. Quantum properties of such systems are strictly described by Heisenberg model of chains with finite number of nodes. The quantum solutions of finite nanomagnets are different from those of mesoscopic and infinite lengths. The Bethe hypothesis is extremely useful in exact solving of the problem. In the paper we apply the Bethe theory to wire nanomagnets consisting of spin *s*_i=1/2 in each node for the length *N* = 4, 6 and 8. The complete set of eigenfunctions were discussed. The scattering and bounded states of the system were classified. The energy bound structures were derived as a function of total spin *S* as well as a quasimomentum *k* of spin waves.
 The attempt of application of the method was done to the nanomagnets consisting of spins *s*_i=3/2. The experimental inelastic neutron scattering results for rings Cr₈ [O. Waldmann et al., Phys. Rev. Lett. 91, 237202, 2003] support the motivation of this paper.

- G/PI.12** SCHEMATICS AND SIMULATIONS OF NANO-MEMORY DEVICE BASED ON NANOPEAPODS
Jeong Won Kang, Ki Ryang Byun, Won Young Choi and Ho Jung Hwang, Department of Electronic Engineering, Chung-Ang University, 221 HukSuk-Dong, DongJak-Ku, Seoul 156-756, Korea
 We investigated endo-fullerene shuttle memory elements based on carbon and boron-nitride nanopeapods using atomistic simulations. The systems proposed could operate nonvolatile nano memory devices or three-terminal nano switching devices when the positions of ionized endo-fullerenes were controlled by gate bias. This work shows a probability of nano-electromechanical memory elements based on nanopeapods in the nanometer ranges, especially, when the electronic properties of boron nitride nanotubes are modified by endo-fullerene encapsulations.
- G/PI.13** SIMULATION OF SELF-ASSEMBLING FORMATION OF BARRIER-LAYER NANOSTRUCTURAL DIODE CONTACTS NI/IR-GAAS N-TYPE
S.A. Beznosyuk, L.V. Fomina, Altai State University, Lenin Av. 61, 656049 Barnaul, Russia
 Nanoscopic models of iridium - arsenide of gallium (111) boundary barrier-layer rectification contact with intermediate chalcogenide gallium layer structure are offered. Calculation of Gibbs free energy change for possible chemical reactions in processes of passivating on boundary between arsenide of gallium and water solutions of sulfur (selenium) salts is carried out. Nanoscopic modeling of layer heterostructures of diode contacts is carried out within the framework of the approach of quantum topology of electron density. Physicochemical interpretation of electrophysical parameters of Schottky junction in case of nanolayer rectification contact is offered and advanced. Considered nanoscopic models of a structure and properties of iridium (nickel) - arsenide of gallium (111) boundaries are used for an explanation of results of experiments on studying stability of electrophysical parameters Ni/Ir-GaAs n-type rectification contacts to influence of an oxidizing atmosphere and the increased temperatures with application of chalcogenide preliminary processing of the semiconductor surface.
- G/PI.14** UNIQUE OPPORTUNITY FOR PHOTO-ACOUSTO-ELECTRONIC RESONANCE IN QUANTUM NANOTUBES
V.V. Pokropivny, Frantsevich Institute for Problems of Materials Science of NASU, Krzhyzhanovsky 3, 03142 Kiev, Ukraine
 Unique properties of nanotubes (NTs) stem from their cylindrical symmetry in conjunction with nanoscale diameter and mesoscale length. There are one-dimensional (1D) quantum nano-meso-cylinders. Only in NTs a joint circulation of the electronic, acoustic, and electromagnetic waves of cylindrical type becomes to be realizable. For all types of vibrations the size effect on classical language causes the whispering gallery of circular modes to arise. On quantum language this means the orbital quantization of energy levels in quantum cylinder where the first of them denotes zero-point vibrations. Such behavior manifests itself in oscillations of physical values, in particular, critical superconducting temperature (Little-Park effect) and conductivity of wires (Altkhuller-Aronov-Spivak effect) in magnetic field. Number of quantum resonance effects were observed in NTs experimentally: 1) photo-electronic resonance (P-E) in heteropolar BNC-NTs (Tomanek effect); 2) photo-acoustic resonance (P-A) effect; 3) acousto-electronic resonance (A-E) in kind of enhancement of electron-phonon coupling. The unique opportunity of triple P-A-E resonance in NTs is advanced here at lucky coincidence of all the parameters, such as the diameter of NTs, the velocity and density of states for phonons and electrons, the frequency of external photons, etc. Unique properties are suggested to arise in this resonant state due to unique opportunity of the lossless transfer of one kind of energy into the another. On this base record nanodevices are proposed, in particular, the nanotubular room-Tc superconductor, the hyper-sound transducer and phonon laser (phaser), the nanoemitter, the nano-antenna, the photovoltaic nanotransducer, etc.
- G/PI.15** RADIOLYTIC PREPARATION OF SILVER CLUSTERS FROM CATIONS-DOPED COLLOIDAL ZEOLITES
V. De Waele(a), S. Mintova(b), M. Mostafavi(a), T. Bein(b), (a)Laboratoire de Chimie Physique-ELYSE, CNRS-Univ. Paris Sud.11, 91405 Orsay, France, (b)Department of Chemistry, LMU, Butenandtstr. 11, 81377 Munich, Germany
 The substantial interest in the preparation and characterization of metallic or semiconductor clusters in the nanometer range is due to their unique electronic and chemical properties distinct from those of the related bulk materials. These materials could be used for designing of microporous-based functionalised assemblies with a wide application in catalysis, solar energy conversion, photonics, or electronics. The formation of silver nanoclusters in colloidal LTA type zeolite stabilized in water suspensions has been performed. In-situ incorporation of Ag⁺ ions in the colloidal zeolites has been carried out under hydrothermal treatment of aluminosilicate precursor solutions in the temperature range of 24-100 °C. The silver clusters have been formed via gamma-radiolysis of the zeolite colloidal suspensions having different particle sizes and various degrees of Ag⁺ loading. Control growth of silver nanoparticle was possible by changing the different processing parameters such as irradiation dose, concentration of zeolite nanoparticles, concentration of silver cation, presence of organic templates, etc.
- G/PI.16** THERMAL TRANSPORT IN SiC NANOSTRUCTURES
Eleni Ziambaras and Per Hyltdgaard, Chalmers University of Technology, Gothenburg, Sweden
 SiC is a robust semiconductor material considered ideal for high-power application due to its material stability and large bulk thermal conductivity defined by the very fast phonons. In this paper, however, we show that both material-interface scattering and total-internal reflection significantly limit the SiC-nanostructure phonon transport and hence the device cooling efficiency. For simplicity we focus on planar SiC nanostructures and calculate the thermal transports both parallel to the layers in a doped-SiC/SiC/SiO₂ heterostructure and across a SiC/metal gate. For the parallel-transport case we find that the phonon-interface scattering produce a heterostructure thermal conductivity significantly smaller than what is predicted in a traditional heat-transport calculation.
 We also document that the high-temperature heat flow across the metal/SiC interface is limited by total-internal reflection effects and maximizes with a small difference in the metal/SiC sound velocities.
- G/PI.17** MODELING OF TUNNEL CONDUCTION IN SEMICONDUCTING NANO-DOT DEVICES
Anne-Sophie Cordan, Yann Leroy, PHASE, BP 10413, 67412 Illkirch, France
 The decreasing dimensions of the devices in microelectronics lead to important quantum effects. Nano-dot array devices are good candidates for single-electron transistors as well as for floating gates in FG MOS transistors. The tunnel transport properties have been extensively studied for metallic nano-dots, both experimentally and theoretically. But for semiconducting nano-dot arrays, the conduction models can still be improved.
 Our aim is to develop models and simulators to understand and forecast the electrical behaviour of nanoelectronic devices. In a first approach, we take the physical parameters into account, like quantum confinement, charge effects and tunnel rates. A new simulator based upon these parameters is then created, in a similar way to the previous one concerning metallic nano-dots. Finally, we try to link geometrical considerations to physical ones. We present here preliminary results showing the different physical effects at work in semiconducting nano-dot devices.

G/PL18

DEPENDANCE OF TEMPERATURE OF HOMOGENE LINE WIDTH OF InGaAs/InAs/GaAs QUNANTUM DOTS

W. Ouerghui(a), A. Melliti(a), M.A. Maaref(a), J. Bloch(b), (a)Unité de recherche de physique des semiconducteurs, Institut Préparatoire aux études Scientifiques et techniques, la Marsa 2070, Tunisia, (b)Laboratoire de photonique et nanostructures, CNRS, UPR20, France

We report a study of dependance of temperature of homogene line width of InGaAs/InAs/GaAs quantum dots (QD'S). The fundamental state photoluminescence(PL) peak of these dots is obtained at 1.03eV for 10 K and its line width at half maximum is in the order of 24 meV. In order to investigate the temperature dependance of the homogene line width of each QD, we have fitted the narrow line by Gaussian profile (wich is related to the size distribution) convoluted with lorentzian profile (wich related to luminescence of each QD.). In our model we have neglected the diffusion between QD'S for temperature under 100 K. Indeed, the diffusion occurs essentially via Wetting Layer (WL) and in our sample the energy gap between the ground state of QD'S and the WL is very hight (400 meV). The temperature dependance of the line width of each QD deduced from the lorentzian was fitted by $\Gamma(T) = \Gamma_0 + aT + b \exp(-\hbar E/kT)$ where the term linear in temperature is due to the exciton scattering with acoustic phonons, and the term non linear in temperature is due to interaction with LO phonons. The coefficient a et b represent the strenght of the exciton acoustic phonon interaction and exciton LO interaction, respectively. The fitting parametres found for a (1.15 μ eV) and b (85 meV) are close to those found in single QD.

G/PL19

PULSE PROPAGATION IN NANO-SCALE DEVICES

Ulrich Wulf(a) and V.V. Skalozub(b), (a)IHP/BTU Joint Lab and Lehrstuhl Theoretische Physik, Postfach 101344, 03013 Cottbus, Germany, (b)Dniepropetrovsk National University, Dniepropetrovsk 49050, Ukraine

The transmission of wave packages through a resonant quantum structure is a fundamental problem relevant to both, basic science and technological applications. We demonstrate that the method of the steepest descend provides an excellent tool for the evaluation of the typical k -space integrals that determine the transmitted pulse: first, the method can be applied under very general conditions. Second, it is possible to provide a systematic analytical expansion for the long-time behavior which cannot be determined numerically. In a first application of our approach a Gaussian pulse is assumed to interact with a Breit-Wigner transmission characteristic. The method of the steepest descend then provides two critical points corresponding to two dominant contributions to the transmitted signal. For packages narrow in k -space one of these contributions is associated with a delayed pulse while the other is a background signal. Our method allows to follow up continuously the transition to the opposite case of an incident package narrow in real space. It results that in the latter case the signal is dominated by a state decaying exponentially in time which can be associated with a Gamov state.

G/PL20

FROM MESOSCOPIC MAGNET TO QUANTUM WIRE. THE BETHE ANSATZ APPLICATION

A. Wal, University of Rzeszow, Institute of Physics, Rejtana 16a, 35-959 Rzeszow, Poland

Molecular nanomagnets are representatives of quantum systems in which significant magnetic size effects are observed. In most cases they are constituted by a few or a dozen or so magnetic ions arranged into regular ring (e.g. Fe8). Such small chains can be treated as quantum wires. In literature magnetic properties of these systems were studied experimentally and these results confirm fully their extraordinary quantum features. By far results were interpreted basing on solutions obtained numerically. In present paper we make know the exact solutions of the systems which we obtained basing on the Bethe theory. The application for this theory for such small systems is quite complicated. We develop mathematical method for inspection of the solutions evolution starting from macroscopic via mesoscopic till nanoscope size of Heisenberg chain. Furthermore we study the properties of the energy band structures (as noncrossing, rarefied effect, etc) and their evolves as a function of magnetic quantum wires size.

G/PL21

OPTICAL PROPERTIES OF A 1D RESONANT BRAGG REFLECTOR

Andrea D'Andrea, Laura Piloizzi, Istituto di Metodologie Inorganiche e dei Plasmi, IMIP, CNR, Roma, Italy

The optical response of a resonant 1D cluster of N quantum wells under Bragg condition shows characteristic features as a function of cluster size.

The super-radiant regime for small N values has been largely studied in the past litterature and ascribed to the presence of only one radiative mode whit radiative damping equal N times that of the single well system. Recently, the 1D resonant photonic crystal limit has been shown to be the exact description of the system in the $N \rightarrow \infty$ limit. In this case the so called "dark modes" becomes bright and condensate in a continuous density of states inside the photonic gap centred at the resonance energy. In the present work, a semiclassical self-consistent framework is adopted to describe the transition zone, connecting the super-radiant regime with the 1D resonant Bragg reflector limit, where the super-radiant mode shares its radiative character with the other $N-1$ dark modes of the system. The evolution of these modes, from dark to bright ones, is studied trough the separation of the diagonal and off-diagonal contributions in the polaritonic matrix obtained by a Feenberg's decomposition.

G/PL22

AB-INITIO ELECTRONIC AND MAGNETOTRANSPORT STUDIES OF M/Si/M TRILAYER SYSTEMS WITH M=Fe or Co

P. Vlaisic(a), M. Alouani(a), H. Dreyssé(a), O. Bengone(b), I. Turek(c), (a)Institute de Physique et Chimie des Matériaux de Strasbourg, UMR 7504 du CNRS, 23 rue du Loess, 67034 Strasbourg Cedex, France, (b)Condensed Matter Theory Group, Physics Department, Uppsala University, 75121 Uppsala, Sweden, (c)Institute of Physics of Materials, Academy of Science of the Czech Republic, 616 62 Brno, Czech Republic

The electronic structure and magnetic properties of M/Si/M (001) trilayer systems with M=Fe or Co have been studied by means a first principle Green's function technique based on the tight-binding linear muffin-tin method in its atomic sphere approximation and in conjunction with the coherent potential approximation to describe the disorder effects like interdiffusion at interfaces. The results show that at M/Si interfaces there is a net charge transfer from M magnetic slab to the Si spacer and a substantial reduction of the Co magnetic moment compared with the bulk value while the Fe magnetic moment remains practically unchanged. The effects of the interdiffusion at the interfaces on the interlayer exchange coupling are analyzed. We are finding that with increasing interdiffusion concentration at the Fe/Si interfaces, the antiferromagnetic coupling between Fe through the spacer becomes more stable, in agreement with experiments. The conductance and giant magnetoresistance ratio, in the current perpendicular-to-plane geometry, are calculated by means of the transmission matrix formulation of Kubo-Landauer formalism. The magnetoresistance oscillates with the spacer thickness for both M=Fe or Co systems and is influenced by the interdiffusion at the interfaces, decreasing for higher interdiffusion concentrations.

Acknowledgments: The financial support was provided by the RTN Network "Computational Magneto-electronics" (Contract No. HPRN-CT-2000-00143) of the European Commission. The computation effort was supported by CINES France.

G/PI.23

MICRO AND MACRO-PHOTOLUMINESCENCE STUDIES ON INAS/INP(001) QUANTUM STICKS

N. Chauvin, G. Bremond, B. Salem*, T. Benyattou, C. Bru-Chevallier, G. Guillot, LPM, UMR CNRS 5511, INSA de Lyon, 69621 Villeurbanne Cedex France, C. Monat, P. Rojo-Romeo, M. Gendry, LEOM, UMR CNRS 5512, Ecole Centrale de Lyon, 69134 Ecully Cedex, France

The quantum dots (QDs) and wires (QWRs) elaborated in the Stranski-Krastanov growth mode are considered as promising structures for optoelectronic devices such as low threshold lasers, detectors or single photon emitters. Such devices have already been realized using InAs QDs on GaAs and InP substrates. However, the high density and the size dispersion of QDs limit analysis of their individual optical properties. To solve this problem, new methods of investigation like micro-photoluminescence (μ -PL) on small mesa or near field spectroscopy through nano-apertures have been developed to investigate the physical properties of various single self-organized III-V QDs. We present a μ -PL study of single elongated InAs quantum QDs, referred to as quantum sticks (QSs), on an InP substrate. The $300 \times 300 \text{ nm}^2$ mesa is processed by e-beam lithography and reactive ion etching (RIE). At room temperature the emission wavelength of the InAs QSs is around $1.5 \mu\text{m}$. The μ -PL spectroscopy as a function of the excitation power density and the temperature demonstrates peaks associated to the ground and excited states of single QSs. These results are correlated with macro-photoluminescence performed on the same bare sample. These results are discussed in the light of the physical properties of such QSs in order to use them in optoelectronic or photonic devices.

G/PI.24

THEORETICAL AND EXPERIMENTAL STUDY OF THE INFLUENCE OF GROWTH TEMPERATURE ON COMPOSITION IN SELF-ASSEMBLED SiGe QD's

A.M. Yaremko, V.P. Bukalo, V.M. Dzhagan, V.P. Klada'ko, V.P. Melnik, M.Ya. Valakh, V.O. Yukhymchuk, Lashkaryov Institute of Semiconductor Physics, NAS of Ukraine, Prospekt Nauki 45, 03028 Kyiv, Ukraine, Z.F. Krasil'nik, D.N. Lobanov, A.V. Novikov, Institute for Physics of Microstructures, RAS, 603600 N.Novgorod, Russia

The influence of the growth temperature on composition x of MBE-grown $\text{Si}_{1-x}\text{Ge}_x$ nanoislands has been studied theoretically. The change of the composition with varying growth temperature has been calculated based on the temperature dependence of the diffusion coefficient. The composition values obtained for the islands grown within the temperature range 550 to 750°C have been compared to those derived from the experimental Raman, HRXRD and SIMS spectra. Using Raman spectroscopy, it has been shown that x of the uncapped islands decreases from 75% to 43% as the growth temperature increases from 550 to 750°C. Observed in experiments higher Si content, as compared with theoretical predictions, results from a diffusion enhancement induced by an inhomogeneous strain around the islands' bases. Si content in the islands capped with Si is significantly higher in comparison with the uncapped ones. There has been found a good correlation between the results of Raman, HRXRD and SIMS experiments.

G/PI.25

BONDING OF SILICON BASED NANO-COMPOSITES ON THE SURFACE OF OPTICAL CRYSTALS

E. Sarantopoulou, Z. Kollia and A.C. Cefalas, National Hellenic Research Foundation, 48 Vassileos Constantinou Avenue, Athens 11635 Greece, S. Šturm, S. Kobe, Jozef Stefan Institute, Jamova 39, 1001 Ljubljana, Slovenia

The deposition of silicon nano-clusters on the surface of optical elements of lithographic projection systems consists a major problem, particularly at 157 nm [1] as irreversibly damages the optical elements, such as CaF₂. Silicon based nano and micro composites are strongly attached to the crystal lattice with ionic bonding. Scanning electron microscopy and X-ray dispersive nano and micro analysis of the defected areas reveals that silicon agglomerations on the surface of optical crystals have different size, and they can penetrate within the crystal lattice as deep as 2 μm from the top of the optical surface.

[1] A. C. Cefalas and E. Sarantopoulou. Micr. Eng. V53, 465 (2000).

G/PI.26

CARBON NANOTUBES TIPS

M. Kaempgen(a), S. Hofmann(b), J.C. Meyer(a), J. Robertson(b), S. Roth(a), (a)Max-Planck-Institute for Solid State Research, Stuttgart, Germany, (b)Electronic Devices and Materials, Engineering Department, Cambridge, U.K.

The geometry of Carbon Nanotubes with its well defined structure and high aspect ratio allows to create extremely sharp and long tips. Such CNT tips can be used as AFM tips and as CFM Tips for chemical force microscopy (CFM). CNT tips are expected to show enhanced local resolution. Different strategies (CVD, PECVD, electrochemical or lithographic catalyst deposition) have been used for direct growth of CNT tips by CVD process, in order to get large yield of working devices. These CNT AFM Tips are characterized by means of SEM images and AFM experiments. Further, we introduced chemical functional groups to the end of the CNT Tip and characterized them by SEM and Raman. Such functionalised CNT Tips has been used for chemical force microscopy (CFM). This technique is used to characterize functional groups on surfaces. We also measured the response to different functional groups on a substrate by CFM.

G/PI.27

NANOCRYSTALS OF HYDROXYAPATITE IN AGGREGATES WITH C60 AS HIGH BIOACTIVE SYSTEM

O.I. Lysko, Medical Radiophysical Department, National Taras Shevchenko University of Kiev, 64 Volodymyrska St., 01033 Kyiv, Ukraine

Bioactive systems base on hydroxyapatite nanocrystals find using in Biomedicine and Bioengineering, as implant materials with surface active properties.

Nanocrystals of hydroxyapatite have very bioactive surface and properties of it depend on size, shape and crystal structure. These parameters of nanocrystals is necessary to control and investigate their behavior on bioactivity of implant hydroxyapatite materials. Bioactive system from hydroxyapatite and fullerene derivates produce singlet oxygen can be efficient photosensitizer. Singlet oxygen has been postulated to play important roles in many photochemical and photophysical processes in biological systems. We choose two types of hydroxyapatite nanocrystals to prepare high bioactive system from hydroxyapatite crystals in aggregates with fullerene C60 and investigate these biosystem in depending on size and crystal structure of nanocrystals by IR, UV-VIS spectroscopy and XPS methods. The results of investigations confirm important roles of surface phosphate, CO and NH groups in activity hydroxyapatite nanocrystals and amount of these groups on surface that determined by size of nanocrystals.

- G/PI.28** AN EFFECT OF GLASS MATRIX UPON FORMATION AND OPTICAL PROPERTIES OF CdSe_xTe_{1-x} NANOPARTICLES
A.P. Molochko, N.P. Solovei, I.V. Bodnar, Belarusian State University of Informatics and Radioelectronics, Minsk, Belarus, V.S. Gurin, Physico-Chemical Research Institute, Belarusian State University, Minsk, Belarus
Semiconductor nanoparticles in glasses are studied intensively from both practical and scientific reasons. They are good material for optical filters, non-linear elements, and size effects in semiconductors stabilized in glasses were the milestones in the quantum confinement concept. Cadmium chalcogenides of complicated composition were not studied in details, however, a series of selenide-telluride nanoparticles reveal non-trivial variation of properties under change of Se/Te ratio due to possible interchange of crystalline structure - wurtzite (Se-rich phases)-sphalerite (TE-rich ones). In the present work, we develop this research with more detailed effect of glass matrix upon optics of the nanoparticles. CdSe_xTe_{1-x} nanoparticles were synthesized within silicate glasses with composition SiO₂-CaO-R₂O (R=Li,Na,K) by the direct introduction of bulk CdSe_xTe_{1-x} compounds into mixture for glass preparation. Depending on Se/Te ratio the glasses showed variation of optical absorption and photoluminescence with spectral features of excitonic maxima in the case of Te-rich compositions. The matrix effect was clearly observed under change of R, and the composition with all three alkali elements was the best to produce the glasses of high quality in the broad interval of x attaining concentration of semiconductors 1 wt.%. This multi-alkali effect is associated with polarization by these cations upon nucleation and growth of semiconductor nanoparticles.
- G/PI.29** SENSING OF BIOMOLECULES/CNT AND WATER/CNT NANOSYSTEMS PROPERTIES ON A TEMPERATURE AND UV-LIGHT ILLUMINATION
D.G. Kolomyets, Radiophysical Faculty, Medical Department, Taras Shevchenko National University of Kiev, The Scientific and Training Center "Physical and Chemical Material Science of Kiev National Taras Shevchenko University and NASU", 64 Vladimirska str., Kiev 01033, Ukraine
The aim of investigation is properties of carbon nanotubes and their interaction with water and biomolecular gel for evaluated conductivity and photoresponse versus architecture of these nanosystems. Covalently - linked single- and multi-walled carbon nanotubes in mixture with DNA polymerized molecules gel and H₂O/CNT layers have been fabricated. Experimental and reviewed results are presented for DNA/(SWCNT or MWCNT) and H₂O/(SWCNT or MWCNT).
The conductivity of Nanosystems, determined from the current-voltage characteristics of (Pt/Ir) tip-molecular layer from DNA/Tubes-(Pt/Ir) tip under temperatures 20 – 325 K have different behaviour due changing DNA molecules contents in molecular layer: semiconductor and metallic for high and low contents, respectively. Calculated density of states distribution in these molecular systems versus energy and energy gap in this distribution confirm this temperature behaviour of molecular layer conductivity. The conductivity of H₂O/(SWCNT or MWCNT) layers, obtained by four probes conductivity measurement method, under temperatures 20 – 325 K can be to increase or decrease due water environment changes, which define contents of OH bonds to carbon atoms in tubes. The increasing of conductivity under UV-illumination is revealed only for nanosystems with DNA: maximum conductivity is at 290 nm, when DNA have absorption maximum. So, these nanosystems have photoresponse, which depend from DNA contents in molecular layers. The models of processes in these nanosystems on based molecular dynamics simulation of mechanical, vibrational and electronic properties of carbon nanotubes were developed. The additional results for these nanosystems, obtained by IR, Raman, optical reflectance spectroscopy, for confirmation these models were used.
- G/PI.30** FERROELECTRIC NANOTUBE ARRAY GROWTH IN ANODIC POROUS ALUMINA NANOHOLES ON SILICON
Sungchul Kang, Kwan Hyi Lee, Won Young Jeung and Jeon-Kook Lee, Materials Science and Technology Division, Korea Institute of Science and Technology, P.O. Box 131, CheongRyang, Seoul 130-650, Korea
One dimensional structures, such as nanotubes, are attracting a great deal of attention in both fundamental and applied studies. The preparation of ferroelectric nanotubes remains a challenge in materials science. The broad range of properties of ferroelectric oxides, such as spontaneous polarization, high dielectric permittivity as well as piezoelectricity make ferroelectric nanotubes an extremely interesting material class for research. We fabricate the nanostructures with significantly smaller diameters in order to explore further the effects of size on the properties of materials
Ferroelectric nanotubes were fabricated by the wetting of the pore wall of porous body such as Anodized Aluminium Oxide(AAO) thin films on a silicon substrate. Sol-gel syntheses within the pores create the PbZrTiO₃ (PZT) nanotube arrays. After the precursor had been brought into contact with the template. The pores within the nano templates act as templates for the synthesis of nanostructures. Because the membranes that are used have cylindrical pores of uniform diameter, a nanotube of the desired material is obtained in each pore. After calcinations of the ferroelectric nanotubes with alumina template, stand alone nanotube arrays were fabricated by removing the template by 6 M NaOH aqueous solutions. Crystallographic characterization was performed with XRD, Raman, and electron diffraction obtained during transmission electron microscopy (TEM) analysis. Preliminary ferroelectric data for the PZT nanotubes supported by the alumina templates were obtained. Ferroelectric properties of a few mm length nanotubes were observed by using the Electrostatic Force Microscopy(EFM).
- G/PI.31** GROWTH OF SiC NANOFIBERS ON CARBON FIBERS
Young-Jae Lee, R&D center, Samsung Fine Chemicals, Co., Ltd., 103-1 Moonji-Dong, Yoosung-Gu, Daejeon 305-380 Korea
The growth of SiC nanofibers was observed on the surface of carbon fibers during carbothermal reduction of SiO₂ in the absence of catalyst at the temperature of 1100-1800 °C. The nanofibers were separated from the carbon fibers and examined by scanning electron microscopy and x-ray diffraction. The diameter and length of nanofibers were ranged from 20 to 70 nm and from 20 to 100 μm, respectively and affected by reaction temperature. Further examinations revealed that the nanofibers were grown from the crystal plates formed on carbon fibers and these plates were observed before in direct reaction of Ga and NH₃ to produce GaN nanowires in the absence of catalyst.

G/PI.32

PREPARATION OF ORDERED NANOWIRE ARRAYS USING POROUS ALUMINA TEMPLATES

A.A. Eliseev, K.S. Napolskii, A.V. Lukashin, Yu.D. Tretyakov, Department of Materials Science, Moscow State University, Moscow 119992, Russia, P. Görmert, Innovent e.V., Prussingstr. 27, Jena 07745, Germany

One of the important challenges in materials science today is the preparation of nanostructures with the controlled properties and dimensions. The most challenging nanosystems are nanowires owing to highest anisotropy parameters in them, which could certainly increase functional properties of nanomaterials. However, the use of the nanostructures is strongly restricted because of their low stability. The approach to this problem is the preparation of nanocomposite materials. One of the promising matrices for preparation of anisotropic nanoparticles is anodized alumina. Anodized alumina is an amorphous aluminum oxide with a highly ordered uniform pore structure (the pore diameter can be controllably varied from 10 to 100 nm). One could expect that this pore system is a perfect reactor for synthesis of nanocomposites due to the limitation of reaction zone by the pore walls. An important advantage of this system is the possibility to incorporate any compound by electrochemical methods, which enables to control the anisotropy parameters of nanostructures. Here we report the formation of nickel and zinc oxide nanoparticles in one-dimensional solid state nanoreactors formed by the porous system of anodized aluminum oxide with different pore diameters. The composites were prepared by pulsed electrochemical deposition. Nanocomposites were characterized by chemical analysis, HRSEM, XRD, FTIR, magnetic measurements and optical spectroscopy. It was showed that particles' shape and size are in good agreement with that of the pores, while the average length of nanowires could be controllably varied. Thus, the control of nanoparticle morphology enables to predetermine magnetic or semiconducting properties of composite. This work is supported by RFBR (03-03-32182) and INTAS (01-204).

G/PI.33

FABRICATION AND CHARACTERIZATION OF CdMnS NANOPARTICLES IN LANGMUIR-BLODGETT FILM MATRIX

V.I. Fediv, A.I. Savchuk, A.G. Voloshchuk, I.M. Fodchuk, Department of Physical Electronics and Non-Traditional Energy Sources, Chernivtsi National University, 58012 Chernivtsi, Ukraine

The nanocrystal formation and growth processes in organized molecular ensembles, in particular, in Langmuir-Blodgett (LB) films, are of a great interest. The development of LB method used to produce mono- and multimolecular layers with a controlled molecular structure and a specified molecular orientation confirms the practical possibility to produce devices with unique characteristics. We report here on optical and magneto-optical characterization of semimagnetic semiconductor CdMnS nanoparticles incorporated in LB films matrix. Semimagnetic semiconductor CdMnS nanoparticles were synthesized by exposure of LB films of Cd and Mn stearate in a atmosphere of H₂S. Quartz and silicon wafers were used as substrates. Nanoparticles distributed into multilayer structures that followed of ellipsometric investigation. The particle sizes were estimated by small-angle X-ray scattering and measurements of the optical absorption. Magneto-optical experiments (magnetoabsorption and Faraday rotation spectra) were carried out at temperature range of (4.2-300) K in magnetic fields up to 5 T. Optical properties of these systems are associated with the quantum size effects and surface states of the nanoparticles. The observed features in magneto-optical properties of CdMnS nanocrystals can be explained in framework of the modified spin exchange interaction in low-dimensional structures on the base of III-xMnxVI semimagnetic semiconductors. The work was supported by INTAS grant No. 2001-0354.

G/PI.34

SYNTHESIS AND CHARACTERIZATION OF METAL NANOPARTICLES

V. Tzitzios, V. Georgakilas, D. Petridis, D. Tassis, Institute of Material Science N.C.S.R "Demokritos", Athens, Greece

It is well established that the size and shape of metal particles are controlling factors for their electrical, optical, magnetic and catalytic properties. The last years several methods have been reported for the synthesis of nanosized metal cluster of several shapes and different sizes, revealing the great technological and scientific interest for these materials. A major interest is focused to noble metals and alloys which are used as catalysts, metals and alloys with magnetic properties and semiconducting metals. In the poster a new and simple method to prepare metal organosols and their characterization will be described.

G/PI.35

ZIRCONIA-BASED NANOCRYSTALLINE MATERIAL SYNTHESIZED BY DIRECTIONAL CRYSTALLIZATION FROM THE MELT

V.V. Alisin(b), M.A. Borik(a), E.E. Lomonova(a), A.F. Melshanov(b), G.V. Moskvitin(b), V.V. Osiko(a), V.A. Panov(a), V.G. Pavlov(b), O.E. Porodinkov(a), M.A. Vishnyakova(a.) (a)Laser Materials and Technologies Research Center of GPI, Russian Academy of Sciences, 38 Vavilov St., Moscow, 117942, Russia, (b)Mechanical Engineering Research Institute, Russian Academy of Sciences, 35 Vavilov St., Moscow, 117942, Russia

Development of advanced non-metal materials, which possess a set of unique mechanical properties combined with chemical inertness and excellent stability under oxidative media over a wide temperature range is still urgent issue of modern material science. Partially stabilized zirconia (PSZ), being a solid solution of zirconium dioxide containing small additions of yttria, is one of such materials.

Presently, a lot of PSZ materials are synthesized primarily through ceramic technology. The technique of a direct HF-melting in a cold container allowed very promising technique for growth of refractory crystals using directional crystallization from the melt. The technique results in high-strength, flawless material of zero porosity. The process is very efficient and may be considered as wasteless since the wastes are easy to recycle. The growing PSZ crystals are crystallizing in cubic lattice of fluorite structure, being a feature of the material at the temperature range corresponding to the crystallization point. Subsequent phase transformations occur in solid phase. The resulting crystals comprise nano-size crystalline formations composed by domains ranging from several nm to hundreds nm and as a rule forming a texture related to the direction of growth. Size and orientation of the domains depend on the material composition, growth conditions and the subsequent heat-treatment regime. Phase compositions of the crystals have been studied by means of Raman spectroscopy, XRD and DTA techniques. The lattice unit cell dimensions were determined. Bending and compressive strength characteristics, microhardness as well as fracture toughness have been determined for various compositions of the materials synthesized under different crystallization regimes.

- G/PL36** MONODISPERSE GOLD NANOPARTICLES FORMED ON BACTERIAL CRYSTALLINE SURFACE LAYERS (S-LAYERS) BY ELECTROLESS DEPOSITION
 S. Dieluwit(a,b), D. Pum(a), U.B. Sleytr(a), W. Kautek(c), (a)Center for Nanobiotechnology, University of Natural Resources and Applied Life Sciences (BOKU), Gregor Mendel-Strasse 33, 1180 Vienna, Austria, (b)Present address: Research Centre Juelich, 52425 Juelich, Germany, (c)Laboratory for Thin Film Technology, Federal Institute for Materials Research and Testing, Unter den Eichen 87, 12205 Berlin, Germany
 The fabrication of patterned arrays of nanoparticles whose electronic, optical and magnetic properties will find technological applications, such as ultra-high-density memories, is currently one of the most important objectives of inorganic material research. In this study, the in situ electroless nucleation of ordered two-dimensional arrays of gold nanoparticles (5nm in size) by using bacterial S-layers as molecular templates and their characterization by small spot x-ray photoelectron emission spectroscopy (XPS) is presented. This yielded the elemental composition of the surface regions and the chemical nature of the bonds and the oxidation and charging state of the chemical entities. The preferential deposition of the gold nanoparticles on the S-layer suggests that topography and functional groups are important for superlattice formation.
- G/PL37** CRITICAL BARRIER THICKNESS FOR THE FORMATION OF InGaAs QUANTUM DOTS
 M. Gutiérrez, M. Hopkinson, J.S. Ng and H.Y. Liu, Department of Electronic and Electrical Engineering, University of Sheffield, Mapping Street, Sheffield S1 3JD, U.K., M. Herrera, D. González and R. García, Departamento de Ciencia de los Materiales e I.M. y Q.I., Universidad de Cádiz, Apartado 40, 11510 Puerto Real, Cádiz, Spain
 The discovery of self-assembled quantum dots (QDs) has attracted much interest because of its possible applications in optoelectronic devices. The low density of QDs formed makes it useful to grow several layers of dots in the form of a stacked structure. In these structures, the buried islands tend to influence the further nucleation of islands in subsequent layers. It has been experimentally found that, when the number of layers increases, island sizes and shapes become more regular with each successive layer.
 Theoretical models have been proposed to elucidate the correlated vertical self-organization. The Stranski-Krastanow (SK) growth produces a tensile region, which induces the preferential nucleation of the next SK island just above the buried 3D-island. Experimental evidence of strain below the quantum dots (QDs) has induced us to study the influence of very thin barrier GaAs layers on InGaAs/GaAs QDs structures. The stress field below the islands brings about In diffusion in the lower islands. This In diffusion due to strain defines the Critical Barrier Thickness for the formation of quantum wells from three dimensional islands. A Critical Barrier Thickness of 6nm was observed in the case of 1.8 nm In_{0.5}Ga_{0.5}As/GaAs QDs structures. Above this thickness stacked QDs show near perfect alignment, whilst below this thickness modulated QWs are observed. The structural behavior is supported by photoluminescence (PL) characteristics.
- G/PL38** NANOPARTICLES SEPARATION BY MESOPOROUS MOLECULAR SIEVES
 A.A. Eliseev, I.V. Kolesnik, A.V. Lukashin, R. B. Vasiliev Department of Materials Science, Moscow State University, Moscow 119992, Russia
 Use of nanoreactors for controlled synthesis of nanomaterials has been recently boosted by the need to prepare uniformly sized nanoparticles with controlled dimensionality. However even colloidal routes usually does not provide high enough monodispersity of the nanoparticles. The separation of nanoparticles with controlled dispersion could be achieved only by a few methods, such as size selective precipitation, which require large quantities of samples. Here we suggest alternative method based on size-selective adsorption of nanoparticles by mesoporous silica sieves. Mesoporous silica is known to have highly ordered uniform pore structure (the pore diameter can be controllably varied from 2 to 50 nm). one could expect that the size of nanoparticles incorporated into porous alumina templates to be consistent with the dimensions of the porous framework. In the present study the samples of oleic-acid-capped PbS quantum dots were synthesized starting from lead oleate and trioctylphosphine sulphide in diphenyl ether at 120oC. PbS colloid was precipitated by ethanol and redispersed in hexane. The size of PbS particles was 5.5 nm with dispersion of 0.5 nm. Optical bandgap was found to be 3.84 eV. Encapsulation of nanoparticles into mesoporous silica matrix (pore diameter ~5 nm) was proved by chemical analysis, TEM, XRD, ED, FTIR, and optical spectroscopy. It was showed that only fraction of particles with diameters below 5 nm was intercalated. The optical bandgap of resulting nanocomposite was found as 4.15 eV which corresponds to the particle size of PbS nanocrystals below 5 nm.
 This work is supported by RFBR (03-03-32182) and INTAS (01-204).
- G/PL39** PH-CONTROLLED SELF ASSEMBLED NANO-HETERO-STRUCTURES BASED ON OLIGOTHIOPHENE FUNCTIONALISED RU NANOPARTICLES
 M. Tarik, A. Yassar, G. Viau, N. Chakroune, A. Jaafari, F. Fievet, P-C. Lacaze, ITODYS, Université Denis Diderot Paris-7, 1 rue Guy de la Brosse, 75005 Paris, France
 Recently there has been a great deal of interest in the synthesis of metal or semiconductor nanoparticles because of their unique size dependent chemical and physical properties which make them potential candidates for electronic and optical devices. Using a variety of approaches, many such dispersions of metals and semiconductors have now been prepared and the synthesis no longer represents a limiting factor. However, the development of easy methods for the assembly of metal and semiconductors nanoparticles into specific architectures remains an important objective. Self-assembly provides a powerful alternative to design multidimensional ordered structures. Here we report the design and synthesis of the self-assembled nano-hetero-structures based on ruthenium nanoparticles functionalized by electroactive oligothiophenes. Using TEM, UV-visible and FTIR we have established that the organization of these nanoparticles into nanospheres can be directly controlled through the modulation of p-p interaction. This finding shows also that the self-assembly nano-hetero-structures may be switched from monodisperse nanoparticles to ordered nanospheres by tuning the pH.

G/PI.40**MOLECULAR CONTROLLED ELECTRONIC DEVICES IT IS ALL A MATTER OF CONTACTS?**

David Cahen, Adi Salomon, Jamal Ghabboun, Hossam Haick, Weizmann Institute of Science, Rehovoth, Israel

Many of the practical and fundamental obstacles for molecular nm scale optoelectronic devices do not apply to hybrid molecular devices. There (sub)-nm molecular structures are incorporated in more classical device structures. Judicious choice of such systems allows us to explore not only the possibilities and limitations of molecules in optoelectronics, but also fundamental issues, e.g., possible unique effects. Electronic transport through molecules is often by tunneling,[a] but experimental evidence is accumulating that in most such devices, the molecule/electrode contact dictates junction behaviour.[a,b] We studied this further by placing series of molecules at metal-semiconductor interfaces. Even as poorly organized, partial monolayers, they can control such interfaces electronically[c] via the electron energetics at the interfaces.[d] In such systems the molecules function as "gatekeepers", i.e., act electrostatically rather than -dynamically. This leads to molecular devices with no current flow through molecules.[c] To make such devices reproducibly, soft contacting methods, that don't damage the molecules, were developed.[c] With these we show the importance of how the molecules are contacted. Intimate contact between molecules and metal can polarize the contacts. Intermixing contacts (such as Au, Ag) can undo this effect[c,e].

[a] D.Cahen, G. odes, Adv. Mater.,14(2002)789; A. alomon et al., Adv. Mater.,15(2003)1881;

[b] Y. elzer et al., Angew. Chem. 41(2002)827; A. alomon et al., to be published;

[c] A. Vilan et al. Nature,404(2000)166; J.Phys.Chem.B, 107(2003)6360; G.Ashkenasy et al.,Acc. Chem. Res. 35(2002) 21;

[d] D. ahen, A. Kahn, Adv. Mater.,14(2003)271;

[e] A. Vilan, D.Cahen, Adv. Funct. Mater.,12(2002)795; H.Haick et al., to be published.

G/PI.41**APPLICATION OF MATHEMATICAL CHEMISTRY APPROACHES IN NANOSCIENCE**

S.A. Beznosyuk, Altai State University, Lenin Av. 61, 656099 Barnaul, Russia

We have used a formalism of quantum statistical operator as a unique approach to simulation of processes in the condensed state nanostructures. There is a hierarchy of three key role processes: quantum-mechanical confinement of molecules, quantum statistical self-assembling of supramolecules, thermo statistical formation of dissipative medium. Mathematical chemistry includes some algebraic, topological and informational approaches to multilateral descriptions of confinement and self-assembling processes. The basic components forming the basis of the self-assembling theory are topological algebraic structure and information of chemical particle in nanosystems. That is cardinal differ from the basic Hamiltonian models of infinite molecule and stochastic models of dissipative medium. It is shown that there are sub- and supra-molecular topological algebraic nanostructures and informations. Self-assembling is caused by some unitary-nonequivalent transformations of quantum statistical operator of the supramolecular systems of confined molecules. Simulation of topological algebraic structures and calculation of their information are given. In its turn the thermo statistical formation of dissipative medium of nanosystems is consistently described by some nonunitary-nonequivalent transformations of quantum statistical operator of the supramolecular systems of confined molecules.

G/PI.42**LANGMUIR-SHAEFER FILMS OF TAILORED MULTIFUNCTIONAL DIPOLAR RUTHENIUM COMPLEXES**

Sabrina Conoci(a), Santo Di Bella(b), Salvatore Petralia (b), Salvatore Sortino(b)and Ludovico Valli(c), (a)Sioptics & post Silicon Technologies Corporate R&D STMicroelectronics, Stradale Primosole 50, 95121 Catania,(Italy), (b)Dipartimento di Scienze Chimiche, Università di Catania, Viale Andrea Doria 8, 95125 Catania, Italy, (c)Dipartimento di Ingegneria dell'Innovazione, Università degli Studi di Lecce, Via Monteroni, 73100 Lecce, Italy

Dipolar ruthenium(II) ammine complexes of 4,4'-bipyridinium (bpy) ligands possess unique characteristics as multifunctional redox switches. Actually, the reversible chemical oxidation of these complexes is accompanied by a dramatic change of their linear and nonlinear optical properties. While RuII complexes possess distinct linear (absorption maxima in the 580-640 nm region) and nonlinear optical features associated with the their intense, low-energy metal-to-ligand charge-transfer (MLCT) electronic transitions, RuIII analogues are transparent in the whole visible region and possess negligible second-order optical nonlinearity. In addition, we have recently demonstrated that self-assembled monolayers of these RuIII/II complexes on an optically transparent metal electrode can be reversibly switched chemically. We report here on the preparation and characterization of multilayers X-type, Langmuir-Shaefer (LS) films of these complexes tailored with hydrophobic tails. To this end, the amphiphilic functional complex, [RuII(NH₃)₅(N-dodecyl-4,4'-bpy)](PF₆)₃ (1), was synthesized and characterized. LS deposition has been done by saturating the water subphase with the NaPF₆ salt. The morphology and the spectroscopic features of the floating films have been tested by Brewster Angle Microscopy and UV-Vis reflection spectroscopy at the water-air interface, respectively. The present approach could represent a general method to achieve Langmuir-Blodgett films of amphiphilic multi-charged salt species.

Wednesday, May 26, 2004

Afternoon

Session V: Joint with Symposium G

Hierarchical self-assembly at surfaces and interfaces

- F/G-V.01** 14:00 -Invited- RECENT ADVANCES ON THE LONG WAY FROM MONOLAYER SELF-ASSEMBLY TO ENTIRE SELF-ASSEMBLED NANODEVICES: A HIERARCHICAL BOTTOM-UP APPROACH
R. Maoz, S. Hoepfner, S. Liu and **J. Sagiv**, Department of Materials & Interfaces, The Weizmann Institute of Science, 76100 Rehovot, Israel
The issue of nanofabrication poses a series of challenging problems in nanoscience today; facing growing demands with regard to both miniaturization and materials diversification, it is generally recognized that the construction of future nanodevices will have to ultimately rely on a "bottom-up" nanofabrication methodology, with other words, a chemical approach. However, the successful advancement of a comprehensive chemical approach to nanofabrication depends on the availability of methods capable of providing sub-nanoscale precision in the three dimensional (3D) manipulation of various molecular-sized components, so as to enable reliable assembly of planned architectural motifs of nanometric dimensions. A generic methodology addressing this basic problem will be described, whereby hierarchical processes of template-assisted self-assembly combined with surface chemical derivatization and lateral chemical patterning can lead to the stepwise growth, according to a predefined build-up plan, of various such architectural motifs of gradually increasing structural and compositional complexity. Examples demonstrating promising aspects of this approach will be given, particularly in the chemical assembly of planned 3D surface arrangements of inorganic nanometric components (e.g. metal and semiconductor nanodots and nanowires) on well-defined molecular templates.
- F/G-V.02** 14:40 MOLECULAR CONTROLLED ELECTRONIC DEVICES IT IS ALL A MATTER OF CONTACTS?
David Cahen, Adi Salomon, Jamal Ghabboun, Hossam Haick, Weizmann Institute of Science, Rehovoth, Israel
Many of the practical and fundamental obstacles for molecular nm scale optoelectronic devices do not apply to hybrid molecular devices. There (sub)-nm molecular structures are incorporated in more classical device structures. Judicious choice of such systems allows us to explore not only the possibilities and limitations of molecules in optoelectronics, but also fundamental issues, e.g., possible unique effects. Electronic transport through molecules is often by tunneling,[a] but experimental evidence is accumulating that in most such devices, the molecule/electrode contact dictates junction behaviour.[a,b] We studied this further by placing series of molecules at metal-semiconductor interfaces. Even as poorly organized, partial monolayers, they can control such interfaces electronically[c] via the electron energetics at the interfaces.[d] In such systems the molecules function as "gatekeepers", i.e., act electrostatically rather than -dynamically. This leads to molecular devices with no current flow through molecules.[c] To make such devices reproducibly, soft contacting methods, that don't damage the molecules, were developed.[c] With these we show the importance of how the molecules are contacted. Intimate contact between molecules and metal can polarize the contacts. Intermixing contacts (such as Au, Ag) can undo this effect[c,e].
[a] D.Cahen, G. odes, Adv. Mater.,14(2002)789; A. alomon et al., Adv. Mater.,15(2003)1881;
[b] Y. elzer et al., Angew. Chem. 41(2002)827; A. alomon et al., to be published;
[c] A.Vilan et al. Nature,404(2000)166; J.Phys.Chem.B, 107(2003)6360; G.Ashkenasy et al.,Acc. Chem. Res. 35(2002) 21;
[d] D. ahen, A. Kahn, Adv. Mater.,14(2003)271;
[e] A.Vilan, D.Cahen, Adv. Funct. Mater.,12(2002)795; H.Haick et al., to be published.
- F/G-V.03** 15:00 SELF-ASSEMBLED PEPTIDE FIBRILS AS POTENTIAL ENGINEERING-MATERIALS
Patrick Mesquida(a), Rachel McKendry(a), Cait MacPhee(b), (a)London Centre for Nanotechnology, Department of Medicine, University College London, U.K., (b)Department of Physics, University of Cambridge, U.K.
Peptide fibrils are an example of a self-assembled, three-dimensional superstructure of peptide or protein molecules, which can form under certain thermodynamic conditions. Depending on the original peptides the specific morphoplogy of the fibrils can vary considerably, ranging from short, coiled filaments to very long rods. The dimensions are usually a few nanometres in width and a few tens of nanometres to several micrometres in length.
Although these fibrils have first been found in biological tissue affected by certain protein-misfolding diseases there is evidence suggesting that the ability to form fibrils is a thermodynamic property generic to any polypeptide chain. Fibrils could also be formed in-vitro from non-disease-related proteins and even from artificially "bottom-up"-synthesized peptide chains which have no biological function at all. In addition to the exploration of their fundamental biochemistry peptide fibrils have recently attracted interest as potentially useful material for technical or biomedical applications, for example in biological gels or in tissue engineering. This project is an investigation of the physical properties of a specific peptide fibril system and of its interaction with surfaces. With this we aim to establish a knowledge base for future applications and first results are presented here.

FRANK-KASPER NANOSTRUCTURES AND THE FIRST SUPRAMOLECULAR QUASICRYSTAL

X.B. Zeng(a), G. Ungar(a), D.R. Dukeson(a), Y. Liu(a), V. Percec(b) and M.N. Holerca(b), (a)University of Sheffield, Department of Engineering Materials, Sheffield, U.K., (b)University of Pennsylvania, Department of Chemistry, Philadelphia, USA

Taper-shaped molecules such as Frechet-type benzylether dendrons with n -alkyl terminal groups self-organize in a variety of bulk thermotropic mesophases with periodicities in the range 3-30 nm; so far about 15 phases with different symmetries have been identified. Four of those are constituted of nearly spherical molecular aggregates ("micelles"), which can be regarded as supramolecular dendrimers. Three have defined crystallographic symmetries: Im3m (body-centred cubic), Pm3n (cubic) and the recently discovered $P4_2/mnm$ (tetragonal). The tetragonal phase has a complex structure, with the unit cell containing 30 "micelles" and a quarter million atoms.[1]. In common with the Pm3n phase it belongs to the class of Tetrahedrally Close Packed (TCP) structures, or Frank-Kasper phases. [2], which are widespread in transition metal alloys. In the talk, the commonality of transition metal atoms and supramolecular dendrimers will be indicated.

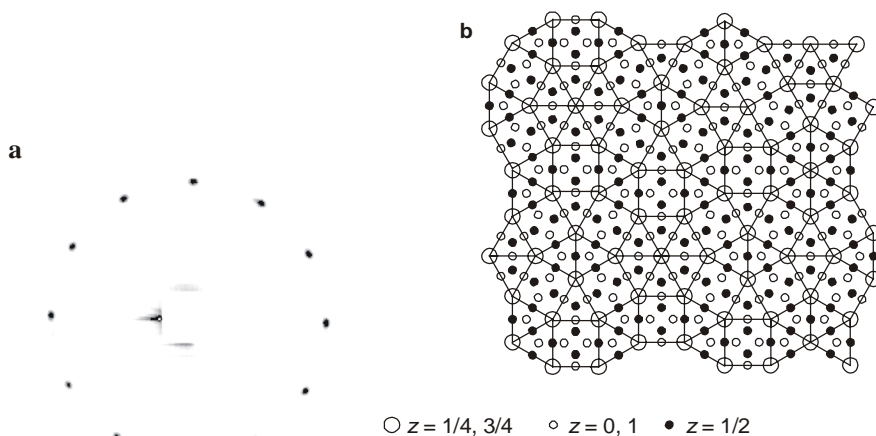
The fourth "micellar" phase, observed in a number of dendrimers, has eluded identification for several years. However, we have recently succeeded in growing monodomains (single crystals) of this mesophase. On the basis of X-ray diffraction of such a domain (see Figure a) and backed by AFM imaging, it was possible to establish that this phase possesses the crystallographically forbidden 12-fold rotational symmetry, and is thus a dodecagonal quasicrystal.[3]. So far quasicrystals, which have non-crystallographic symmetry and have quasi-periodic rather than truly periodic lattices, have only been observed in certain metal alloys.[4]. We have constructed a model of the structure (Figure b, view down the 12-fold axis) and the simulated diffraction pattern gives a reasonable match with that recorded for all orientations. Due to their exceptionally high symmetry, the prospect of growing self-assembled quasicrystals with "periodicities" on the optical scale (still some way off) opens exciting possibilities for generating wide photonic bandgap materials through supramolecular self-assembly.

[1]Ungar, G., Liu, Y. S., Zeng, X. B., Percec, V., Cho, W. -D. *Science* **299**, 1208 (2003).

[2]Frank, F. C. & Kasper, J. S. *Acta Cryst.* **11**, 184-190 (1958).

[3]Zeng, X.B., Ungar, G., Liu, Y., Percec, V., Dulcey, A.E., Hobbs J. K. *Nature* in press.

[4]Janot, C. *Quasicrystals: a primer* (Oxford University Press, 1992)



15:40

BREAK

Session VI

16:10 – 17:50

Nanotechnology and Public Perceptins and Issues of Scientific Ethics:

Can we keep public confidence and avoid the concerns met by other technologies?

Presentations: **Professor Mark Welland (Cambridge)**
 Dr. Renzo Tommellini (CEC)

Discussion

17:50 – 19:00

POSTER SESSION 2

- G/PIL.01** THERMAL EMISSION AND BAND-FILLING EFFECTS ON THE RISE TIME OF InGaAs/InAs/GaAs QUANTUM DOTS
A. Melliti(a), M.A. Maaref(a), B. Sermage(b), J. Bloch(b), F. Saibi(c), F. Hassen(c), H. Maaref(c), (a)Unité de Recherche de Physique des Semiconducteurs et capteurs, Institut Préparatoire aux Etudes Scientifiques et Techniques, LAMarsa 2070, Tunisie, (b)Laboratoire de Photonique et de Nanostructures, CNRS, UPR20, France, (c)Laboratoire de Physique des Semiconducteurs, Faculté des Sciences de Monastir, Monastir, Tunisie
 In this communication, we present an experimental study of the thermal emission and band-filling effects on the rise time of high quality InGaAs/InAs/GaAs quantum dots emitting at 1.2 micrometer at 10K. At excitation density of 10^4 Wcm^{-2} , the photoluminescence rise time, which is dominated by the relaxation time, of the ground and first excited states are independent of temperature (40 ps). At excitation density of 5600 Wcm^{-2} the ground (first excited) state photoluminescence rise time varies from 90 ps (110 ps) at 10 K to 40 ps (70 ps) at 160 K. This behavior is attributed to the band-filling and thermal emission effects on the efficiency of the relaxation.
- G/PIL.02** TRANSIENT SIMULATION FOR KINETIC RESPONSIVE BEHAVIORS OF ELECTRIC-SENSITIVE HYDROGELS SUBJECT TO THE APPLIED ELECTRIC FIELD
Jun Chen, Department of Mechanical Engineering, National University of Singapore, Hua Li, Institute of High Performance Computing, Singapore, K.Y. Lam, Department of Mechanical Engineering, National University of Singapore
 In this paper, the kinetics of polymer-based electric-stimulus-responsive hydrogels is investigated. The studied hydrogels are mainly composed of three phases, i.e. the interstitial water, mobile ions and a three-dimensional networked structure of hydrophilic polymer-chains crosslinked to each other. With consideration of the chemo-electro-mechanical coupling effect and the multi-phasic (water, ion and polymer-based solid phases) interactions, a newly developed mathematical model, the multi-effect-coupling electric-stimulus (MECe) model, is briefly presented to simulate the responsive behaviors of electric-sensitive hydrogels immersed into a bath solution under an externally applied electric field. The full formulation of the MECe model is a set of nonlinear partial differential equations, consisting of the Nernst-Planck equations for the concentration distributions of diffusive ionic species, the Poisson equation for the pattern of electric potential, and the continuum mechanical equation for the mechanical deformation of hydrogels. In order to solve the complex MECe model, a novel meshless Hermite-Cloud method is used in numerical implementations. The simulations in this paper focus on the one-dimensional transient analysis for the kinetics of hydrogels, including the variations with time for the distribution of diffusive ionic concentrations, electric potential as well as the hydrogel displacement. Some significant discussions on the simulated results are also made.
- G/PIL.03** EXCITON DYNAMICS IN SELF-ORGANIZED InAs/GaAs QUANTUM DOTS
A. Melliti(a), M.A. Maaref(a), F. Hassen(b), H. Maaref(b), J. Tignon(c), B. Sermage(d), (a)Unité de recherche de physique des semiconducteurs et capteurs, Institut préparatoire aux études scientifiques et techniques, La Marsa 2070, Tunisia, (b) Laboratoire de physique des semiconducteurs, Faculté des Sciences de Monastir, Monastir, Tunisia, (c) Laboratoire de physique de la matière condensée, Ecole Normale Supérieure, 24 rue Lhomond, 75231 Paris cedex 05, France, (d) Laboratoire de Photonique et de Nanostructures, CNRS, Route de Nozay, 91460 Marcoussis, France
 In this communication, we report a study of the exciton dynamics in self-organized InAs/GaAs quantum dots (QD's) grown by molecular beam epitaxy on (001) oriented GaAs substrate. We have combined continuous wave (CW) and time resolved (TR) photoluminescence (PL) results as a function of temperature to determine the radiative lifetime of the small QD's of the sample (diameter = 14 nm). We have found that the excitonic radiative lifetime is of the order of 800 ps and is almost independent of temperature. On the other hand, we have observed that for intermediate temperature range, the PL intensity of large QD's remains constant over a few hundred of picoseconds. We have attributed this behavior to two processes : the refilling of the large QD's by carriers escaped from small QD's and the state blocking caused by the effects of Pauli exclusion.
- G/PIL.04** ON THE ELECTRONIC TRANSPORT AND OPTICAL PROPERTIES OF SOME NEW POLY(AZOMETHINE) URETHANES IN THIN FILMS
 Mihaela Rusu(a), A. Stanciu(b), Mihaela Vasiloschi(a), G.G. Rusu(a), Mihaela Gîrtan(a), G.I. Rusu(a), (a)“A.I.Cuza” University, Faculty of Physics, Bd.Carol I 11, Iassy 700506, Romania, (b)“P.Poni” Institute of Macromolecular Chemistry, Aleea Grigore Ghica Voda 41 A, Iassy 6600, Romania
 The temperature dependences of the electrical conductivity and the Seebeck coefficient for some new poly(azomethines) are studied. The measurements have been performed using thin films ($d=150\text{-}3050 \text{ nm}$) deposited from solution. It is found that the investigated polymers have semiconducting properties. Values of some semiconducting parameters of these films have been calculated (activation energy of electrical conduction, $E_a=1.00\text{-}1.70 \text{ eV}$, charge carrier concentration, ratio of carrier mobilities). The correlations between these parameters and the molecular structure of the respective polymers are discussed. The optical energy gap ($2.20\text{-}3.00 \text{ eV}$) have been determined from the absorption spectra.
- G/PIL.05** RHODAMINE 6G IMPREGNATED POROUS SILICA: A PHOTOLUMINESCENCE STUDY
 A. Anedda, C.M. Carbonaro, F. Clemente, R. Corpino, P.C. Ricci and S. Rossini, Dipartimento di Fisica, Università di Cagliari and INFN, UdR-Ca, s.p. n°8, Km 0.7, 09042 Monserrato, Cagliari, Italy
 Owing to their optical, thermal, chemical and mechanical properties, sol-gel synthesized mesoporous silica monoliths are suitable hosts for organic dyes. Optical properties of embedded dyes can be affected by the surrounding silica matrix: shifts in absorption and emission spectra and variations of the photoluminescence quantum yield can be found when confining a dye into a mesoporous host.
 The aim of this work is to study the optical properties of porous silica monoliths impregnated with Rhodamine 6G (R6G) and to assess the feasibility of their use as lasing media. The host-guest interactions have been investigated by varying both the porosity of the silica matrix and the concentration of the R6G in ethanol solutions. A comparison with the optical properties of R6G ethanolic solutions is made and the photostability and the time stability of the samples have been tested through photoluminescence analysis.

G/PII.06**PHOTOLUMINESCENCE OF SILICA PARTICLES COATED WITH ZnO**

Márcia C. Neves, Tito Trindade, Chemistry Department, CICECO, University of Aveiro, 3810-193 Aveiro, Portugal, [M.J. Soares](#), A. Neves, T. Monteiro, Physics Department, University of Aveiro, 3810-193 Aveiro, Portugal

In recent years, considerable progress has been made in the synthesis of nanostructures, including nanoparticles for a range of semiconductors.1 These nanosized materials are of great scientific and technological interest because they have different properties to those of bulk solids of the same composition. The research on novel synthetic approaches towards nanomaterials is paving the way also to the preparation of new composite particles showing well-defined morphologies.

Recently, we have reported the preparation of SiO₂/ZnS particles using a solution method in which mild temperatures, less than 100°C, were used.2 In this method,2 synthetic well-defined SiO₂ particles acted as substrates favouring the formation of morphological uniform nanoparticles of ZnS which coated the silica particles. We report here that these composite particles can be used as precursors to produce ZnO coated sub-micron silica, by a simple calcination process. The XRD of the powders confirm the presence of pure hexagonal-ZnO. The SEM and TEM images show that uniform ZnO shells coat the silica particles yielding morphological well-defined core/shell particles. The photoluminescence of the precursor particles (SiO₂/ZnS) and the SiO₂/ZnO were investigated in detail and are reported here.

[1] T. Trindade, P. O'Brien, N. Pickett, Chem. Mater. 13, 3843 (2001).

[2] O. C. Monteiro, M. C. Neves, T. Trindade, J. Nanosci. Nanotech., 4, 137 (2004). We are grateful to the University of Aveiro (project No.3.64.33.7/NANOENG/CTS15).

G/PII.07**PHOTOLUMINESCENCE FROM POROUS SILICON IMPREGNATED WITH COBALT PHTHALOCYANINE**

[V. Vrkoslav\(a\)](#), [I. Jelínek\(a\)](#), [M. Matocha\(b\)](#), [V. Král\(b\)](#), [J. Dian\(a\)](#), (a)Charles University Prague, Ke Karlovu 3, 121 16 Prague 2, Czech Republic, (b)Institute of Chemical Technology, Technická 5, 166 28 Prague 6, Czech Republic

Photoluminescence quenching of porous silicon in presence of various analytes is used for sensing purposes. Sensor elements from as prepared porous silicon exhibit high sensitivity in gas phase detection but relatively low operational stability. Stabilization of porous silicon surface with organic molecules enables to enhance operational stability and optimize sensor response for specific analytes. We modified porous silicon surface using cobalt phthalocyanine by means of physical adsorption in the porous matrix. Infrared spectra showed no presence of new chemical bonds in porous silicon samples. We observed modified photoluminescence quenching response from these porous silicon samples impregnated with cobalt phthalocyanine. From concentration dependence of photoluminescence quenching in presence of various organic and inorganic analytes in gas phase we determined sensitivity of sensor response, from time evolution of porous silicon photoluminescence we evaluated operational stability of sensor elements. Link between chemical properties of cobalt phthalocyanine and variation of sensor response of impregnated porous silicon is discussed.

G/PII.08**CHARACTERISATION OF STRUCTURE AND DEFECTS IN DOT-IN-WELL LASER STRUCTURES**

[M. Gutiérrez](#), M. Hopkinson, K. Groom and H.Y. Liu, Department of Electronic & Electrical Engineering, University of Sheffield, Sheffield S1 3JD, U.K., M. Herrera, D. González and R. Garcia, Departamento de Ciencia de los Materiales e I.M. y Q.I., Universidad de Cádiz, Apartado 40, 11510 Puerto Real, Cádiz, Spain

Recent progress in the development of 1.3 μm InAs/InGaAs dots-in-a-well (DWELL) laser structures has led to efficient CW room temperature operation with low current thresholds. Present devices suffer from gain saturation, a consequence of the finite dot density, and to carrier escape due to the small energy separation between the quantum dot (QD) ground and first-excited states. In order to improve device performance, we have examined methods to increase the QD density through the use of strained buffer layers and using multiple QD planes. We have also examined modification of the energy barrier through the incorporation of InAlAs layers. The structural effect of these modifications has a marked effect on the structure of the DWELL QD lasers. Initial attempts at 3 or 5 multi-layer QD structures showed substantial degradation in electrical properties compared to successful single layer structures. Analysis by Transmission Electron Microscopy (TEM) has identified the presence of a macroscopic defect arising from the complex interaction of QDs. The defects are observed to propagate threading dislocations, which we suggest are the primary cause of the poor electrical characteristics. A mechanism for this creation for the creation of these defects and a method for their control presented. Using this method we have recently fabrication a defect free 5 layer stacked structure with record low threshold current density. The use of thin InAlAs capping layers is observed to strongly modify the structure of the QDs due to the suppressed migration of surface indium atoms in the presence of the aluminum containing layer.

G/PII.09**METAL NANOCULSTER DIFFUSION IN POROUS SUBSTRATES ASSISTED BY PLASMA**

P. Brault, A. Caillard, [A.L. Thomann](#), Groupe de Recherches sur l'Énergétique des Milieux Ionisés UMR6606-CNRS, Institut Polytechnique de l'Université d'Orléans, BP6744, 45067 Orléans Cedex 2, France, J. Durand, Institut Européen des Membranes UMR5635-CNRS, Université de Montpellier II - CC 47, Place Eugène Bataillon, 34095 Montpellier Cedex 5, France, R. Durand, Laboratoire de Matériaux Catalytiques et Catalyse en Chimie Organique UMR5618-CNRS, Ecole nationale supérieure de chimie de Montpellier, 8 Rue de l'école Normale, 34296 Montpellier Cedex 5, France, T. Sauvage, Centre d'Études et de Recherches par Irradiation UPR33-CNRS, 3A Rue de la Férolierie, 45071 Orléans cedex 2, France, S. Escibano, DRT/DTEN/SCSE/LHPAC CEA Grenoble, 17 rue des Martyrs, 38054 Grenoble cedex 9, France

Metal filling of porous material has a large amount of application especially in heterogeneous chemistry, as catalysis. We propose a new efficient method for realizing metal concentration gradients in porous material. The method is known as plasma sputter deposition and belongs to physical vapour deposition techniques. Briefly a negatively biased Pt target is sputtered by Ar⁺ present in a plasma created by a high frequency excitation antenna. The substrate (commercial E-Tek porous carbon tissue coated with a carbon / PTFE porous diffusion layer) is located in front of the sputtering target and immersed in the plasma during the deposition process. The main interest is to realize deposition of atoms on a substrate with simultaneous exposure of plasma ions. The diffusion into the substrate can be assisted by the surrounding plasma either as a thermal process or non-thermal process. MEB analysis has shown that nanoclusters (3-5 nm) of Pt are formed at the surface. The diffusion profile of the Pt into the diffusion layer can be deduced from RBS measurements. It follows an inverse power (N_{Pt}(z) ∝ t^{-1.2}) or a bi-exponential law, depending on the deposition conditions. First tests of these objects as fuel cell electrodes have demonstrated equivalent performance than conventional electrodes, which contains 5 or 7 times more Pt concentrations.

G/PIL.10**PHOTOLUMINESCENCE IN NANOSTRUCTURED ZnO GROWN BY ELECTRODEPOSITION**

B. Mari(a), F.J. Manjón(a), M. Mollar(a), J. Cembrero(b), R. Gómez(c), (a)Departament de Física Aplicada, Universitat Politècnica de València, 46071 València, Spain, (b)Departament d'Enginyeria Mecànica i Materials, Universitat Politècnica de València, 46071 València, Spain, (c)Departament de Química Física, Universitat d'Alacant, Alacant, Spain

Zinc Oxide (ZnO) is a wide gap semiconductor that can be grown under nanostructured form by galvanostatic electrodeposition (ED) at low temperatures (65°C). The physical properties of ZnO combined with its nanostructured form are suitable for luminescent and photovoltaic applications. Hexagonal ZnO nanocolumns with different size and density controlled by the growth parameters are obtained by electrodeposition onto a conducting substrate. The photoluminescence properties of ZnO nanocolumns are strongly dependent of the subsequent annealing procedure and consequently of their crystalline quality. Raman spectroscopy was used to evaluate the crystalline quality of the samples which evolves with the annealing temperature from the one corresponding to completely disordered ZnO crystals to the other corresponding to single crystals with a long range order. The broad bands exhibited by the Raman spectra of the as-grown samples are in good agreement with the one-phonon density of states obtained from ab initio calculations. Furthermore the recrystallization process as a function of the annealing temperature observed in the Raman spectra is well correlated with the huge excitonic photoluminescence activity in the samples annealed at 400 °C. The dependence of the emission properties of the samples on the crystal size and annealing temperature will be discussed.

G/PIL.11**HYDROGENATION OF STRAIN ENGINEERED InAs/(InGa)As QUANTUM DOTS**

S. Mazzucato, D. Nardin, M. Capizzi, A. Polimeri, A. Frova, INFN – Physics Dept., Univ. of Roma “La Sapienza”, P.le A. Moro 2, 00185 Roma, Italy, P. Frigeri, L. Seravalli, S. Franchi, CNR-IMEM Institute, Parco delle Scienze 37a, 43100 Parma, Italy

Strain and carrier confinement are controlled in InAs/(InGa)As quantum dots (QDs) by varying the thickness d and/or the In composition x of the lower (InGa)As confining layer (CL). This has allowed achieving 1.3 μ m emission at room temperature (RT), while 1.50 μ m emission has been achieved only below ~100K because of a rapid quenching of the photoluminescence (PL) for increasing T [1].

Since hydrogen passivates point defects in semiconductors, we have H irradiated strain engineered InAs/(InGa)As heterostructures (3 ML thick InAs layer, lower CL with $x=0.15-0.35$ and $d=60-1000$ nm) to improve their optical properties. Irradiation has been performed by a Kaufmann source, with samples at 300 C. Hydrogen doses, dH , were varied from zero to 1x10¹⁹ ions/cm². The PL efficiency increases with dH , reaches a maximum (optimum dH), then decreases because of an insurgence of non radiative defects. The optimum dH increases with d , the integrated PL efficiency increasing by as much as 25 times in QDs emitting at low energy. Correspondingly, the maximum temperature of PL emission increases by ~70K and RT emission at 1.5 μ m is achieved. Non radiative centers, therefore, determine the thermal quenching, in particular in the case of lower CLs richer in indium. Therein, indeed, a greater lattice mismatch between the heterostructure and the GaAs buffer and substrate is expected to give rise to a higher concentration of structural defects. Measurements as a function of temperature and power density will be discussed also. Measurements as a function of excitation energy are in progress and are aimed to achieve a deeper understanding of the origin and location of the structural defects responsible for the thermal quenching.

[1] L Seravalli et al., Appl. Phys. Lett. 82, 2341 (2003)

G/PIL.12**MODIFICATION OF CaF₂ FILMS BY IMPLANTATION OF ACTIVE METALS IONS**

D.A. Tashmukhamedova, Tashkent State Technical University, Univirsitetskaya Street, 2 Home, 700095 Tashkent, Uzbekistan

In last years sharply has increased interest to obtained nanostructure which are applied at creation of new perspective devices of solid-state electronics. One of the basic methods of creation of such structures is ion-implantation. This work is devoted to study of composition, structure and properties of three-component nanostructure, created in near surface CaF₂/Si (111) films by ion-implantation and after annealing. The implantation was carried out by Ва ions with energy Е0=1 keV. In process of ion-implantation on CaF₂ surface at first (at $D=1014$ сm⁻²) there were separate dotted strongly disturbed phases with the sizes ~ 5 - 10 nm. With growth of ions dose near to these dotted there were similar phases and separate formed cluster sites (islets). At a dose ~1015 сm⁻² the sizes of these sites reached up to 1 - 2 microns. The further increase of ions dose results in growth of the sizes cluster of phases and at dose $D = (2 - 6) \cdot 1016$ сm⁻² occurs overlap of these phases. The Auger-electron spectroscopy results have shown, that barium concentration in near surface is 35 - 40 аt.%. 25 - 30% of Ba ions is chemical compound Ca_{1-x}Ba_xF₂. For modification of surface carried out post-implantation annealing. Is established, what at temperature Т = 1000 K on surface CaF₂ implanted with a low dose (~1015 сm⁻²) are formed Ca_{0.6}Ba_{0.4}F₂ islets (nanocrystallines), and at implanted with high doses (2·1016 сm⁻²) - continuous film of this compound with thickness 50 – 60 Å.

G/PIL.13**THE FORMATION OF NANOCRYSTALLINE STRUCTURES ON THE SURFACE OF METALS BY THE LOW-ENERGY ION IRRADIATION**

I.V. Tereshko, V.V. Glushchenko, A.M. Tereshko, I.E. Elkin and V.V. Abidzina, Belarusian - Russian University, Prospect Mira 43, 212005 Mogilev, Belarus

The goal of this paper is to show the results of experimental studies of formation of nanoclusters in metals by the low-energy ion irradiation and computer simulation of nonlinear effects on an atomic scale. The subjects of the investigation were polycrystalline armco-iron and instrumental steels. All samples were irradiated by low-energy ions of residual gas in discharge plasma. The fine dislocation structure of the samples was being studied using the transmission electron microscopic method. The electrical resistance and microhardness measurements were made before and after the irradiation. We showed that the process of low-energy influence led to the formation of a complex multilayer structure in the near-surface area. There were the layers with the amorphous structure, a microcrystalline and nanocrystalline structure. The low-energy ion irradiation led to a change of physical and mechanical properties of irradiated materials. It is necessary to emphasize that samples behavior depends on the time elapsed after stopping irradiation. These modifications in materials could be understood within the conception of active self-organizing processes in crystal lattices. We showed by a computer simulation that nonlinear oscillations were excited in the system of coupled atomic oscillators in crystal lattices, which resulted in the formation of nanoclusters.

G/PII.14

THERMAL SPIKES IN NANOSCALE TRACKS OF SWIFT HEAVY IONS IN WIDE BAND GAP DIELECTRICS

Alexander E. Volkov and Michael V. Sorokin, Institute of General and Nuclear Physics, Russian Research Centre "Kurchatov Institute", Kurchatov Sq.1, 123182 Moscow, Russia, Kurt Schwartz, Gesellschaft fuer Schwerionenforschung, GSI, Planckstrasse 1, 64291, Darmstadt, Germany

High energy deposited by high charged energetic ions considerably excites electronic subsystem of a target while the ionic subsystem remains practically unperturbed at initial moments. Subsequent energy transfer from the excited electrons to target atoms can result in the nanosecond localized temperature increase (thermal spike) stimulating structure transformations in the nanometric vicinity of the projectile trajectories. Depending crucially on temperature levels achieved in the tracks this effect manifests a new possibility for monitoring of the kinetics of nanoscale heterostructures formation and can be interesting for modern technologies.

New self-consistent model of thermal spike from in swift heavy ion track in wide band gap dielectrics is presented. This model takes into account interactions between different charge carriers (electrons, holes, excitons) resulting from excitation of the electronic subsystem of dielectrics. Special attention is devoted to the effect of direct creation of Frenkel pairs (F and H color centers) during fast decay of selftrapped excitons that is typical for such materials. Energy balance resulting from lattice defects creation, material heating during decay of electronic excitations and spatial heat spread is described. The weaker temperature increase in SHI tracks than that was predicted before for wide band gap dielectrics is found.

G/PII.15

SPATIAL SEGREGATION OF COMPONENTS IN MULTICOMPONENT SOLID SOLUTIONS IRRADIATED WITH SWIFT HEAVY IONS

Alexander E.Volkov and Denis N. Korolev, Institute of General and Nuclear Physics, Russian Research Centre "Kurchatov Institute", Kurchatov Sq.1, 123182 Moscow, Russia

It was observed that energy losses of swift heavy ions (SHI) in solids can be converted into considerable modification of the point defect concentration in the vicinity of the projectile trajectory. Subsequent kinetics of initial inhomogeneous distribution of defects results in their directed diffusion currents having axis symmetry. The defect currents cause diffusion of atoms (Kirkendall effect). Due to different partial mobilities that can result in spatial segregation of alloy components in the vicinity of SHI tracks. Knowledge of the governing mechanisms of such segregation in nanometric vicinity of SHI trajectories gives a new possibility of monitoring of formation of regions enriched with impurity atoms that can be interesting for advanced methods of manufacturing of low-dimension structures.

Analytical and numerical investigations made in this paper allow to extract the values of parameters of systems where the spatial segregation of alloy components can be observed. Relative changes of the impurity concentration as well as the characteristic times of the kinetics of the segregation are obtained for such systems. It is known that due to different migration barriers and preexponential factors the ratio between the partial diffusion coefficients of alloy components can be reversed when the temperature increases. In this case the component which is faster at low temperatures becomes the slowest at high temperatures. So, the accumulation of the component in the track vicinity can be alternated to its depletion in this region. Parameters of systems where such effect can be observed are also determined in this research.

G/PII.16

MAGNETORESISTANCE DUE TO DOMAIN WALLS IN SEMICONDUCTING MAGNETIC NANOSTRUCTURES

V.K. Dugaev, J. Berakdar, MPI fuer Mikrostrukturphysik, Halle, Germany, J. Barnas, A. Mickiewicz University, Poznan, Poland, W. Dobrowolski, Institute of Physics, PAN, Warsaw, Poland, V.F. Mitin, Institute of Semiconductor Physics, Kiev, Ukraine, M. Vieira, ISEL, Lisbon, Portugal

Recent experiments show that magnetoresistance of nanowires and nanoconstrictions based on GaMnAs magnetic semiconductors can be very large reaching 2000% [1]. We analyze theoretically this effect in terms of a thin domain wall model [2] and under the depletion conditions. The model is justified in the limit of long wavelength of charge carriers as compared to the domain wall width, which is a realizable condition in the case of magnetic semiconductors. We show that the largest magnetoresistance occurs when the splitting of electron bands is large enough to ensure full spin polarization of holes in p-type materials. Such a situation is realizable in heavily Mn-doped and strongly compensated GaMnAs semiconductors. Transport through domain walls takes then place owing to spin-flip scattering. We have calculated the resistance of the domain wall as a function of the polarization and the hole density. Spin-orbit interaction is shown to play an important role in the magnetoresistance. We also discuss the role of localization corrections related to disorder. At low temperatures the magnetoresistance is strongly influenced by localization effects. We also suggest that magnetoresistance can be electrically controlled by a gate in the nanoconstriction region.

1. C. Ruester, T. Borzenko, et al. Phys. Rev. Lett. 91, 216602 (2003).

2. V.K. Dugaev, J. Berakdar, J. Barnas, Phys. Rev. B 68, 104434 (2003).

G/PII.17

THERMALLY INDUCED RELAXATION PROCESSES IN SUPER-HARD NANOCOMPOSITES STUDIED BY MEANS OF INTERNAL FRICTION MEASUREMENTS

S.Z. Li(a), Q.F. Fang(b), Z.S. Li(b), J. Gao(c), P. Nesladek(d), J. Prochazka(d) and S. Veprek(d), (a)Qingdao University of Science and Technology, Qingdao 266042, P.R. China, (b)Key Laboratory of Internal Friction and Defects in Solids, Institute of Solid State Physics, Chinese Academy of Sciences, Hefei 230031, P.R. China, (c)Chengdu Tool Research Institute, Chengdu 610051, P.R.China, (d)Institute for Chemistry of Inorganic Materials, Technical University Munich, 85747 Garching, Germany

We investigated the processes that are responsible for the stability of nanostructure and/or self-hardening of superhard nc-TiN/a-Si₃N₄ and nc-TiN/a-Si₃N₄ nanocomposites upon annealing, using the internal friction measurements by means of torsion pendulum and vibrating reed method. It is shown that stable nanocomposites, that were deposited under conditions of a sufficiently high nitrogen pressure and temperature in a high density plasma, show neither self-hardening nor internal friction up to a temperature of 800 °C achievable in our friction measurements. These stable nanocomposites show no change of the superhardness of ~8805; 40 GPa upon annealing to 1100 °C. In contrast, the unstable coatings that were deposited under a low temperature or nitrogen pressure or low plasma density show self-hardening and a distinct internal friction peak with well defined activation energy due to completion of the stable nanostructure upon the annealing. Both the self-hardening and the friction peak vanish after annealing to 750 °C.

G/PII.18**A COMPARATIVE STUDY OF PURE AND DOPED WITH PARAMAGNETIC IMPURITIES SEMICONDUCTOR NANOCRYSTALS**

A.I. Savchuk, V.I. Fediv, Ye.O. Kandyba, T.A. Savchuk, D.V. Ivanchenko, Department of Physical Electronics and Non-Traditional Energy Sources, Chernivtsi National University, 58012 Chernivtsi, Ukraine, A. Perrone, Physics Department and National Nanotechnology Laboratory of National Institute of Matter Physics, University of Lecce, 73100 Lecce, Italy

Nanometer-scale semiconductor particles offer a wide variety of possible applications in optical and optoelectronic devices. Semiconductor nanoparticles being embedded into dielectric matrix can exhibit different behavior mainly due to their small size. Another way to modify the properties of nanoparticles is to add impurities. In particular, paramagnetic impurities can lead to significant changes in magnetic and magneto-optical properties and create new base materials for the field of spin electronics. In this work we study growth parameters, optical and magneto-optical properties of CdS and CdMn:S nanocrystals prepared by their embedding in SiO₂ and polymer matrices. Absorption and photoluminescence spectra of undoped CdS and doped CdS:Mn nanocrystals were compared for the samples grown by different physical and chemical methods at different conditions. In the magnetoabsorption and Faraday rotation spectra of the CdS:Mn nanocrystalline samples typical features have been revealed which are related to the spin exchange interaction between the localized magnetic moments of Mn²⁺ ions and the band-carriers spins. Possible mechanisms of the influence of the reduction of dimensionality on spin exchange parameters in zero-dimensional structures are discussed.

The work was supported by INTAS grant No. 2001-0354.

G/PII.19**TEMPERATURE MODIFICATIONS OF BLUE EMISSION IN MESOPOROUS SILICA**

A. Anedda, C.M. Carbonaro, F. Clemente, R. Corpino, and P.C. Ricci Dipartimento di Fisica, Università di Cagliari, and INFN, UdR-Ca, s.p. n°8, Km 0.7, 09042 Monserrato, Cagliari, Italy

Sol-gel synthesis of mesoporous silica allows to investigate the effect of chemical and physical confinement in a transparent inorganic dielectric host and to project specific silica-based devices such as organic-inorganic hybrid for catalysis, electric transport and laser media [1, 2]. Moreover the study of the optical properties of mesoporous silica is strongly related to the topic of Si-related thin layers in the circuit integration technology [3]. In order to examine the possible interaction of guests with the silica matrix we investigate the optical properties of the host itself.

Porous silica is characterized by a huge surface-to-volume ratio and by a network of disordered and interconnected pores. The optical properties are mainly related to the chemical and physical conditions of the silica matrix. The influence of the silica surface can be analyzed by means of optical spectroscopy (time resolved photoluminescence and excitation of photoluminescence) with synchrotron radiation at room and low temperature (8 K). In particular we show that the blue emission strongly increases with respect to the UV emission at low temperature allowing a better characterization of the emitting center.

[1] H. Huang, A. Choudrey, P. Yang, Chem. Commun. 12 (2000) 1063, and references therein.

[2] M.A. Garcya-Sanchez, A. Campero, J. Non-Cryst. Solids 296 (2001) 50.

[3] G.G. Qin, J. Lin, J.Q. Duan, G.Q. Yao, Appl. Phys. Lett. 69 (1996) 1689.

G/PII.20**QUANTUM CONDUCTANCE OF AU NANO-WIRE PRODUCED IN TEM**

M. Arita, T. Tajiri, K. Hamada, R. Hirose and H. Miyagi, Hokkaido University, Sapporo, Japan

In the last decade, intensive studies on metal nano-wires have been reported using STM and mechanically controllable braking junction (MCBJ) methods. While the quantum conductance (QC) of nonmagnetic materials occurs with the step of $G_0 = 2e^2/h$, the step of ferromagnetic wire is known to be $G_0/2$. In this report, we present the QC experiments of Au produced in a transmission electron microscope (TEM). For this purpose, we made a piezo-driven TEM holder usable for a conventional TEM (JEM 200CX). During the formation of nano-wire between two Au tips, the images and the conductance were measured. When the wire having a length of several nm and a width of less than 1 nm, QC was observed. While the nG_0 (n : integer) quantization was observed in many cases, QC showing $G_0/2$ step was realized in several percent of them. Reducing the magnetic field by switching off the TEM objective lens (residual field: ~ 40 Oe), the probability of the appearance of $G_0/2$ quantization was reduced.

G/PII.21**MOTT-SCHOTTKY ANALYSIS OF NANOCOLUMNAR ZnO FILMS**

F. Fabregat-Santiago(a), J. Bisquert(a), B. Marí(b), J. Cembrero(c), (a)Departament de Ciències Experimentals, Universitat Jaume I, 12080 Castelló, Spain, (b)Departament de Física Aplicada, Universitat Politècnica de València, València, Spain, (c)Departament d'Enginyeria Mecànica i de Materials, Universitat Politècnica de València, València, Spain

Electrodeposition of ZnO on a conducting substrate forms an array of hexagonal crystalline columns normal to the substrate. Typical column size of ca. 200 nm wide and 500 length is obtained, and sizes and surface-volume ratios can be controlled by the growth parameters. The columnar ZnO structure is considered potentially useful for electrooptical and photovoltaic applications. It is believed that electrodeposited ZnO columnar crystals are strongly doped showing a large electronic conductivity. For electronic applications, it is important to quantify the electronic properties of the columnar array. It was shown that porous semiconductor electrodes obey the Mott-Schottky relationship of capacitance vs. potential provided that the thickness of solid elements is large enough to sustain a depletion zone. This should be the case in the columnar ZnO films. Therefore, we applied the electrochemical impedance spectroscopy (EIS) technique to obtain the capacitance/voltage characteristics. Impedance measurements were done in a standard three electrodes electrochemical cell with a Pt wire as counter-electrode and reference Ag/AgCl (KCl 3M). The electrolyte used was LiClO₄ 0.5M in water at pH 7. The results indicate a linear characteristic of $C-2(V)$ from which dopant density can be obtained. Results for a variety of films will be reported.

G/PII.22

MAGNETORESISTANCE IN GRANULAR FE - SRF2 FILMS

Hiroyuki Hosoya, Masashi Arita, Kouichi Hamada, Ryusuke Hirose, Hokkaido University, Sapporo, Japan

The research of a metal-insulator granular film which shows a tunnel type giant magnetoresistance (TMR) effect is expected for application such as sensors. While oxides have mainly been used for the insulator, a large TMR ratio was reported in the MgF₂-Fe system. In this work, we investigated another fluoride as the insulating material i.e. SrF₂. The TMR character and the microstructure were studied for Fe-SrF₂ films prepared by co-evaporation of Fe and SrF₂. The thickness of the films was 150 – 250 nm.

By the increase of Fe composition from 25 to 50 vol.%, the surface roughness (Ra) of the films estimated by AFM observations was monotonically decreased (2.0 to 0.8 nm). Within this composition range, all films showed TMR. The maximum TMR value was 5 %. Further increase of Fe composition induced the percolation of Fe particles and metallic conductance was recognized. By TEM observations, the particle size was mainly 2 – 3 nm. Resistivity of these films was between 10⁴ (25 vol.% Fe) and 10⁻¹ ohm cm (50 vol.% Fe) which was 2 – 3 order larger than the values of films using oxides. These values are quite similar as the one in the Fe-MgF₂ system. This must be due to the large band gap of fluorides (~ 11 eV). The influence by the temperature during deposition will also be discussed.

G/PII.23

ON THE MECHANISM OF ELECTRONIC TRANSPORT IN SOME CHELATE MODIFIED POLYSULFONES

G.G.Rusu(a), A.Airinei(b), I.Cuplunul(c), C.Baban(a), Petronela Prepelicu (a), G.I.Rusu(a), (a)Faculty of Physics, "A.I.Cuza" University, Iassy, Romania, (b)"P.Poni" Institute of Macromolecule Chemistry, Iassy, Romania, (c)Faculty of Physics, University of Bucharest, Bucharest, Romania

The studied polymers (chelate modified polysulfones) have been prepared by the polycondensation reaction between chloro-end-capped polysulfones and bis(2,4-dihydroxybenzaldehyde) Cu²⁺ in the dimethyl sulf oxide dichloromethane system, in the presence of an aqueous sodium hydroxide solution. The temperature dependence of electrical conductivity and Seebeck coefficient of the respective polymers were investigated using thin-film samples (d=200-2550nm) deposited from chloroform solution onto glass substrates. The samples with stable structure can be obtained by submitting them, after preparation, to a heat treatment consisting of several successive heating/cooling cycles within a temperature range, 300K-475K. The polymers under study have typical semiconducting properties. The values of some characteristic parameters of these films (activation energy of electrical conduction, E_a = 0.46-0.65 eV; ratio of carrier mobilities, b=1.1-1.5; etc.) of investigated polymers have been determined. The nature of the electrical conduction mechanism is interpreted in terms of band-conduction model. Also, the granular structure of the films plays an important role in the conduction mechanism.

G/PII.24

ELECTRON FIELD EMISSION FROM SEMICONDUCTOR CATHODES COATED WITH NANOCOMPOSITE SiO₂(Si) FILMS

A.A. Evtukh(a), V.G. Litovchenko(a), I.P. Lisovsky(a), I.Z. Indutnyy(a), M.O. Semenenko(a), H. Hartnagel(b), O. Yilmazoglu(b), (a)Institute of Semiconductor Physics, National Academy of Science of Ukraine, 45 Prospekt Nauki, 03028, Kyiv, Ukraine, (b)Technische Universitat Darmstadt, Institut fur Hochfrequenztechnik, Merckstrasse 25, 64283 Darmstadt, Germany

Efficient electron field emission from silicon flat cathode coated with SiO_x film (x ≈ 0.3) was observed both before and after thermal (1000 oC) annealing with subsequent etching in HF solution. Oxide films were produced by silicon thermal evaporation in vacuum (10⁻⁵ Torr.). Using optical spectroscopy in visible light and in infrared ranges, and AFM technique the structural features of these films were investigated. It was shown, that initial SiO_x film can be represented as SiO₂(Si) composite. Thermal annealing causes further phase segregation in the film material and it is transformed into SiO₂(Si) composite. During such a process silicon grains size decreases and their density increases. The model of electron field emission from the surface of such films was proposed. It was supposed that limitation process of the current flow under high electric fields is connected with Fowler-Nordheim tunneling through barriers Si – SiO₂(Si) + vacuum or Si – vacuum. Current peaks on emission I-V characteristics were explained in the framework of resonance tunneling mechanism.

Investigated structures seems to be perspective for application as flat field emission cathodes in vacuum electronic devices and in flat-panel field emission displays.

G/PII.25

/

G/PII.26

EFFECT OF RUTILE TYPE CONTENT ON NANOSTRUCTURED ANATASE-TYPE TiO₂ ELECTRODES SENSITIZED WITH CdSe QUANTUM DOTS CHARACTERIZED WITH PHOTOACOUSTIC AND PHOTOELECTROCHEMICAL CURRENT SPECTROSCOPIES

T. Toyoda, T. Tsuboya, Q. Shen, Department of Applied Physics and Chemistry, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo 182-8585, Japan

Dye-sensitized solar cell (DSSC) based on nanostructured TiO₂ electrodes has received much attention in recent years, since it shows high energy conversion efficiency exceeding 10% and good-term stability. Besides organic dyes, narrow-band-gap semiconductors can also be used as sensitizers. In this paper, we report the optical absorption by photoacoustic (PA) technique and photoelectrochemical (PEC) current characterization of nanostructured anatase-type TiO₂ electrodes sensitized with CdSe quantum dots and the influence against the addition of rutile type TiO₂ nanoparticles. PA and PEC current spectra shift to lower photon energy region as the CdSe quantum dots adsorbed, indicating optical absorption due to the CdSe quantum dots and the transfer of photoexcited electrons of the CdSe quantum dots to the TiO₂ conduction band. PA spectra show that the intensities of the TiO₂ electrodes with rutile-type content are higher than those without one, indicating that adsorbing CdSe quantum dots in the former are much more than the latter. PEC current spectra show that the intensities of the TiO₂ electrodes with rutile-type content are higher than those without one. These results can give rise to possible effects which are classified as light scattering enhancement, increase in charge injection and improvements of transfer properties owing to the addition of rutile-type TiO₂ nanoparticles. Part of this work was supported by a Grant-in Aid for Scientific Research (Nos. 14750645 and 15510098) and that on Priority Area 417 (No. 15033224) from the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government. Part of this work was carried out under the 21st Century COE program on "Coherent Optical Science".

G/PII.27

PHOTOSENSITIZATION OF NANOSTRUCTURED TiO₂ ELECTRODES WITH CdSe QUANTUM DOTS: CHARACTERIZATION BY PHOTOACOUSTIC AND PHOTOELECTROCHEMICAL METHODS

T. Toyoda, H. Yamamoto, M. Hayashi, Q. Shen, Department of Applied Physics and Chemistry, The University of Electro-Communications, 1-5-1 Chofugaoka, Chofu, Tokyo 182-8585, Japan

TiO₂ is a promising candidate for photoanode material. Dye sensitization is a method used to extend the photoresponse of TiO₂ electrodes to visible region. To realize a more efficient solar energy conversion than the organic dyes, semiconductor quantum dots (QDs) are used as sensitizers. The band-gap energy of semiconductor QDs can be turned by controlling their size to match the spectral distribution of sunlight. In this paper, we report the optical absorption and photoelectrochemical (PEC) characteristics of nanostructured TiO₂ electrodes on which CdSe QDs are adsorbed. Optical absorption spectra can be measured with photoacoustic (PA) method. PA method is a photothermal technique and it is useful for obtaining optical absorption characteristics of strongly scattering TiO₂ electrodes. The fundamental absorption edge shifts to lower photon energy (longer wavelength) region and the PA intensities below the band-gap region of TiO₂ increase rapidly with an increase in CdSe QDs deposition time, indicating an increase in optical absorption due to the large growth of CdSe QDs. Also, the increase in PEC current intensity and clear shift of spectrum to the lower photon energy region are observed with the increase in CdSe QDs deposition time, indicating the possibility that photoexcited electrons of CdSe QDs are transferred to the conduction band of nanostructured TiO₂ electrodes (photosensitization). Part of this work was supported by a Grant-in aid for Scientific Research (Nos. 14750645 and 15510098) and that of Priority Area 417 (No. 15033224) from the Ministry of Education, Culture, Sports, Science and Technology of the Japanese Government. Part of this work was carried out under the 21st Century COE program on "Coherent Optical Science".

G/PII.28

PHOTOCATALYTIC PROPERTIES OF NANOCRYSTALLINE TiO₂ POWDERS PREPARED BY SOL-GEL METHOD FOLLOWED BY SUPERCRITICAL DRYING

Yu.V. Kolen'ko(a), B.R. Churagulov(a), M. Kunst(b) and C. Colbeau-Justin(c), (a)Materials Science Department, Moscow State University, Moscow, Russia (b)Hahn-Meitner-Institut, Berlin, Germany, (c)LIMHP-CNRS, Université Paris 13, Villetaneuse, France

Nanocrystalline anatase powders - a metastable form of TiO₂ with the particle size 20-23 nm and high photocatalytic activity for the oxidation of phenol in water were synthesized by sol-gel method followed by supercritical drying in isopropanol. The products were characterized by XRD, TGA, SEM, TEM, FTIR, UV-VIS spectroscopy, BET and BJH methods. Their electronic properties were determined by Time Resolved Microwave Conductivity.

Photocatalytic activities of prepared samples were tested in the reaction of phenol photodegradation in water. The relationship between the photoactivity and structure, texture, charge-carrier lifetimes, bandgap energies, thermal treatment of the products is established. The effective method of synthesis of photocatalysts on basis TiO₂ - sol-gel method followed by supercritical drying in isopropanol is offered, and the received powders can be used in photocatalysis without additional thermal treatment.

G/PII.29

NANOCOMPOSITES FOR MEMBRANES WITH MIXED ELECTRONIC-IONIC CONDUCTIVITY

V. Zyryanov, Institute of Solid State Chemistry and Mechanochemistry SB RAS, Kutateladze str., 18, 630128 Novosibirsk, Russia, M. Ivanovskaya, L. Ivashkevich, D. Kotsikau, Research Institute for Physical and Chemical Problems of Belarusian State University, Leningradskaya str. 14, 220050 Minsk, Belarus, J. Criado, Instituto de Ciencias de Materiales de Sevilla, 4192, Spain, and S. Neophytides, Institute of Chemical Engineering & High temperature Processes, Stadio 18, Platani, Rion Achaias, 26500 Patras, Greece

Nanocomposites, prepared from mixtures of perovskite- and fluorite-like complex oxides, are synthesized and investigated. The compounds revealing good ionic conductivity (Bi_2O_3 , $\text{Ce}_{0.8}\text{Cd}_{0.2}\text{O}_{2-x}$, $\text{La}_{0.8}\text{Sr}_{0.2}\text{Ga}_{0.8}\text{Mg}_{0.2}\text{O}_{3-x}$) and electronic one (solid solutions based on SrFeO_3 , LaMnO_3 and $\text{Ce}_{0.8}\text{Pr}_{0.2}\text{O}_{2-x}$) were taken by preparing the composites. Two techniques were used for synthesis - mechanochemical activation routine, followed by calcinations, and thermal treating of hydroxides obtained by sol-gel method.

Effects of doped additives (La, Sr, Ca, Ba, and Nd to "A" sub-lattice; Ga, Mg, Zr, Fe, Al, Ti, and Sn to "B" sub-lattice) on an inter-diffusion of components of composites were investigated. Complex doping of the perovskites was found to decrease chemical interactions in composites, and also improve their operational characteristics and stability.

The work was supported by INTAS (grant 01-2162).

G/PII.30

THE EFFECT OF COMPOUND PROPORTIONS ON THE PIEZORESISTANCE EFFECT IN CARBON-ELASTOMER NANOCOMPOSITES

M. Knite, V. Teteris, A. Kiploka, J. Zicans, I. Yuchnevicha, Ilona Pavlovska Riga Technical University, 14 Azenes St., Riga 1048, Latvia, B.Polyakov, University of Latvia, 84 Krovalda St., Riga 1063, Latvia

In earlier studies [1,2] a giant effect of mechanical strain on electric resistivity has been observed in polyisoprene-carbon black (CB) nanocomposites. Of all the composites examined, the best results were obtained on samples belonging to the region of percolation phase transition with 10 mass parts (m.p.) of carbon nano-particles. Presently reported is a study of the effect of proportions of compounds and vulcanization parameters on the strain-resistivity relationship in CB nanocomposite elastomers. The piezoresistance coefficient $K=dR/dp$ is found to change the sign with mass concentration of sulphur. The observed correlation between mechanical properties and K is discussed. Atomic force microscope with a conductive tip was used for investigations of the electro-conductive carbon nano-size channel network on the surface of nanocomposites. The change of electrical resistance vs. pressure is explained by changes of the structure of the electro-conductive nano-size channel network of carbon particles revealed by atomic force microscopy studies.

G/PII.31**MICRO-ELECTROMECHANICAL SYSTEMS BASED ON 3C-SiC/Si HETEROSTRUCTURES**

Ch. Förster, V. Cimalla, M. Fischer, J. Pezoldt, O. Ambacher, FG Nanotechnology, Zentrum für Mikro- und Nanotechnologien, Technische Universität Ilmenau, PF100565, 98693 Ilmenau, Germany and K. Brückner, M. Hein, FG Hochfrequenz- und Mikrowellentechnik, Institut für Kommunikations- und Meßtechnik, Technische Universität Ilmenau, PF100565, 98693 Ilmenau, Germany

Wide bandgap semiconductors like SiC are excellent materials for high temperature, high frequency and high power applications. Furthermore the properties of SiC are typical for materials suitable for modern applications in micro-sensors, micro-actuators as well as in micro- and nano-electromechanical systems (MEMS, NEMS). Novel applications of SiC/Si based MEMS and NEMS are dosing and sensor systems for micro- and nano-fluidic systems, e.g. for fast and reliable biomedical testing and analysis. We have developed a technology for processing SiC/Si-based MEMS and NEMS. A micro dosing head for pulmonic amount of liquid in very small area are realized. This dosing head consist of parallel operating multi micro pipes running at a defined pressure. Furthermore, we used 3C-SiC/Si heterostructures to process resonator bars having geometries in the sub μm range and a thickness of 250 nm. These bars open the possibility to evaluate the viscosity of water based nano-droplets or to measure the mass of particles, for example proteins, positioned on the bars.

G/PII.32**IN VITRO COMPARATIVE STUDIES FOR TITANIUM SUBSTRATES COATED WITH PULSED LASER DEPOSITED AND MAGNETRON SPUTTERED HYDROXYAPATITE FILMS**

L. Verestiuc(a), M. Bercu(b), C. Morosanu(c), C. Plapcianu(c), F. Miroiu(d), I.N. Mihailescu(d), (a)Faculty of Medical Bioengineering, University of Medicine and Pharmacy Iassy, 16 University Street, Iassy, Romania, (b)Faculty of Physics, Bucharest University, P. O Box MG-11, 77125 Bucharest, Romania, (c)National Institute for Materials Physics, PO Box MG-7, 77125 Bucharest-Magurele, Romania, (d)National Institute for Lasers, Plasma and Radiation Physics, PO Box MG-54, 77125 Bucharest-Magurele, Romania

Chemical growth of calcium phosphate films on top of apatite structures is an essential step for promoting implants integration in human bones. This paper presents a comparative study of calcium phosphate chemical growth onto HA base layers deposited onto titanium substrates by pulsed laser deposition and magnetron sputtering methods. Amorphous and crystalline HA as-deposited films were characterized by FTIR and XRD measurements. Then the bioactive structures were immersed for 25 days at 37°C in SBF and SBF with addition of 0.1% collagen. The growth stages were monitored by gravimetric measurements and estimation of Ca and P concentrations by atomic absorption spectroscopy, respectively by colorimetric method. The calcium phosphate deposits were investigated by FTIR spectroscopy, Optical and Scanning Electron Microscopy. In case of the immersion in typical SBF, the quantity of chemically grown calcium phosphate is higher for amorphous base layers as compared to the crystalline ones, similarly with the previous results reported for the in vitro studies on HA/Si structures. The average thickness of the new chemical grown calcium phosphate layers is in the range 3-10 μm , as evaluated from the ratio of mass increase to growth area. The collagen presence into the SBF results in complex structures onto the biomaterial surface, with strong involvement of protein in the surface assembly process, as suggested by FTIR and SEM results.

G/PII.33**PROPERTIES OF OXYGEN PERMEATION MEMBRANE MATERIALS $\text{R}_0.6\text{Sr}_0.4\text{Co}_0.8\text{Fe}_0.2\text{O}_3$ -δ (R = La, Ce, Pr, Nd, Sm, Dy and Yb)**

E.V. Iakubovitch(a), O.S. Petrova(b), N.N. Oleynikov(b), V.A. Ketsko(a), (a)Kurnakov Institute of General and Inorganic Chemistry, Russian Academy of Sciences, Leninsky prospect, 31., 119991 Moscow, Russia, (b)Lomonosov Moscow State University, Department of Inorganic Chemistry, Vorobjovy Gory, 119899 Moscow, Russia

The high density of oxygen permeation in $\text{R}_0.6\text{Sr}_0.4\text{Co}_0.8\text{Fe}_0.2\text{O}_3$ -δ (R = La, Ce, Pr, Nd, Sm, Dy and Yb) causes a strong interest to this materials because of opportunity to use them as oxygen membranes. The functional properties of perovskite systems studied can be realized only in the high density state so that warm pressing of mechanically activated powders was used for synthesis. Materials obtained have been studied by X-ray powder diffraction, thermogravimetric analysis and scanning electron microscopy.

Solid solutions LSCF and their alloyed analogues were prepared starting from the nitrates of included cations. For synthesis of our samples a mechanical activation was used both before the final nitrates decomposition and before pressing into tablets. The tablets were pressed (two methods were used: usual pressing and warm pressing at the temperature of 250°C) under the pressure of 30 MPa and annealed at different temperatures: 1000°C, 1100°C, 1200°C, for 3 h in "Nabertherm" oven with further cooling. The results of the X-ray powder diffraction analysis correlate with the theoretical calculations of tolerant factor in perovskite materials. The tolerant factor values for $\text{R}_0.6\text{Sr}_0.4\text{Co}_0.8\text{Fe}_0.2\text{O}_3$ -δ, where R = La, Ce, Pr, Nd and Sm solid solutions are included in the stability range of $t = 0.88 - 1.10$. It was also shown that the single phase samples can be obtained even after annealing only at 1000°C for both types of pressing. The microstructure of the single phase anion-deficient perovskites $\text{R}_0.6\text{Sr}_0.4\text{Co}_0.8\text{Fe}_0.2\text{O}_3$ -δ (R = La, Ce, Pr, Nd and Sm) was found to be homogeneous with crystallites size as well as porosity distribution in ceramics characteristic of each rare-earth metal specified. For multiphase samples different types of crystallites were observed.

G/PII.34**TiO₂ NANOROD/Ag NANOCOMPOSITE IN HOMOGENEOUS NONPOLAR SOLUTION: SYNTHESIS AND PHOTOCATALYTIC PROPERTIES**

P. Davide Cozzoli(a), Roberto Comparelli(a), Elisabetta Fanizza(a), M. Lucia Curri(b), Angela Agostiano(a,b), (a)Dipartimento di Chimica, Università di Bari, via Orabona 4, 70126 Bari, Italy, (b)CNR IPCF Sez. Bari c/o Dip. Chimica, Università di Bari, Via Orabona 4, 70126 Bari, Italy

Nanosized metal/semiconductor oxide composites represent efficient bi-functional catalysts. The coupling with noble metals has also been demonstrated to increase the photocatalytic and photoelectrochemical responses of semiconductor oxides by reducing the fast recombination of the photogenerated charge carriers. Among the various materials, the well-known TiO₂ and Ag can still offer unexplored opportunities for the realization of novel nanocomposite systems. TiO₂ is the most studied semiconductor for environmental clean-up applications and silver is an extremely attractive noble metal to be investigated at the nanoscale, due to its remarkable catalytic activity. In this work a novel colloidal approach toward semiconductor/metal nanocomposites is presented. Organic-soluble anatase TiO₂ nanorods are used for the first time to stabilize Ag nanoparticles in optically clear nonpolar solutions in the absence of specific ligands for silver. Metallic silver is generated upon UV-illumination of deaerated TiO₂ solutions containing AgNO₃. The Ag nanoparticles can be obtained in different size-morphological regimes as a function of the irradiation time, due to light-induced photo-fragmentation and ripening processes. The proposed photocatalytic approach offers a convenient method for producing a TiO₂/Ag nanocomposite systems with a certain control over the metal particle size without use of surfactants and/or additives. Stable colloidal TiO₂ nanorods-stabilized Ag nanoparticles can be potentially available for a number of applications that require "clean" metal surfaces, such as homogeneous organic catalysis, photocatalysis and sensing devices.

A LUMINESCENCE STUDY OF NANO-POROUS DIATOMS

K.S.A. Butcher(a), J.M. Ferris(b), M.R. Phillips(c), M. Wintrebert-Fouquet(a), Nemanja Jovanovic(a), C.J. Garvey(b), E. Drabarek(b), W. Vyverman(d) and V.A. Chepurinov(d), (a)Physics Department, Macquarie University, NSW 2109, Australia, (b)Australian Nuclear Science and Technology Organisation, PMB 1 Menai 2234, NSW, Australia, (c)Microstructural Analysis Unit, Faculty of Science, University of Technology, Sydney, Broadway NSW 2007, Australia, (d)Laboratory of Protistology and Aquatic Ecology, Department of Biology, University of Gent, Krijgslaan 281-S8, -9000 Gent, Belgium

Porous silica is now used routinely in the microelectronics industry, and has potential applications in fibreoptic based photonic structures. However the recent production of synthetic forms of porous silica offer only a limited range of physical structures to study with a corresponding limit to the potential for optoelectronic device development. Alternatively, nature has provided a ready supply of intricately shaped silica structures: the micro-algae, diatoms, routinely assemble silica 'shells' at scales of tens to a few μm , and have regularly spaced pores to $<10\text{nm}$ width. We have investigated the luminosity of several types of diatomaceous material, including field-collected benthic diatoms from shallow streams and culture-grown single species (eg *Achnanthes subessilis*). The energy of the luminescence peaks for these different species, provides an indication of the defect structure of the diatoms in comparison to other forms of silica. The luminescence may also be affected by quantum size effects related to the porous structure of the material and photonic properties associated with the hole structure. This study of the luminescence properties of diatoms provides a basis for assessing the usefulness of the diatoms for potential optoelectronic and/or photonic applications. Cathodoluminescence and photoluminescence data are presented here, as are some structural results.

Session VII

G-VII.01 09:10 -Invited-

INFLUENCE OF MOLECULAR ARCHITECTURE ON THE PROPERTIES AND PERFORMANCE OF CuPc-C₆₀ PHOTOVOLTAIC DEVICES

Tim Jones, Sandrine Heutz, Paul Sullivan, Brett Sanderson, Stephan Schultes, Centre for Electronic Materials and Devices, Department of Chemistry, Imperial College London, London SW7 2AZ, U.K.

The performance of photovoltaic (PV) devices based on molecular materials has been improving rapidly in recent years, with one of the most efficient organic PV devices reported to date based on a copper phthalocyanine (CuPc)/fullerene (C₆₀) heterojunction [1]. It is well known that the short exciton diffusion lengths in organic semiconductors remains one of the key limitations for producing more efficient PV devices. In this work we show how controlling the molecular architecture can have a significant influence on the performance of the basic CuPc/C₆₀ cell fabricated by organic molecular beam deposition (OMBD). In particular, we show how layer mixing can lead to significant improvements and utilise the molecular control offered by OMBD to study the influence of layer composition and architecture on device performance. A maximum power conversion efficiency is obtained for devices containing a mixed layer of ratio 75:25 CuPc:C₆₀ surrounded by thin continuous layers of pure organic material at the electrode interfaces (see figure below). A structure containing a compositional gradient where the CuPc:C₆₀ composition is varied from purely donor to purely acceptor via three mixed layers of increasing acceptor composition leads to further improvements in efficiency [2]. Detailed atomic force microscopy (AFM) studies show that the morphology of the films is profoundly modified by co-deposition and these observations are used to rationalise the observed trends in PV device efficiency. The implications of this work for future developments in organic PV devices will be discussed.

[1] P. Peumans and S. R. Forrest, Appl. Phys. Lett. **79** (2001) 126.

[2] P. Sullivan, S. Schultes, S. Heutz, T.S. Jones, Appl. Phys. Lett. **84** (2004) 1210.

G-VII.02 09:45

SEARCH FOR FUTURE MATERIALS FOR ADVANCED PHOTOVOLTAIC CONCEPTS, SUCH AS NANOCOMPOSITE OR EXTREMELY THIN ABSORBER (ETA) SOLAR CELLS

F. Lenzmann(a), B. O'Regan(a), J.v. Roosmalen(a), M. Nanu(b), A. Goossens(b), (a)Solar Energy Department, ECN, Westerduinweg 3, 1755 ZG Petten, The Netherlands, (b)Laboratory for Inorg. Chemistry, Faculty of Applied Sciences, Delft University of Technology, Julianalaan 136, 2628 BL Delft, The Netherlands

Nanostructured ETA solar cells and other related approaches towards advanced solar cell concepts have recently overcome the conceptual stage and are currently reaching respectable white light efficiencies of up to 4 % under one sun illumination intensity [1,2]. The systems in question can be described as nanocomposite materials consisting of interpenetrating nano-networks of TiO₂ (electron conducting network) and CuInS₂ (hole conducting network). The presence of thin layers of Al₂O₃ and/or In₂S₃ at the interface between the TiO₂ and CuInS₂ phases has been shown to be crucial for the suppression of interface recombination [2,3], which seems to be the most relevant factor limiting the overall performance of such photovoltaic systems. A successful approach for the development of these systems in the past few years has been semi-empirical materials research backed up and rationalized by continuously more elaborate models for the theoretical description. In this contribution we follow the tradition of this approach for the investigation of new materials options for the absorber component in these solar cells. Quantum sized colloidal nanoparticle-solutions of MoS₂ and WS₂ have been synthesized for the assessment of the potential of such materials as absorbers in ETA solar cell systems based on mesoporous TiO₂ films. The ability of size-quantized MoS₂ to inject electrons into the conduction band of TiO₂ could be concluded on the basis of surface photovoltage measurements of TiO₂ films sensitized by MoS₂ nanoparticles.

G-VII.03 10:00

DESIGN, SYNTHESIS AND PHOTOVOLTAIC PROPERTIES OF [60]FULLERENE BASED MOLECULAR MATERIALS

José L. Segura, Francesco Giacalone, Rafael Gómez, Nazario Martín, Departamento de Química Orgánica, Facultad de Ciencias Químicas, Universidad Complutense de Madrid, 28040-Madrid, Spain, Dirk M. Guldi, Radiation Laboratory, University of Notre Dame IN 46556, USA, Christoph Brabec, Helmut Neugebauer, N. Serdar Sariciftci, Christian Doppler Laboratory for Plastic Solar Cells, Linz Institute for Organic Solar Cells (LIOS), Physical Chemistry, Johannes Kepler University Linz, 4040 Linz, Austria, Franz Padinger, Konarka Austria Forschungs- u Entwicklungsges.m.b.H., Gruberstrasse 40-42, 4020 Linz, Austria

In this communication we present recent results of our group in the design and synthesis of materials for organic solar cells. Our contribution in this area is twofold. The first one involves the design and synthesis of C₆₀/p-conjugated system donor-acceptor ensembles. Modification of the p-conjugated systems are focused on tailoring (i) the absorption cross-section of the chromophore in the visible, (ii) the oxidation potential of the oligomeric or dendrimeric donor moiety, (iii) the size, shape or chemical makeup of the oligomer, and (iv) the stabilization of the radical ion pairs. A second contribution of our group involves the development of novel [60]fullerene derivatives with enhanced solubility and good acceptor properties as materials for photovoltaic devices. [70]fullerene analogues have also been investigated in order to increase the absorption coefficient in the visible region which is of critical importance to improve device efficiencies.

G-VII.04 10:15

STUDY OF SILICON NANOCRYSTAL SIZE DISTRIBUTION IN MOS nc-Si MEMORIES BY FT-DLTS
S. Ferraton, L. Montès, J. Zimmermann, IMEP-INPG, 23 rue des Martyrs, 38016 Grenoble, France, A. Souifi, Laboratoire de Physique de La Matière, UMR-CNRS 5511, INSA de Lyon, Bât.502, 20 Av. Albert Einstein, 69621 Villeurbanne Cedex, France

Silicon nanocrystals embedded in thin SiO₂ oxides are extensively studied to build high-density, low-power, and high reliability non volatile memories. However, a very few number of papers have been devoted to the determination of the electron trap centers in the Si dots or at their surface states.

In this paper, we have studied the slow traps related to the nc-Si by Fourier Transform Deep Level Transient Spectroscopy. The studied samples consist of LPCVD nc-Si deposited on thermal SiO₂ oxides with thicknesses ranging from 0.8 nm to 2.5 nm on p-type Si substrates. The Si dots are then capped with a 8 nm-thick high temperature oxide (HTO) before deposition of n+poly Si gates. Reference samples without nc-Si have been fabricated for each tunnel oxide thickness. By changing the experimental conditions, we have shown that it is possible to evidence fast interface traps at the SiO₂/Si interface and slow states near the nc-Si layer. The slow states have been identified as quantum levels within the dots or surface states of the dots. For the reference samples, we have also identified slow states at the interface between the thermal and the deposited oxide. The interesting point of this study is that the Si dot signal can be considered as the contribution of many dots with various diameters in good agreement with the dot size distribution ranging from 2 nm to 8 nm in our case. Finally, it appears that FT-DLTS is a good way for controlling the nanocrystal uniformity in NVMs. This is a key point for reproducible device parameters.

G-VII.05 10:30

NEW ADVANCES IN THE ELABORATION OF SILICON-BASED NANOWIRES AND NANOCABLES
D. Cornu(a), M. Bechelany(a), K. Saulig(a), F. Chassagneux(a), C. Jacquier(a), T. Epicier(b) and P. Miele(a), (a)Laboratoire des Multimatériaux et Interfaces, UMR 5615 CNRS, Université Claude Bernard Lyon 1, 43 Bd du 11 Novembre 1918, 69622 Villeurbanne Cedex, France, (b)GEMPPM, UMR 5510 CNRS, INSA Lyon, 20 Avenue Albert Einstein, 69621 Villeurbanne Cedex, France

Numerous studies have been devoted to nanotubes (NTs) and nanowires (NWs) of various chemical composition. These nanomaterials offer exciting opportunities e.g. for thermostructural applications (nanocomposites) or for applications in nanoelectronic. Among those, silicon-based nanowires are particularly interesting due to their intrinsic chemical and electronic properties which can be emphasized at the nanoscale. For example, SiC NWs could be more efficient than carbon NTs in nanoelectronic for high temperature, high power and high frequency applications. Moreover, coaxial multielement nanostructures (nanocables, NCs) could offer good opportunities particularly as reinforcement agents for mechanical applications, the outer shell acting as an interface between the nanofiber and the matrix. Only few methods have been developed to elaborate such NCs and they usually involve heavy technical apparatus, non suited for industrial process.

Recently we reported on the preparation of SiC, Si₃N₄ and SiO₂ NWs by direct reaction between silicon and carbon under N₂ or Ar/O₂. Moreover we prepared SiC@BN NCs composed of a SiC core coated with several layers of boron nitride. Those NCs are several micrometers long with 50nm diameter. This general method has been extended to the elaboration of other nanocables (SiC@SiO₂ and Si₃N₄@BN). The structure and chemical composition of these nanomaterials have been investigated by HRTEM, EDX and EELS, and will be discussed in the present paper.

10:45

BREAK

Session VIII

G-VIII.01 11:10 -Invited-

UNUSUAL QUANTUM CONFINEMENT EFFECTS IN IV-VI MATERIALS

Guy Allan and **Christophe Delerue**, IEMN - Dept. ISEN, 41 boulevard Vauban, 59046 Lille Cedex, France

Nanostructures of IV-VI materials such as PbSe have recently attracted much attention due to their optical properties in the (near)-infrared range, at technologically important wavelengths. Their large exciton Bohr radius (46 nm in PbSe) offers the possibility to study systems in the strong confinement regime. But IV-VI semiconductors have a cubic rock salt lattice and a peculiar band structure compared to usual zinc-blende semiconductors. For example, PbSe has a direct but degenerate bandgap at the L point of the Brillouin zone and there are several saddle points at critical wave vectors. For these reasons, quantum confinement has unusual effects and our aim in this talk is to discuss its influence on the optical properties of PbSe nanostructures on the basis of tight binding calculations. We present results for PbSe nanocrystals and quantum wells. In the case of brick-shaped PbSe nanocrystals, we study the evolution with size of the absorption spectrum in a wide range of energy and we compare to ellipsometry measurements [1]. Whereas the optical threshold is always blue-shifted when the size is reduced, we show that peaks in the spectra corresponding to transitions at some critical points of the Brillouin zone can be red-shifted. Our theory explains this peculiar behavior in agreement with the experimental data. We also show that the confinement leads to a strong anisotropy of the dielectric constant for thin PbSe layers. The calculated density of states is compared to STM spectroscopy measurements [2], showing a nice transition from 0D (zero dimensional) structures to 2D ones. Finally we discuss the case of spherical PbSe nanocrystals [3] for which fluorescence and stimulated emission have been experimentally observed.

[1] Z. Hens, D. Vanmaekelbergh, E. S. Kooij, H. Wormeester, G. Allan, and C. Delerue, Phys. Rev. Lett. 92, 026808 (2004).

[2] Z. Hens, B. Grandidier, D. Deresmes, G. Allan, C. Delerue, D. Stiévenard, and D. Vanmaekelbergh, Europhys. Lett., in press.

[3] G. Allan and C. Delerue, to be published.

G-VIII.02 11:45

PHOTOLUMINESCENCE DECAY DYNAMICS OF NON-INTERACTING SILICON NANOCRYSTALS
O. Guillois, N. Herlin-Boime and C. Reynaud, Laboratoire Francis Perrin (URA CEA-CNRS 2453), Service des Photons, Atomes et Molécules, DSM/DRECAM, CEA-Saclay, 91191 Gif/Yvette Cedex, France, G. Ledoux, LPCML CNRS UMR5620, UCBL Lyon I, 69622 Villeurbanne Cedex, France, F. Huisken, MPI f. Astronomie, Heidelberg and Friedrich-Schiller Universität, Jena, Germany

Time-resolved photoluminescence measurements on size-selected silicon nanocrystals have been carried out in order to elucidate the non-exponential behavior of the photoluminescence decay kinetics. The nanoparticles are gas-phase synthesized, extracted as a supersonic beam, size-selected, and deposited downstream as films of variable densities. The nanoparticle number densities were determined by atomic force microscopy. The photoluminescence properties appear totally independent of the film density. Even in the very low density film where nanoparticles are completely isolated from each other, the decay kinetics corresponds to a stretched exponential law. This means that the stretched exponential kinetics does not originate from the interaction between nanoparticles, but is actually a characteristic of the silicon nanocrystals.

G-VIII.03 12:00

POROUS SILICON PARTICLES; A NEW NANOMATERIAL

Takashi Matsuura and Nicholas St J Braithwaite, The Open University, Oxford Research Unit, Foxcombe Hall, Boars Hill, Oxford OX1 5HR, U.K.

Silicon fine particles with many nanopores distributed randomly on their surfaces have been fabricated for the first time. Our original fabrication method comprises simply of immersion of the raw silicon fine particles into a mixture of hydrofluoric acid and manganese dioxide powder, followed by rinse and dry. It is far easier than combination of the conventional anodic reaction method applied to the planar silicon wafer and the following dicing-off into particles. Our resultant porous silicon particles contain randomly distributed pores with a size ranging up to several micrometres on the surface, depending on the immersing condition. The minimum pore size was smaller than our SEM resolution limit, but we assume it similar to that in the planar porous silicon wafer, ie., nanometres or less. The porous silicon particles showed photoluminescence activity similar to that observed from a porous surface of a silicon wafer, when irradiated with UV light. Because of the simplicity and generality of the fabrication process with no need to supply external electrical current or energetic activation, the material has a wide range of application potential for novel devices and the method could be extended to other semiconductors such as GaAs to produce porous particles. *Now with EE, University College London.

G-VIII.04 12:15

VAN DER WAALS INTERACTIONS OF POLYAROMATIC HYDROCARBON DIMERS

Svetla D. Chakarova and Elsebeth Schroder, Department of Applied Physics, Chalmers University of Technology and Gothenburg University, 41296 Gothenburg, Sweden

Although density functional theory (DFT) in principle includes even long-range interactions, standard implementations employ local or semi-local approximations of the interaction energy and fail at describing the van der Waals interactions. We show how to extend a recent density functional which includes van der Waals interactions for planar systems [Phys.Rev.Lett. 91, 126402] to also include an approximate treatment of planar molecules. We use this functional to calculate binding distances and energies for dimers of several of the smallest polyaromatic hydrocarbons (PAHs) - benzene, naphthalene, anthracene and pyrene, and obtain results consistent with experiments and other theoretical studies.

12:30

LUNCH

Thursday, May 27, 2004

Afternoon

Session IX: Joint with Symposium F
SPM, Structural, electrical and optical properties

F/G-IX.01 14:00 -Invited-

ELECTRONIC FUNCTIONS OF SINGLE SUPRAMOLECULAR NANOSTRUCTURES AT INTERFACES

J.P. Rabe, Department of Physics, Humboldt University Berlin, Newtonstr. 15, 12489 Berlin, Germany
Prototypical *two-terminal* electronic devices like hybrid-molecular diodes can be made from single nanometer-sized molecules in a tunnelling junction. The orientation of the diodes and the asymmetry of the current-voltage characteristics depend on the frontier orbitals of the molecules as well as on the configuration of the electrodes [1]. The size of the devices is determined by the contacts.

Three-terminal devices like field-effect transistors have been fabricated with carbon nanotubes and gate widths on the 100 nm-scale [2]. The electrodes, however, are not readily scalable to nanoscale dimensions, which means in particular that the third, i.e. the gate electrode cannot be positioned accurately close to any nanometer-sized molecule.

Here we present a prototypical field-effect transistor, in which the current through a molecular diode is modified by a charge transfer complex linked to the molecule in the STM junction [3]. The gating effect is attributed to the dipole of the charge transfer complex. Since the complex is formed by an electron acceptor covalently bound to the molecule in the gap, and an electron donor coming from the ambient fluid, this set-up constitutes a chemical-field-effect transistor (Chem-FET) with nanometer-sized gates.

[1] F. Jäckel, Z. Wang, M.D. Watson, K. Müllen, J.P. Rabe, *Chem. Phys. Lett.* **387** (2004) 372.

[2] J. A. Misewich, R. Martel, Ph. Avouris, J.C. Tsang, S. Heinze, J. Tersoff, *Science* **300** (2003) 783.

[3] F. Jäckel, M.D. Watson, K. Müllen, J.P. Rabe, *Phys. Rev. Lett.* in press.

F/G-IX.02 14:40 -Invited-

FUNDAMENTAL PROCESSES AT THE SINGLE MOLECULE LEVEL

F.C De Schryver, KULeuven, Department of Chemistry, Leuven, Belgium

To an increasing extent coupling of photophysical techniques to microscopy has allowed to obtain information heterogeneous organic and bioorganic and macromolecular systems by mapping their spectral and (photo) chemical properties.

In this contribution photophysical properties of structures eventually containing either a single central chromophore or decorated with chromophores at the rim will be addressed. The energy dissipation processes including annihilation, energy hopping, energy transfer and electron transfer at the ensemble and single molecule level will be discussed. One of the most intriguing findings at the single molecule level was the presence of collective on/off jumps in the fluorescence intensity traces of the dendrimers (1). Back and forward single electron transfer at the single molecule level will be illustrated. Electronic properties of a single donor-acceptor system in an supramolecular array studied by scanning tunneling microscopy will be addressed.(2)

(1) Ph. Tinnefeld, K.D. Weston, T. Vosch, M. Cotlet, J. Hofkens, K. Müllen, F.C. De Schryver, M. Sauer J. Am. Chem. Soc., 124,14310-14311 (2002) J. Hofkens, M. Cotlet, T. Vosch, P. Tinnefeld, K.D. Weston, C. Ego, A. Grimsdale, K. Müllen, D. Beljonne, J.-L. Brédas, S. Jordens, G. Schweitzer, M. Sauer, F.C. De Schryver Proc.Acad.Sci. USA100, 13146-13151 (2003) R. Gronheid, A. Stefan, M. Cotlet, J. Hofkens, J. Qu, K. Müllen, M. Van der Auweraer, J.W. Verhoeven, F.C. De Schryver Angew.Chem 42, 4209-4214 (2003)

(2) A. Miura, Z. Chen, S. De Feyter, M. Zdanowska, H. Uji-i, P. Jonkheijm, A.P.H.J. Schenning, E.W. Meijer, F. Würther, F.C. De Schryver J.Am.Chem.Soc, accepted

F/G-IX.03 15:20

PATTERNING BY LANGMUIR-BLODGETT MONOLAYERS

B. Pignataro, L. Sardone, A. Raudino, G. Marletta, Dipartimento di Scienze Chimiche, Università di Catania, V.le A. Doria 6, 95125 Catania, Italy

The formation of laterally nanostructured monolayers of dimyristoyl-phosphatidylcholine (DMPC) has been achieved by vertical dipping of mica substrate in a Langmuir-Blodgett trough. Dynamic scanning force microscopy investigation allowed to find the experimental conditions (subphase temperature, film pressure, transfer speed) to obtain conventional plane-like monolayers or laterally ordered strip arrays or chaotic worm-like structures. In particular, the strip-like structures were found to consist of periodic condensed phase domains growing along the upstroke direction of the substrate. The directionality of this phenomenon jointly with the exponential decay dependence of the strips dimension upon substrate upstroke speed indicates that the origin of the patterning arises just from the periodic modulation of the three phase contact line during the transfer process.

These findings have been interpreted on the basis of a simple time-dependent mean-field theoretical picture. The model calculates the instability of a molecular film deposited over a thin sub-phase layer of varying thickness (in space and time) lying between the LB film and a solid substrate. In addition, LB film is described as coexisting liquid-like and gas-like domains which arrange their space position and surface fraction in order to minimize the total free energy.

15:40

BREAK

Session X

- G-X.01** 16:00 -Invited- SEMICONDUCTOR NANOPARTICLES AS ELECTRONIC MATERIALS
B. Sun and N.C. Greenham, Cavendish Laboratory, Madingley Road, Cambridge CB3 0HE, U.K.
Nanometre-sized particles of inorganic semiconductors provide size-tuneable optical properties, and can be deposited by convenient solution-processing techniques. In this talk, I will describe recent progress in photovoltaic devices based on composites of CdSe nanoparticles and conjugated polymers, where the nanoparticles act as the electron acceptor. Efficient operation requires effective transport of the electrons perpendicular to the plane of the film, and I will show how this can be achieved through control of the particle shape and the film processing conditions. Semiconductor tetrapods (four limbs extending in a tetrahedral fashion from a common core) are particularly effective as the electron transporter in combination with poly(p-phenylenevinylene) derivatives as the hole transporter, and allow solar power conversion efficiencies as high as 3% to be achieved. I will also describe spectroscopic and electrical measurements which examine the charge-transfer and charge-transport processes occurring in polymer/nanoparticle composites.
- G-X.02** 16:35 INTEGRATION OF SI QUANTUM DOTS IN MEMORY DEVICES
T. Baron(a), F. Mazen(b), B. De Salvo(c), M. Gely(c), S. Decossas(a), C. Gerardi(d), G. Ammendola(d), S. Lombardo(e), (a)LTM, 17 Rue des Martyrs, 38054 Grenoble, France, (b)LPM, 20 Avenue A. Einstein 69621 Villeurbanne Cedex, France, (c)CEA-DRT, LETI/DTS, CEA/GRE, 17 Rue des Martyrs, 38054 Grenoble, France, (d)ST-Microelectronics R&D Catania/Agrate Italy, (e)IMM-CNR, Catania, Italy
Silicon nanocrystals (nc-Si) memories have serious potential for pushing further the scaling limits of conventional NAND Flash until the 65 nm technological node [1]. The technology process based on discrete storage nodes is fully CMOS compatible. The electrical characteristics of these memories depend strongly on the surface coverage achieved with nc-Si and the spread in dot size and density.
We present in this contribution a complete study of nucleation and growth of nc-Si on SiO₂ by CVD. We propose an original two steps process which allows to control separately and precisely the nc-Si density and size and hence the surface coverage. Using a proper chemical surface preparation, a high density of 1.5x10¹² cm⁻² with size dispersion on the order of 10% is obtained. nc-Si are then integrated in an industrial memory device. Electrical characterisation of the devices will be presented and compared with electrical properties of individual nc-Si measured by UHV Electrostatic Force Microscopy. The feasibility of a double bit cell, by creating two virtual transistors out of one, is demonstrated.
- G-X.03** 16:50 WORLD BEST PEAK TO VALLEY CURRENT RATIOS IN SiGe/Si BASED ESAKI DIODES
M. Stoffel, G.S. Kar and O.G. Schmidt, Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, 70569 Stuttgart, Germany
Semiconductor tunnelling structures exhibiting negative differential resistance (NDR) are of great interest for high frequency and digital applications. In particular, high peak current densities and low valley current densities resulting in peak to valley current ratios (PVCR) greater than 2 are usually required. Since high frequency operation needs low capacity devices, the p⁺/i/n⁺ structures were grown on semi-insulating Si(001) substrates. Low temperature solid source molecular beam epitaxy was used to obtain sharp doping profiles. The growth parameters of the intrinsic region containing a Si_{0.55}Ge_{0.45} alloy were varied to optimize the device performance. A record PVCR of 5.6 was achieved at room temperature. This high value together with a valley voltage of 0.45 V and a swing voltage of 1.0 V make this device of particular interest for digital circuit applications. At 5 K, a PVCR of 7.6 was measured, which is the highest value ever reported for a SiGe based tunnel diode. Further improvements are expected by increasing the Ge concentration in the intrinsic region. Since the Ge content in pseudomorphic SiGe alloys is limited by the critical thickness, self-assembled Ge quantum dots were embedded in the intrinsic region. A detailed optimization of the growth parameters leads to a maximum PVCR of 2.6 at room temperature and of 3.5 at 5 K. These values, which fulfill the requirements for logic applications, are also the highest ever reported for Ge quantum dot based Esaki diodes.
- G-X.04** 17:05 /
- G-X.05** 17:20 ELECTRON LOCALIZATION AND CONFINED ELECTRON GAS IN NANO-POROUS ELECTRIDES
P.V. Sushko, A.L. Shluger, Department of Physics and Astronomy, University College London, Gower St., London WC1E 6BT, U.K. and K. Hayashi, M. Hirano, H. Hosono, Transparent Electro-Active Materials Project, ERATO, JST, KSP C-1232, 3-2-1 Sakado, Takatsu-ku, Kawasaki 213-0012, Japan
The recent advent of inorganic electrides opens exciting opportunities for studying the properties of an electron gas of controlled density confined in regular nano-pore arrays over a wide temperature range. The nano-porous main group oxide 12CaO·7Al₂O₃ (C12A7) can be transformed from a wide-gap insulator to an electride where electrons substitute anions in cages constituting a positive frame. The concentration of thus formed electron gas can be varied between about 10¹⁹ to 2×10²¹ electrons exhibiting a spectrum of different optical and magnetic behaviour. We use an embedded cluster method to elucidate the transport and optical properties of this system. Our ab initio calculations of the electronic structure give a consistent explanation of its high conductivity and optical absorption. They show that the electrons confined in inert positive frame are localized in cages and undergo hopping between neighbouring cages. We correlate their behaviour with the polarisation and deformation of nano-cages. Studies of these novel and poorly understood crystals provide a deeper insight into the dependence of electron gas behaviour on dimensionality and topology, and into design of new transparent conductors, electron emitters and electrides.

17:40 – 19:00

POSTER SESSION 3

G/PIII.01**DEVELOPMENT OF A NEW SYNTHESIS METHOD TO POLY(THIENYLENE VINYLENE) : POLYMERISATION AND ORGANIC SOLAR CELL PROPERTIES**

Laurence Lutsen(a), Anja Henckens(b), Kristof Colladet(b), Martin Knipper(b), Jean Manca(a), Dirk Vanderzande(b), (a)IMEC, IMOMEC division, Wetenschapspark 1, 3590 Diepenbeek, Belgium, (b)Laboratory of Organic and Polymer Chemistry, Limburg University, Institute for Material Research, Division Chemistry, Univ. Campus, Building D, SBG/OS, 3590 Diepenbeek, Belgium

This novel process allows the synthesis of low band gap conjugated polymers like poly(2,5-thienylene vinylene) derivatives in good yields, with high molecular weight, good quality (low defect level) and in large scale.

Compared to the other known methods as Gilch route, Xanthate route or Sulphinyl route, this invention has the advantages of leading to

1. Monomers and precursor polymers stable in time in inert atmosphere.
2. Polymers with a much lower polydispersity around 2 to 3 (PD @ 20-30 for the Xanthate route).
3. Reproducibility between batches 4. Polymers obtained through polymerisation reaction carried out at a temperature ranging from -78°C to room temperature
5. Good yields > 50%
6. Polymers with low defect level
7. Polymers with increased λ_{max} (around 545 nm for PTV at high temperature and 570 nm at RT, only 500-520 nm at high temperature for the Xanthate route depending on batches).
8. Large-scale synthesis is possible Such conjugated polymers are very useful for organic solar cells, organic transistors and all other kind of electronic devices. The precursor and the conjugated polymer are discussed all together with preliminary organic solar cells results.

G/PIII.02**SELF ASSEMBLY OF FLOUR-AND OTHER POLYMERS WITH LASER LIGHT AT 157 nm**

Z. Kollia, E. Sarantopoulou, A.C. Cefalas, National Hellenic Research Foundation, TPCI, Athens 11635, Greece, S. Kobe, Department of Nanostructured Materials, Jozef Stefan Institute, Jamova 39, Ljubljana, Slovenia

Control of self assembly of polymers following surface treatment of their thin films on Si substrates by laser light, is important for further development of laser micro- machining and polymer surface preparation with lasers. Laser ablation of polymer at 157 nm is a new method for polymer surface preparation for biochip manufacturing. At 157 nm polymers are ablated only through photochemical dissociation avoiding thus localized thermal heating which is the source of surface defects and deformation. However the efficiency of binding biopolymers on polymer surfaces depend on their surface morphology after laser light illumination. Self-assembly in micro and nano scale of fluor-and other polymers depends besides film composition, and on the wavelength of the laser pulse, its fluence and intensity. At higher laser fluence at 157 nm, regular complex structures appear on the surface of the remaining polymer.

G/PIII.03**SYNTHESIS AND CHARACTERIZATION OF MESOPOROUS TITANIA THIN FILMS BY SOL-GEL METHOD**

L. Armelao(a), E. Bontempi(b), G. Bottaro3, L. E. Depero(b), F. Poli(c) and E. Tondello(c), (a)INSTM and CNR-ISTM, Dipartimento di Scienze Chimiche, Padova University, Italy, (b)INSTM and Dipartimento di Ingegneria Meccanica, Brescia University, Italy, (c)INSTM and Dipartimento di Scienze Chimiche, Padova University, Italy

TiO₂-based materials are widely employed for the development of photoelectrodes, electrochromic and gas sensing devices. In particular, a great attention has been focused on crystalline TiO₂ in the anatase phase, due to its photocatalytic activity. At this regard, the use of nanocrystalline porous films with high surface area seems to play a key role on the catalytic activity of such systems. For this purpose, the use of mesoporous materials, having an ordered arrangement of pores with sizes in the 2 to 50 nm range, have gained increasing interest.

In recent years, many studies has been focused on the synthesis and characterization of mesoporous silica with particular attention on both the formation mechanism of the mesostructure and the identification of the obtained mesophases. Conversely, transition metal oxide-based materials have been less explored. This work reports the sol-gel synthesis and characterisation of mesoporous TiO₂-materials obtained by the self-assembly of inorganic species and surfactants. In particular mesoporous titania films have been prepared by dip-coating from solutions of prehydrolysed titanium isobutoxide (Ti(i-OC₄H₉)₄) in presence of hexadecyltrimethylammonium bromide (CTAB). The structural and morphological characterisation of the thin films was obtained by X-Ray Reflectivity (XRR), 2D X-Ray Diffraction (XRD2) and Atomic Force Microscopy (AFM). Moreover, surface and in-depth chemical composition was studied by X-ray Photoelectron Spectroscopy (XPS). Relevant results, concerning the relation between pore size and synthesis condition are presented and discussed.

G/PIII.04**MILLING OF POLYMERIC PHOTONIC CRYSTAL BY FIB**

E. Pialat, T. Trigaud, V. Bernical, J.P. Moliton, Université de Limoges, Laboratoire UMOP, Limoges, France

Today, organic materials offer enormous competitive potential in the field of optical telecommunications, so that an "all polymeric way" can be imagined for the design of local transmissions. The introduction of the WDM (Wavelength Division Multiplexing) method is an important step to increase the bandwidth. Achievement of such a technique can be carried out by a breakthrough initially imagined by Yablonoitch and John, the "Photonic-crystals", that is to say devices with Photonic Band Gap (PBG).

A possibility to maintain the flexibility properties of polymeric compounds consists of obtaining 2D devices with a PBG by milling an organic film at submicronic scale. An obvious way to perform such a process is to make use of the Focused Ion Beam (FIB) technique. A special ionic column with two asymmetric lenses has been computed and constructed in the laboratory to etch a 2D lattice in a polymeric layer. The geometry of the array is the result of a computing program working in the finite-difference-time domain (FDTD) and leading to the plotting of the first Brillouin zone, with a forbidden band centred at around 1.55 μm , the wavelength for telecommunications. In this paper we focus on physic and chemical mechanisms inducing the milling in PMMA of the periodic array corresponding to the computed PBG device. The different parameters, as refreshing and scanning times are studied over the electronic stopping power of impinging ions by means of on line SIMS (Secondary Ion Mass Spectrometry).

- G/PIII.05** SYNTHESIS OF Fe₃O₄ THIN FILMS BY SOLID STATE REACTIONS
A. Ilijinas(a), R. Brucas(b), V. Stankus(a), J. Dudonis(a), (a)Department of Physics, Kaunas University of Technology, Studentu 50, 3031 Kaunas, Lithuania, (b)The Material Physics Department, Uppsala University, Box 256, 75105 Uppsala, Sweden
 Magnetite, Fe₃O₄ is conducting material with a large degree of spin-polarization at room temperature. Thin films nanostructures of this material have a great perspective for future spintronics devices. Unfortunately magnetite thin films has many difficulties to synthesize it by in-situ methods.
 Our suggested new method for preparation of Fe₃O₄ thin films is using solid state reactions by annealing Fe₂O₃ and Fe multilayer structures in vacuum or by laser annealing in atmosphere. Primal structures (Fe₂O₃ and Fe) were formed by reactive magnetron deposition method, using special construction facing target sputtering system with Fe planar targets. The purpose of our investigation was to know, how magnetic properties of thin films, formed by such method, depends on microstructure and synthesis conditions. Crystal structure of as deposited thin film system, structural changes of this systems after annealing at different conditions and phase composition formation were measured and analyzed using X-ray diffraction method. The surface morphology were investigated by AFM (Atomic Force Microscopy). Samples magnetic properties were measured with MFM (Magnetic Force Microscopy) and MR (Magneto Resistance) measurements. The results shows that it is possible to synthesize magnetite thin film using this method. Sizes of crystallites depends on synthesis conditions. The investigation of films shows strong correlation between micro or nanostructure peculiarity and magnetic properties.
- G/PIII.06** NANOPATTERNING OF MOLECULAR MAGNETS BY LITOGRAPHICALLY CONTROLLED WETTING
M. Cavallini, M. Massi, F. Biscarini, C. Albonetti, CNR - ISMN Sez. Bologna, Via P. Gobetti 101, 40129 Bologna, Italy, D. Ruiz-Molina, J. Gomez, C. Rovira, J. Veciana, Institut de Ciencia de Materials de Barcelona (CSIC), Campus Universitari de Bellaterra, 08193 Cerdanyola, Spain
 We present an application of lithographically controlled wetting (LCW) for patterning molecular magnets on a large area and with nanometer resolution. In LCW, a stamp is placed close to a liquid thin film; in this manner the stamp protrusions drive the liquid to distribute under the protrusions by capillary forces. As the solution solidifies due to solvent evaporation, the deposited solute gives rise to the pattern. We used a solution of molecular magnets, viz. Mn₁₂ complexes. By controlling the concentration of the solution, the stamp-surface distance and interactions between the clusters and the surface, we can pattern either arrays of monolayer stripes or droplets made of molecular magnets. The stripes were investigated by atomic force microscopy and magnetic force microscopy.
- G/PIII.07** ION IRRADIATION OF ALLOY NANOCLUSTERS IN SILICA
G. Mattei, V. Bello, G. De Marchi, P. Mazzoldi, INFN - Univ of Padua, Dept of Physics, Padua, Italy, C. Maurizio, INFN, ESRF, GILDA-CRG, Grenoble, France, G. Battaglin, INFN - Univ of Venice, Dept of Physical Chemistry, Venice, Italy
 The control over the optical response of composite materials made by mono-elemental or metal alloy nanoclusters embedded in silica-based matrices is of paramount importance for controlling the optical properties of the composite. Such materials exhibit peculiar nonlinear optical properties which are function of the cluster size and composition and of the relative position between the laser and the plasma wavelengths. In this work, we use a multi-step approach for modifying either the composition of the alloy clusters or the dielectric environment around them. In the first step noble metal nanoclusters are synthesized by sequential ion implantation, which, in combination with thermal treatments, has demonstrated to be a very effective technique to obtain glass-based composite materials. The second step is ion irradiation which allows, by properly tuning the nuclear component of the energy released to the system, to create a halo of satellite clusters around the original ones. We will present some results concerning irradiation of AuAg and PdAg alloy nanoclusters evidencing the effect of the same irradiation conditions in these two different bi-component nano-structured targets.
- G/PIII.08** EPITAXY GROWTH OF IRON ON Si(001) BY ION BEAM SPUTTERING
Shu-Fang Chen, Chuan-Pu Liu, Department of Materials Science and Engineering, National Cheng Kung University, Tainan, Taiwan
 We demonstrate the possibility of growing epitaxy iron islands by ion beam sputtering in an UHV-based system on a Si(001) substrate. The deposition method consists in sputtering an iron target with argon ions. The argon ions are controlled under high energy and low flux. The first part of the study deals with the deposition parameters such as substrate temperature and deposition temperature. In the second part, the deposited islands are studied using X-ray diffraction; transmission electron microscopy; atomic force microscopy and secondary electron microscopy. The results show that, with increasing ion energy in the range of 0.8~1.5kV, the Iron island size distribution becomes more uniform, the mean island decreases while the island density increases. The island size is about 20nm. The Iron islands deposited at room temperature are found to have FCC structure and to present a perfect epitaxial relationship with the (100) Si substrate.
- G/PIII.09** SYNTHESIS AND STUDY OF ELECTRONIC TRANSPORT PROPERTIES OF SOME NEW CHELATE COMPOUNDS CONTAINING SILOXANE
M. Marcu, M. Cazacu, "P.Poni" Institute of Macromolecular Chemistry, Iassy, Romania, Mihaela Vasiloschi, L. Leontie, G.I. Rusu, Faculty of Physics, "A.I.Cuza" University, Iassy, Romania
 The Schiff base of 2,4-dihydroxybenzaldehyde with 1,3-bis(aminopropyl) tetramethyldisiloxane has been synthesised and complexed with four transition metals: copper(II), nickel(II), cobalt(II), and cadmium(II). The obtained chelates were transformed in polyester structures by polycondensation with bis(p-carboxyphenyl)diphenylsiloxane.
 The electrical and thermoelectrical properties of the respective polymers were studied on samples of thin films (d=150-3500 nm) deposited, from dimethylformamide solution, onto glass substrates. The temperature dependence of electrical conductivity and Seebeck coefficient were studied using surface-type cells and also sandwich metal/polymer/metal structures. All polymers have semiconducting properties. The values of some parameters (thermal activation energy $E_a=1.05-1.80$ eV; ratio of carrier mobilities, $b=1.2-2.5$, etc) have been calculated. Some correlations between these parameters and molecular structure of the polymers were established.

- G/PIII.10** **POROUS THIN FILMS GROWN BY SIZE-SELECTED SI-NANOPARTICLES**
F. Voigt(a), R. Brüggemann(a), F. Huisken(b), G.H. Bauer(a) (a)Institute of Physics, Carl von Ossietzky University, 26111 Oldenburg, Germany, (b)Institute of Solid State Physics, Friedrich-Schiller University, 07743 Jena, Germany
 Size selected Si-nanoparticles (Si-nc) with diameters ~ 3 nm prepared in a flow reactor with CO₂-laser induced SiH₄-decomposition have been accumulated as thin films on different substrates. Si-nanoparticles show strong luminescence in the visible regime after oxidation of their surface. The thin films contain clusters of conglomerated Si-nc which conserve the electronic properties of the single Si-nc such as the compression of electronic wave functions which has been verified by spectral photoluminescence measurements. The degree of volume filling analyzed experimentally to about 0.3 has been reproduced by a simplified numerical Monte-Carlo stick-ball model for the local arrangement of the Si-nc versus film growth time. We have studied charge transport during the growth of these porous thin films by simultaneous coplanar current measurements (interdigital metal contacts) and see three regimes:
 i) negligible transport at the beginning of film growth due to missing connections, ii) a superlinear increase of current with exponent 3/2 which will be discussed in terms of percolation transport, and iii) a linear increase with further film thickness.
- G/PIII.11** **MAGNETIC PROPERTIES OF NANOCRYSTALLINE Sm-Fe COMPOSITES FABRICATED BY PULSE LASER DEPOSITION AT 157 nm**
S. Kobe, K. Žužek, Department of Nanostructured Materials, Jozef Stefan Institute, Jamova 39, Ljubljana, Slovenia, E. Sarantopoulou, Z. Kollia, A. C. Cefalas, National Hellenic Research Foundation, TPCI, Athens 11635, Greece
 Sm-Fe thin films 10-50 nm thick, were deposited on a Si wafer coated with ~ 150 nm thick layer of Ta by ablating solid Sm_{13.7}Fe_{86.3} and other targets. Sm-Fe was ablated using a molecular fluorine laser at 157 nm [1] at low laser energy of 25 mJ per pulse. The dimensions of the deposited nanocrystals on the Si-Ta substrate were varied between 10-500 nm. The composition of the nanocrystals in Fe and Sm, grown by Pulse Laser Deposition (PLD), remains the same as the initial target composition, in contrary to the growth using PLD at longer wavelengths. The coercivity of the films after annealing at 6000 C was ~ 0.1 T. The magnetic properties, the morphology and type of the films, depend on the experimental conditions.
 [1] 157 nm Laser Spectroscopy of diatomic and triatomic molecules. E. Sarantopoulou and A. C. Cefalas. In "Ultraviolet spectroscopy and UV lasers" edited by Marcel and Dekker, 191-227, New York 2002.
- G/PIII.12** **ALUMINA NANOTUBE ARRAY AND ITS FORMATION MECHANISM**
Y.F. Mei(a), G.G. Siu(a), X.L. Wu(b), Paul K. Chu(a) (a)Department of Physics and Materials Science, City University of Hong Kong, Kowloon, Hong Kong, China, (b)National Laboratory of Solid State Microstructures and Department of Physics, Nanjing University, Nanjing 210093, China
 Porous anodic alumina (PAA) has recently attracted much attention in the fabrication of nanomaterials and nanostructures because of its applications as templates and the self-organized mechanism although the materials were discovered in the 1950's. The formation mechanism of individual alumina nanotubes and their array anodized under a pulsed voltage was analyzed using transmission electron microscopy in this work indicating voids in both the anodic porous alumina membrane and the tube walls of the alumina nanotubes. Circular, crack-like, and wheel-like voids were observed and considered to be responsible for the formation of the alumina nanotubes and their array. Based on the microstructural observation of individual alumina nanotubes, the morphology of the tube wall filled with the voids was experimentally determined to aid the understanding of the formation mechanism of alumina nanotubes. Our observations and analyses provide more detailed information on the self-organized mechanism of anodic porous alumina membranes.
- G/PIII.13** **ESAVD OF NANOCRYSTALLINE TiO₂-BASED FILMS FOR PHOTOCATALYSIS APPLICATIONS**
 Xianghui Hou and Kwang-Leong Choy, School of Mechanical, Materials, Manufacturing Engineering and Management, The University of Nottingham, University Park, Nottingham NG7 2RD, U.K.
 Nanocrystalline TiO₂-based films have been deposited using a novel and cost-effective Electrostatic Spray Assisted Vapour Deposition (ESAVD) method for photocatalysis applications. The deposited films mainly have anatase phase with different grain size and surface morphology. This paper reports the ESAVD of TiO₂-based films and the characteristics and photocatalytic properties of the films. The relationship of process, microstructures and photocatalytic performance of the films will be presented. The results demonstrate that ESAVD process can produce nanocrystalline anatase films with good photocatalytic activity, and further enhancement of photocatalytic property can be achieved by introducing appropriate dopants.
- G/PIII.14** **STRUCTURAL ANALYSIS OF THE THERMAL EVOLUTION OF Si NANOCCLUSERS PRODUCED BY PECVD**
Simona Boninelli and Francesco Priolo, INFN-MATIS and Dipartimento di Fisica e Astronomia, Università di Catania, via Santa Sofia 64, 95123 Catania, Italy, Fabio Iacona, Corrado Bongiorno and Corrado Spinella, CNR-IMM, Sezione di Catania, Stradale Primosole 50, 95121 Catania, Italy
 Si nanoclusters (nc) embedded in SiO₂ have been produced by thermal annealing of SiO_x films prepared by PECVD. The structural properties of the system have been investigated by energy filtered transmission electron microscopy (EFTEM) and dark field transmission electron microscopy (DFTEM). As deposited SiO_x films are homogeneous amorphous materials; the first steps of the phase separation between Si and SiO₂, the formation of well defined amorphous clusters, their crystallization and the increase of the crystalline fraction have been analyzed as a function of the annealing temperature and time. The capability of the EFTEM technique to detect all the clusters, independently of their crystalline state, has allowed a very reliable determination of some parameters, such as the Si nc mean radius and density as a function of the annealing temperature, not available by using conventional TEM analyses.

G/PIII.15**THERMAL EVOLUTION OF COBALT NANOCRYSTALS EMBEDDED IN SILICA**

C. Maurizio(a), G. Mattei(b), P. Canton(c), E. Cattaruzza(b), C. de Julian Fernandez(b), P. Mazzoldi(b), F. D'Acapito(a), G. Battaglin(d), (a)INFM-OGG, European Synchrotron Radiation Facility, BP 220, 38043 Grenoble Cedex, France, (b)INFM and Dipartimento di Fisica, Università di Padova, via Marzolo 8, 35131 Padova, Italy, (c)Dipartimento di Chimica Fisica, via Torino 155/b, 30172 Venezia-Mestre, Italy, (d)INFM and Dipartimento di Chimica Fisica, Università di Venezia, Dorsoduro 2137, 30123 Venezia, Italy

Composites formed by metal magnetic nanoparticles embedded in dielectric matrices draw much interest for their application in magnetic recording as well as in optoelectronic technology. Basic questions concerning the composite formation and stability are far from being understood and modeled. In particular, Co nanoparticles can occur in multiple crystalline phases, which can result in large differences in the magnetic moment and crystalline anisotropy, so affecting the possible application in magnetic recording. In this work, cobalt clusters (in the nm-range of size) were synthesized in silica glass by different techniques. Samples were characterized by transmission electron microscopy and in-situ grazing incidence x-ray diffraction (exploiting a synchrotron radiation beam), following their evolution during thermal treatments in vacuo up to T=1000 C. In the case of composites obtained by ion implantation, that are constituted of hcp Co particles, the transition from hcp to fcc structure expected around 400 C for the bulk phase was not detected; nevertheless, a significant amount of fcc nanoparticles were found at higher temperatures. The results obtained, peculiarly related to the finite size of the particles, are discussed.

G/PIII.16**RF-SPUTTERING OF GOLD ON SILICA SURFACES: DYNAMICS FROM CLUSTERS TO CONTINUOUS FILMS**

Lidia Armelao(a), Davide Barreca(a), Gregorio Bottaro(b), Giovanni Bruno(c), Alberto Gasparotto 2, Maria Losurdo(c), Eugenio Tondello(b), (a)ISTM-CNR and INSTM, Padova University, Padova, Italy, (b)INSTM and Department of Chemistry, Padova University, Padova, Italy, (c)IMIP-CNR, Bari, Italy

Metal nanoparticles have gained a markedly increasing consideration with regard to both scientific and technological purposes. In particular, gold-silica nanosystems are among the most studied thanks to their extensive applications in non-linear optics and heterogeneous catalysis. The possibility of obtaining prescribed material features by tailoring Au/SiO₂ nanostructure and morphology has motivated the investigation of various preparation methodologies for these nanosystems. Among the various synthetic approaches, RF sputtering is one of the most feasible thanks to its inherent versatility and the capability of tailoring the surface coverage, as well as the particle size and distribution, under controlled processing conditions.

In the present work, Au/SiO₂ nanocomposites were prepared by RF-sputtering of gold from Ar plasmas on amorphous silica substrates at temperatures as low as 60°C. The interrelations between nanosystem properties and processing conditions were investigated by means of a multi-technique characterization. While LRI (Laser Reflection Interferometry) was employed for the in-situ monitoring of the growth, ex-situ analyses were dedicated to the investigation of Au/SiO₂ nanostructure, chemical composition, optical properties and surface morphology (Glancing-Incidence X-ray Diffraction (GIXRD), Transmission Electron Microscopy (TEM), Spectroscopic Ellipsometry (SE), X-ray Photoelectron Spectroscopy (XPS), UV-Vis absorption, Atomic Force Microscopy (AFM)). A proper choice of the preparation conditions enabled the switching from cluster-like systems to continuous nanophasic Au thin films with a fine modulation of the material characteristics.

G/PIII.17**SIZE-REDUCED SILICON NANOWIRES: FABRICATION AND ELECTRICAL CHARACTERIZATION**

Robert Juhasz, Kai Kylmänen, Augustinas Galeckas, and Jan Linnros, Dept of Microelectronics and Information Technology, Royal Institute of Technology, Electrum 229, 164 40 Kista-Stockholm, Sweden

Silicon nanowires of diameters down to 100 nm and typical lengths of 1 μm have been fabricated in Silicon on Insulator material by electron beam lithography and subsequently size-reduced by three different methods: Photoelectrochemical etching in a hydrofluoric acid solution, thermal oxidation, and chemical etching in a potassium hydroxide solution. The smallest obtained nanowire diameter was 40 nm, though our previous results from silicon nanopillar size-reduction indicate that diameters ranging down to 10 nm are possible. To enable accurate control of the photoelectrochemical size-reduction, a micro-electrochemical cell was developed, enabling single nanowires to be exposed to the etching solution while being illuminated by a laser or a lamp. The arrangement allows contact leads to be extended to metal contact pads located outside the cell, which can be connected by probes, allowing in-situ electrical characterization of a nanowire during etching. Electrical characterization of both initially fabricated and size-reduced nanowires was performed at room temperature, demonstrating a conductance scaling with cross-sectional area. The resulting differences in surface termination from the various size-reduction methods, and its influence on conductance was also considered. Finally, we believe the micro-electrochemical cell to be an appealing approach both for controlled fabrication of single nanowires and for their potential use as (bio-) chemical detectors.

G/PIII.18**CALCIUM PHOSPHATE PRECIPITATION IN CATIONIC TEMPLATES**

Bénédicte Prelot, CNRS - LAMMI, Univ Montpellier 2, Bât. 15, Case courrier 015, Place Eugène Bataillon, 34095 Montpellier cedex 5, France, and Thomas Zemb, LIONS, Service de Chimie Moléculaire, CEA Saclay, 91191 Gif sur Yvette cedex, France

A simple and effective mean for controlling electrostatic interactions during mineral precipitation is the use of cationic system. Such cationic systems have been studied in order to template calcium phosphate (hydroxyapatite or HAP) precipitation and obtain mesoporous materials. Mixtures of cationic surfactants with a phosphate head-group and a quaternary ammonium have been used in order to obtain a template with adjustable surface charge and test the supposed charge-matching effect. This effect manifests by a strong dependence of the template shape on molar ratio, which governs the charge per unit area of the surfactant as well as the variability of the growing inorganic network.

We first explore the effect of high ionic strength and pH variation on phase diagram. A hexagonal structure was observed for anionic surfactant, and such organization is still preserved in the presence of small quantity of cationic. Synthesis of HAP is then performed using various volume fraction of template and independently various ratio of anionic and cationic. For sample with low amount of surfactant and an excess of anionic, TOC analysis showed more than 80% of the added surfactant was trapped in the precipitate. These samples display in SAXS 3 main peaks that are characteristic of hexagonal structure. Such structure, where a repetition distance is lower than surfactant chain length, has not yet been found in pure surfactant self-assembly. SAXS of this new structure indicates some long range order, but symmetry is not known since higher orders cannot be detected. This HAP-template hybrid material disappears after calcination, and the BET surface of calcined powders is smaller than for the HAP as particles synthesized in homogeneous conditions.

G/PIII.19**PATTERNING BY LANGMUIR-BLODGETT MONOLAYERS**

B. Pignataro, L. Sardone, A. Raudino, G. Marletta, Dipartimento di Scienze Chimiche, Università di Catania, V.le A. Doria 6, 95125 Catania, Italy

The formation of laterally nanostructured monolayers of dimyristoyl-phosphatidylcholine (DMPC) has been achieved by vertical dipping of mica substrate in a Langmuir-Blodgett trough. Dynamic scanning force microscopy investigation allowed to find the experimental conditions (subphase temperature, film pressure, transfer speed) to obtain conventional plane-like monolayers or laterally ordered strip arrays or chaotic worm-like structures. In particular, the strip-like structures were found to consist of periodic condensed phase domains growing along the upstroke direction of the substrate. The directionality of this phenomenon jointly with the exponential decay dependence of the strips dimension upon substrate upstroke speed indicates that the origin of the patterning arises just from the periodic modulation of the three phase contact line during the transfer process.

These findings have been interpreted on the basis of a simple time-dependent mean-field theoretical picture. The model calculates the instability of a molecular film deposited over a thin sub-phase layer of varying thickness (in space and time) lying between the LB film and a solid substrate. In addition, LB film is described as coexisting liquid-like and gas-like domains which arrange their space position and surface fraction in order to minimize the total free energy.

G/PIII.20**NANOPARTICLES OF TERNARY COMPOUNDS IN THE SYSTEM Zr-Ge-O: PRODUCTION BY THE ORGANIC-FREE SOL-GEL METHOD AND INCORPORATION INTO SILICA GLASSES**

V.S. Gurin and E.V. Frolova, Physico-Chemical Research Institute, Belarusian State University, Minsk, Belarus, E.A. Tyavlovskaya and K.N. Kasparov, Institute of Electronics, National Academy of Sciences of Belarus, Minsk, Belarus, N.I. Gorbachuk, Belarusian State University, Minsk, Belarus

A study of compounds in the oxide system with zirconia and germania is of great importance from several points: (i) polymorphism of the both components strongly dependent on size of particles and occurrence of dopants; (ii) glass-forming ability of GeO₂ fairly different from that of ZrO₂; (iii) variable coordination of Zr in different phases (6-7-8) and Ge (4-6) that provides feasibility of complicated network structures. High ionic conductivity of zirconia-based materials and excellent mechanical and refractory features of these ceramics open many applications, however, properties of composites with zirconia are not fully understandable. Germania is rather rare dopant in zirconia-based system, but it works not only by the effect of great difference of ionic radii ($R_{Zr^{4+}}/R_{Ge^{4+}} \sim 2$) in the solid solutions, but also through formation of stable chemical compounds. They were touched only in bulk phases, and very few works have investigated them to date. In the present research, we synthesized several Zr-Ge-O nanophases by the two methods. The first one is a sol-gel technique issued from inorganic salts; the second one is a matrix (sol-gel derived silica glass) incorporation due to coadsorption followed by solid phase transformations under elevated temperatures. Nanoparticles were detected with XRD, TEM, and features of the system were extensively studied with FTIR, ESR, XPS, UV/Vis absorption, and photoluminescence.

G/PIII.21**ELECTRIC FIELD AND TIP-SURFACE INTERACTION DEPENDENCE IN NANOPATTERN DEPOSITION BY ELECTROPULSED SCANNING PROBE MICROSCOPY**

L.V. Melo(a,b), E. Delgado(a) and P. Brogueira(a,b), (a)Physics Department, Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisboa, Portugal, (b)ICEMS, Instituto Superior Técnico, Av. Rovisco Pais, 1049-001 Lisboa, Portugal

The reduced dimensions of novel integrated devices and systems stresses the need for new nanopatterning techniques. We showed that metallic pixels of about 30nm can be deposited by applying -12V pulses to a tip coated with a CoCr metallic film while scanning in tapping mode AFM[1]. Electropulsed AFM deposition at different negative pulse voltages and different tip-surface interaction conditions is reported in this work.

Pulse voltages were applied from -17V to -9V (no deposition is observed for voltages from 0 to -8V). Film thickness increases almost linearly from 2.3nm at -9V to 5.6nm at -17V. Deposited pixel size varies from 30nm to about 150nm respectively. This indicates a direct relation between the applied electric field and the amount of material deposited. The deposited thickness increases, from 4.4nm to 5.6nm when the strength of the tip-surface interaction increases, i.e., the amplitude setpoint is reduced from 54% of the engage value to 49%. Pixel size seems also to increase. This is compatible with a larger amount of material deposited for a stronger interaction. Preliminary results also indicate that the pulse voltage needed for depositing increases as the substrate is oxidized, and that the pulse voltage needed for deposition does not depend on the Si wafer degree of doping (from intrinsic to strongly doped).

[1]P. Brogueira, L.V.Melo, "Novel nanosized patterning technology based on electropulsed scanning probe microscopy", *Mat.Sci.Eng. C* 23 (2003) 77-80.

G/PIII.22**STRUCTURAL MODIFICATION OF SILICON DURING THE FORMATION PROCESS OF POROUS SILICON**

R.J. Martín-Palma, J.M. Martínez-Duart, Departamento de Física Aplicada, Universidad Autónoma de Madrid, 28049 Cantoblanco, Madrid, Spain, L. Pascual, A. Landa, P. Herrero, Instituto de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Científicas, 28049 Cantoblanco, Madrid, Spain

Due to its particular structure and surface reactivity, porous silicon (PS) has stimulated much research and many applications in different fields were pointed out: light emitting diodes, optical sensors, biomedical applications, interference filters, waveguides, gas sensors, solar cells, etc. However, the formation mechanisms of PS are still unclear due to the difficulty of characterizing very thin porous layers. In particular, the PS/Si interface will play an important role on the optoelectronic behavior of PS-based devices. Thus, the morphology of this interface will determine the optical spectrum of PS-based optical filters, waveguides, microcavities, or the electrical response of such devices as LEDs, sensors, solar cells.

In the present work, direct examination allowed us to perform a deep insight into the formation mechanisms of PS. In particular, the structure of the PS/Si interface and that of the silicon nanocrystals that compose PS were analyzed in detail. For that purpose high resolution transmission electron microscopy (HRTEM) cross sectional analysis was performed. Furthermore, image processing was used to study in detail the structure of PS. Finally, the mechanism of PS formation and lattice matching between the PS layer and the Si substrate is analyzed and discussed.

G/PIII.23**PRODUCTION OF NANOSIZED PARTICLES IN THERMAL REDUCTIVE PLASMA**

A.V. Samokhin, N.V. Alexeev, Y.V. Tsvetkov, Y.V. Blagoveshensky, Baikov Institute of Metallurgy and Material Science RAS, 49 Leninsky pr., Moscow, Russia

Production of nanosized powders by using thermal plasma flow of hydrogen or hydrocarbons partial oxidation products is discussed.

Fundamentals of reducing gases production in plasma are briefly discussed on the basis of chemical thermodynamics and kinetics including calculations of the yield and the composition of reaction products as well as energy consumption.

Thermodynamics of metal oxides reduction such as tungsten, molybdenum, nickel, cobalt, copper and zinc oxides is presented at high temperature as well as thermodynamics of metals carbonitride synthesis under reaction of metals chlorides with hydrogen and hydrocarbon-air plasma.

Results of experimental investigation of nanosized tungsten, molybdenum, nickel and cobalt powders production by oxides reduction as well as synthesize titanium carbonitride from titanium chloride in hydrocarbon-air plasma are presented. Specific features of these processes are determined in comparison with the reduction in hydrogen plasma.

The possibilities of metal carbides synthesis under oxides reduction in plasma flow is discussed. It is possible to produce nanosized metal-carbon composition with specified carbon content.

Methods to control the mean particle sizes and chemical composition of nanosized powders during plasma reduction is developed from the experimental results.

G/PIII.24**INVESTIGATION of ELECTRIC CHARACTERISTICS of ZnCdHgTe/CdTe NANOSCALED INTERFACE**

G. Khlyap, P. Sydorчук, State Pedagogical University, 24 Franko str., Drogobych 82100, Ukraine

Semiconductor solid solution ZnCdHgTe is proposed as promising material alternative to widely used CdHgTe due to improved structural parameters. The epitaxial layers optimized for wavelength region 4-14 μm are seemed to be sufficiently prospective for different nanoscaled optoelectronics applications. However, as ZnCdHgTe are grown on (111)-oriented monocrystalline CdTe substrates and the lattice mismatch is about 1.3%, it is important to examine electric characteristics of interfaces in heterostructures ZnCdHgTe/CdTe taking into account effect of space-charge region nanoscaling.

Heterostructures p-ZnxCdyHg1-x-yTe/p-CdTe ($0 \leq x \leq 0.2$, $0 \leq y \leq 0.23$), were investigated at $T = 300 \text{ K}$ in range of applied voltage $V_a = 0,3 \text{ V}$. Principal attention was focused on current-voltage (I-V) and capacitance-voltage (C-V, test signal frequency $f = 1 \text{ kHz}$) studies. C-V measurements including C-V-profiling were performed. I-V measurements demonstrated the space-charge-limited current in whole range of applied bias. Numerical analysis of the experimental data revealed superposition of S-like curve (\sim up to 1.3 V) and exponential section (as the applied voltage increased up to 3 V). Reverse portions of the I-V-characteristics were demonstrated two modes of carriers transport: velocity saturation regime, where $m \gg 1.0$, and mobility regime, under which the SCL current appears as the square dependence of the applied voltage ($m \gg 2.0$).

G/PIII.25**AN IMPEDANCE SPECTROSCOPY INVESTIGATION OF NANOCRYSTALLINE CsPbBr3 FILMS**

G. Conte and G. Vitale, INFN and Electronic Engineering Dept., University "Roma Tre" Via della Vasca Navale 84, 00146 Rome, Italy, P. Aloe and F. Somma, INFN and Physics Dept., University "Roma Tre", Via della Vasca Navale 84, 00146 Rome, Italy

Recently ternary compounds of CsPbBr₃ produced by co-evaporating CsBr and PbBr₂ purified powders are attracting much interest for their interesting optical characteristics and potential applications in luminescence based detector and devices. Indeed, nano-crystallites are produced in the thin film material as evidenced by optical spectroscopy and X-Ray diffraction. These ternary nano-aggregates are wide-gap semiconductors with direct band-to-band transition. Identification of the nano-crystallites in the film is based on a similarity of the observed spectroscopic properties with those of the bulk CsPbBr₃ purified by the Bridgman technique. The materials object of this study have been deposited by Physical Vapour Deposition inside an UHV apparatus on DC7059 optical glass. We report on an impedance spectroscopy study in a wide frequency range and temperature aimed to identify the role of the surface located defects. These materials show an exciton absorption also at RT. The FWHM of the exciton peak is used to evaluate, together with X-ray analysis, the quality of the deposited material. The transport mechanisms have been analysed to achieve a better understanding of the current paths whereas spectral photoconductivity has been used to investigate the density of gap-states. Results show as the Fermi level is pinned by the surface states which induce an electron accumulation layer at the crystallite surface influencing the current transport at lower and intermediate temperature while, at the higher, an activate transport mechanism is observed. Hopping transport can be addressed both at high and low temperature with an average energy barrier of $0.95 \pm 0.02 \text{ eV}$. DC and AC measurements will be presented to illustrate the active transport mechanisms at the different temperatures.

G/PIII.26**STUDIES OF IRON-CONTAINING SILICA FILMS ON Si**

J. Sabataityte, I. Simkiene, G.J. Babonas, A. Reza, Semiconductor Physics Institute, Gostauto 11, 2600 Vilnius, Lithuania, R. Szymczak, H. Szymczak, M. Baran, M. Kozłowski, Institute of Physics, Polish Academy of Sciences, al. Lotnikow 32/46, 02-668 Warsaw, Poland, S. Gierlotka, High Pressure Research Center Unipress, Polish Academy of Sciences, Warsaw, Poland

Recently, the systems of iron particles embedded in oxide matrix, which have been prepared by various techniques, received a lot of attention due to their potential applications. Low-cost sol-gel methods for production of silica glasses are most promising due to low temperatures used and the possibility to vary the state of iron ions in final hybrid structures by changing the composition of precursors and conditions of thermal treatment. Though bulk porous silica matrix has been widely studied, the formation of doped silica films and their interaction with semiconductor substrate were not well examined.

In this work the iron-containing silica films on Si substrates were investigated. The structures were prepared by sol-gel spin-on technique from precursors composed of TEOS solution in ethanol and 5-10% of FeCl₃·6H₂O water solution. The colloid solutions were deposited by spinning on cleaned Si (100)-oriented substrates. The structures were annealed for 2 h at 550°C in air, Ar or H₂ atmosphere. The samples were characterized by optical properties making use of spectroscopic ellipsometry technique in the range 1-5 eV. The magnetic properties were studied by measuring the temperature and field dependences of magnetic moment. The physical properties were correlated with sample structure examined by AFM and SEM.

G/PIII.27

ELECTRIC PROPERTIES OF NaSbSe₂ THIN FILMS: EXPERIMENT AND NUMERICAL SIMULATION

G. Khlyap, State Pedagogical University, 24 Franko str., Drogo bych 82100, Ukraine, V. Bilozertseva, S. Ovcharenko, S. Krivonos, N. Dyakonenko, National Technical University "KPI", 21 Frunze str., Kharkov 61022, Ukraine

Sb-contained semiconductors are attractive for design of various field-effect sensors operating under different environmental conditions. Room-temperature electric properties of thin (up to 1 nm) amorphous films NaSbSe₂ grown by pulsed laser deposition and resistive evaporation in quasi-closed volume on glass substrates under different ($T_{\text{substr}} = 300 \text{ K}$ and 373 K) temperatures of the substrate were investigated under normal atmospheric conditions. TEM and X-ray diffraction methods applied for studying the film surface were shown nano-inhomogeneous cluster-like relief. There are no data concerning electric properties of the films. Simplest non-destructive method of current-voltage measurements was applied in order to study effect of the relief of the film surface on the corresponding properties. The current – voltage dependencies measured at the room temperature were registered as power-like ones: $I_{\text{exper}} \sim T_{\text{tun}} \exp[e(V_a)m/kBT]$, where V_a stands for applied bias, T_{tun} is transparency coefficient and $m > 1$. Numerical analysis and simulation of experimental data demonstrated non-trivial mechanism of carriers transfer as tunneling caused by cluster-like relief of the film surface. Results obtained under the investigations are seemed to be useful for further improvement of growth technology and device fabrication.

G/PIII.28

NANOSTRUCTURAL CHARACTERIZATION OF VOID-SPECIES ARRANGEMENT IN TOPOLOGICALLY DISORDERED SOLIDS WITH POSITRON ANNIHILATION LIFETIME TECHNIQUE

O. Shpotyuk, Pedagogical University of Czestochowa, 13/15, al. Armii Krajowej, 42201 Czestochowa, Poland + Institute of Materials of SRC "Carat", 202 Stryjska str., 79031 Lviv, Ukraine and J. Filipecki, Pedagogical University of Czestochowa, 13/15 al. Armii Krajowej, 42201 Czestochowa, Poland

Positron annihilation lifetime (PAL) spectroscopy has been rarely applied for defect characterisation of topologically disordered materials without translational symmetry such as fine-grained ceramics and non-oxide glasses because of high complications in the correct interpretation of the obtained PAL data. The main aim of this work is to develop for the first time a meaningful interpretation of PAL characteristics for functional ceramics and glasses at the example of mixed transition-metal manganite ceramics with a spinel structure and vitreous chalcogenide semiconductors of different chemical compositions. The experimental PAL measurements (the LT computer program of J. Kansy) are performed with an ORTEC spectrometer, using ²²Na source placed between two identical sandwiched samples. The methodological possibilities of PAL technique in application to the investigated disordered materials is checked at the example of different fitting procedures with arbitrary and fixed PAL parameters.

It is shown that the obtained experimental results can be satisfactorily explained in the framework of modified concept of the native vacancy-like defects, these defects being open-volume microvoids of atomic and sub-atomic sizes created technologically during melt quenching (chalcogenide glasses) or large-angle grain boundaries attributed to the middle PAL component at the level of 0.25 ns (functional ceramics). Being characterized by close positron lifetimes, these nanoscale extended defects are not distinguishable ones. The input of bulk positron lifetime is probably revealed in this PAL component too.

G/PIII.29

IN SITU CONDUCTANCE MEASUREMENT OF Fe-SrF₂ GRANULAR FILM DURING TEM OBSERVATION

Ryusuke Hirose, Masashi Arita, Kouichi Hamada, Takayuki Tajiri, Hiroyuki Hosoya, Tamaki Shibayama, Hokkaido University, Sapporo, Japan

A conductance of particles causing single electron tunneling is an interesting subject to be studied. The conduction of a metal particle system is strongly influenced by the geometry of particles. In this work, therefore, in-situ conductance measurement was performed during the TEM observation.

The experiments were carried out using a homemade special TEM holder which was driven using a piezo actuator. The sample investigated was a Fe-SrF₂ granular film deposited on a sharp Au tip. The apex of this tip had a size of 20 nm and the film thickness was 40 nm. After the TEM observation of the sample, it was confirmed that Fe particles having the size of 2 ~ 3 nm were embedded in SrF₂. By the approach of another Au tip (a counter electrode) onto the Fe-SrF₂/Au tip, the tunneling current was observed. So-called the I-V data were measured for different inter-tip distances. As a result, the current becomes small as the contact area is small. When the area was 700 nm², the Coulomb blockade appeared in the I-V curve which correspond to the observed particle size.

G/PIII.30

PHOTOACOUSTIC AND PHOTOELECTROCHEMICAL CURRENT CHARACTERIZATION OF NANOSTRUCTURED TiO₂ ELECTRODES

T. Toyoda, M. Hayashi, Q. Shen, Department of Applied Physics and Chemistry, The University of Electro-Communications, Chofu, Tokyo 182-8585, Japan

We report the effect of voltage in a concentrated KCl electrolyte applied to nanostructured TiO₂ electrodes during their final preparation processes on photoacoustic (PA) and photoelectrochemical (PEC) current spectra and their excitation light modulation frequency dependence to clarify their response characteristics. The PA signal intensities of the TiO₂ electrodes with different applied voltage treatments are higher than that without the treatments below the fundamental absorption edge. These results suggest an inner-band transition due to an increase in carrier concentration owing to donor levels formed by partially reduced Ti ions following the applied voltage treatments. The PEC current spectra for the applied voltage treatments show broad bands above the fundamental absorption edge and the intensities increase with the increase of applied voltage. The increase with different applied voltage treatments implies an increase in carrier concentration due to donor level formation by the treatments. The modulation frequency dependence indicates the increase in the interfacial thermal-resistance to prevent heat diffusion at the interface between nanostructured TiO₂ film and the substrate with the increase in applied voltage.

G/PIII.31**POROSITY OF ANODIC ALUMINA MEMBRANES FROM ELECTROCHEMICAL MEASUREMENTS**

Carmelo Sunseri, Chiara Spadaro, Patrizia Bocchetta, Salvatore Piazza, Francesco Di Quarto, Dipartimento di Ingegneria Chimica dei Processi e dei Materiali, Università di Palermo, Viale delle Scienze, 90128 Palermo, Italy

The electrochemical fabrication of alumina membranes by anodising aluminium in sulphuric acid solutions was investigated in the concentration interval from 0.1 to 1.5 M at the temperature of 16 °C, in order to study the influence of the acid concentration on the final characteristics of the membranes. A procedure based on the high-field mechanism of growth of anodic oxides was developed in order to evaluate the morphological features of porous layers. Since the thickness of the barrier film, separating the porous layer from the metal, does not change during the steady-state growth of an anodic porous layer, the rate of displacement of the metal-oxide interface toward the metal must be equal to the rate of displacement of the pore base toward the oxide. As a consequence, porosity can be expressed in terms of the ratio i_{diss}/i_{ion} , where i_{diss} is the dissolution current density at the pore base, and i_{ion} is the ionic current density at the metal-oxide interface. Pore diameter can be determined from geometrical considerations, while average pore population can be obtained from the ratio of porosity to the average surface area of a single pore. The reliability of this procedure was checked by comparison with experimental results relative to membranes prepared in various conditions. On this basis, the porosity of membranes prepared in sulphuric acid solutions was found to be influenced by the acid concentration, with a value of about 40% at 0.3 M decreasing to less than 20% at 1.5 M. Also pore size and pore population were found to change with acid concentration. This behaviour could be explained in terms of a mechanism of pore nucleation. A minimum pore size of about 20 nm was achieved in 1.5 M H₂SO₄.

G/PIII.32**CHARACTERISATION OF CO/Al₂O₃/CO/NiFe MULTILAYERS ELABORATED BY ULTRA-HIGH VACUUM ION BEAM SPUTTERING**

E.H. Oubensaid(a), C. Maunoury(a), T. Devolder(a), N. Marsot(a), C. Schwebel(a), (a)Institut d'Electronique Fondamentale, Université Paris Sud, Bâtiment 220, 91405 Orsay Cedex, France

Magnetic tunnel junctions constitute a great progress for technological applications like magnetic sensors or magnetic-random-access-memory.

We have elaborated Co(5nm)/Al₂O₃(0.2nm)/Co(1nm)/NiFe(6nm) magnetic tunnel junctions by ultra-high vacuum ion beam sputtering. Initially, we have worked on 15x15 mm² Si(100)/SiO₂ substrate in order to optimize the deposition process and study the magnetic properties of each electrode (Co, NiFe) and the full stack by AGFM and P-MOKE measurements. Our multilayer shows a good magnetic behavior with two distinct switching fields. Transmission Electronic Microscopy (TEM) have been performed, to have a better knowledge of the interface state between the substrate, the cobalt electrode and the alumina layer. Now, we are going to elaborate micro-devices by using a shadow mask. The goal is to determine the electric properties of our alumina layer and the tunnel magneto-resistance (TMR) of these junctions.

G/PIII.33**CHARACTERIZATION OF MAGNETIC NANOSTRUCTURED FILMS MADE OF VARIOUS NANOPARTICLES SYNTHESIZED BY PULSED RF PLASMA CVD**

L. Matsui and T. Nagasawa, JCII, Kandajinbo-cho, chiyoda-ku, Tokyo, Japan and Toshiba R&D center, Kawasaki, Japan

Dry process is very attractive for contamination-free thin film making. We attempted to synthesize Ga containing FePt nanoparticles using pulsed RF plasma CVD and create the assembled nanoparticle films. Magnetization of the films was investigated for various compound nanoparticles.

The plasma was modulated with a square-wave on/off cycle of varying period. The synthesized particles were collected onto silicon substrate placed on the plasma electrode. TEM analysis showed two kinds of particles, one of which is nanometer size and isolated and the other appeared a coagulate of nanometer size particles. The size of coagulate was controlled in the 10–100 nm range by adjusting the plasma-on time. The size distribution was as small as 5%. Ga content was investigated by changing the source gas vapor pressure and the plasma conditions. Magnetization was measured by vibrating sample magnetometer. Heat treated FePt particle films over 650 °C in hydrogen atmosphere showed the large magnetization. The effect of Ga doping level on the film magnetization was investigated and analyzed from the viewpoint of melting point of the alloy compound. (This research is financially supported by New Energy and Industrial Technology Development Organization.)

G/PIII.34**ANOMALOUSLY STRONG ABSORPTION OF MICROWAVE POWER BY POROUS SILICON**

Yu.V. Gorelinskii, Kh.A. Abdullin, B.N. Mukashev, A.C. Serrikanov, Institute of Physics and Technology Kazakstan Ministry of Education and Science, 480082 Almaty, Kazakstan

Low-dimensional silicon systems, such as porous silicon and nano silicon particles embedded in amorphous silica currently arouse considerable interest. A common feature of these materials is the quantum confinement is due to the presence of nanoscale particles. In recent years, many unusual properties have been found in the two kinds of low dimensional silicon materials such as visible light emission and high conductivity even higher than that of c-Si, etc [1,2].

We have revealed for the first time anomalously strong absorption of microwave power by porous silicon layer. The porous layer ~20 μm was grown on high purity, high resistivity (~3 kΩ cm⁻¹) silicon substrate. After the sample annealing in air at 400-500C Q-factor of microwave (~37 GHz) cavity strongly decreased, up to zero. That is equivalent to high conductivity of film ($\tau=0.001 - 0.01 \text{ } \Omega \text{ cm}^{-1}$) and it is much higher than that of c-Si substrate. The high conductivity of the porous layer comes mainly from conduction through the nano-crystalline grains, while the interfaces are essentially insulating. The phenomenon was investigated for different thickness of porous layers in the temperature region of 77-300K as well as versus of microwave power level and density of external magnetic field. Details of experiments and discussion will be presented in report.

[1]. L. T. Canham, Appl. Phys. Lett. 57, 1046 (1990).

[2]. Yu.He, Y. Wei, G. Zheng, et al., J. Appl. Phys. 82, 3408 (1997).

G/PIII.35**STRUCTURE AND MAGNETIC PROPERTIES OF THERMAL TREATED FE-MG GRANULAR FILMS**

C. de Julián Fernández, E. Cattaruzza, G. Mattei and P. Mazzoldi, INFN and Dip. Fisica, Univ. Padova, via Marzolo 8, 35131 Padova, Italy, G. Battaglin, INFN and Dip. Chimica Fisica, Univ. Venezia, Dorsoduro 2137, 30123 Venezia, Italy, P. Canton, Dip. Chimica Fisica, Univ. Venezia, via Torino 155/b, 30172 Venezia-Mestre, Italy, C. Maurizio and F. D'Acapito, GILDA-CRG, ESRF, B.P. 220, 6 rue J. Horowitz, 38043 Grenoble, France

Magnetic granular systems such as Fe-Cu, Co-Cu and Fe-Ag films are composed by two immiscible metals, one magnetic and the other not-magnetic. Such systems show peculiar magnetic properties and enhanced magnetoresistance. Magnetic granular films are usually obtained by means of non-equilibrium synthesis techniques and further thermal treatments that produce the segregation of magnetic nanograins in the conductive matrix. In this work, we investigated the structural and magnetic properties of Fe-Mg granular films: having Mg a small melting point (650° C), it is expected that the segregation process occurs at reduced temperature.

Fe-Mg films on SiO₂ were obtained by rf magnetron sputtering co-deposition, with the Fe/Mg ratio ranging from 0.1 to 0.8. Grazing incidence X-ray diffraction (GIXRD) measurements showed that the films are formed by a strongly textured (002) Mg nanostructure. No diffraction peaks corresponding to Fe were observed. Thermal treatments at 700° C and/or 800° C in a forming gas atmosphere were realized. The magnetic moment of these samples is larger than the as-prepared ones, and they show square hysteresis loops at room temperature. GIXRD studies showed the presence of nanostructured MgO and another phase, different from the alpha-Fe. Rutherford Backscattering spectrometry investigation showed that these films have a depth-dependent composition: at the surface Fe, Si and O are present, while an intermediate MgO layer is formed at the interface with the substrate. This suggests that Mg atoms react with SiO₂ forming oxide, and that Si atoms migrate at the surface. Preliminary investigation with synchrotron radiation GIXRD of the films thermal evolution is also discussed.

G/PIII.36**STRUCTURAL AND OPTICAL STUDY OF SnO₂ NANOBELTS**

D. Calestani, M. Zha, A. Zappettini, L. Lazzarini, G. Salviati, L. Zanotti, IMEM-CNR, Parco Area delle Scienze 37/A, 43010 Fontanini Parma, Italy, G. Sberveglieri, SENSOR Lab., INFN - Univesità di Brescia, Via Valotti 9, 25133 Brescia, Italy

1D semiconducting oxides nanowires or nanobelts are a new interesting family of compounds characterized by unusual chemical and physical properties which make them suitable for basic research and device applications (gas sensors, transistors...).

The authors have successfully carried out a systematic study to obtain large scale (> 1 cm²) reproducible and homogeneous depositions of SnO₂ nanobelts on oxide-based substrates (Al₂O₃, ...). The growth has been carried out by a low-cost vapour transport/deposition process (Patent pending). The structural and optical properties of the SnO₂ nanobelts have been studied by Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X-Ray Diffraction (XRD), Photoluminescence (PL) and Cathodoluminescence (CL). SEM studies have shown the nanobelts were typically a few tenths of nm thick and hundreds of micrometers long. TEM investigations revealed the samples were <101> oriented high quality single crystals grown in the tetragonal Cassiterite structure. Large area XRD investigations excluded the presence of spurious phases. PL and SEM-CL spectroscopy have been carried out at different temperatures and injection power conditions both on large area and on single nanobelts respectively. A large and structured emission band peaked at about 590 nm has been found and resulted to be much more intense than the near band edge transition of SnO₂. Different dimensions of the nanobelts did not affect the optical properties of the samples which were found to be stable in a wide temperature range (up to 1000 °C). The results pointed out the SnO₂ nanobelts studied are reliable for future device applications.

G/PIII.37**CRYSTAL QUALITY DEPENDENCE OF PHOTOLUMINESCENCE IN NANOSTRUCTURED ZnO GROWN BY ELECTRODEPOSITION**

B. Marí(a), F. J. Manjón(a), M. Mollar(a), J. Cembrero(b), R. Gómez(c), (a)Departament de Física Aplicada, Universitat Politècnica de València, 46071 València, Spain, (b)Departament d'Enginyeria Mecànica i Materials, Universitat Politècnica de València, 46071 València, Spain, (c)Departament de Química Física, Universitat d'Alacant, Alacant, Spain

Zinc Oxide (ZnO) is a wide gap semiconductor that can be grown under nanostructured form by galvanostatic electrodeposition (ED) at low temperatures (65°C). The physical properties of ZnO combined with its nanostructured form are suitable for luminescent and photovoltaic applications. Hexagonal ZnO nanocolumns with different size and density controlled by the growth parameters are obtained by electrodeposition onto a conducting substrate. The photoluminescence properties of ZnO nanocolumns are strongly dependent of the subsequent annealing procedure and consequently of their crystalline quality. Raman spectroscopy was used to evaluate the crystalline quality of the samples which evolves from the one corresponding to completely disordered ZnO crystals to the other corresponding to single crystals with a long range order. The broad bands exhibited by the Raman spectra of the as-grown samples are in good agreement with the one-phonon density of states obtained from ab initio calculations. Furthermore the recrystallization process as a function of the annealing temperature observed in the Raman spectra is well correlated with the huge excitonic photoluminescence activity in the samples annealed at 400 °C. The dependence of the emission properties of the samples on the crystal size and annealing temperature will be discussed.

G/PIII.38**LOW COST TECHNIQUE FOR MEASURING IN SITU STRAIN OF NANOSTRUCTURES**

A. Rizzo(a), D. Rizzo(b), U. Galietti(b),(a)ENEA, UTS MAT-Tec, CR Brindisi, SS Appia Km 714, 72100 Brindisi, Italy, (b)DIMEG - Politecnico di Bari, Italy

A novel, inexpensive device for measuring the strain of thin films during the deposition process is described. The measurement of the electrical resistance of the commercial strain gauge provides the strain values from which the stress of the film/substrate can be derived.

Thin films of various materials, including metals, ceramics, and nanostructures have been investigated over temperatures ranging from 22 to 100 °C. Plotting residual strain after cooling, it was possible to measure the sample's linear thermal expansion coefficient, nearly free from the creep effect. The performance of the measuring system (sensitivity, accuracy and reproducibility) are presented and discussed. Advantages and limitations of usage of the system are given as a conclusion.

G/PIII.39

FePt NANOPARTICLES: SELF-ORGANISED ARRAYS EMBEDDED ON SiO Matrix And Compacted Powder
C. Luna, M. P. Morales, C. J. Serna, O. Chubykalo, J. M. González and M. Vázquez, Instituto de Ciencia de Materiales, CSIC, 28049 Madrid, Spain

Monodispersed magnetic nanoparticles self-organised into superlattices onto a substrate are considered to be of real interest in the development of future magnetic storage systems due to their potential ultra-high storage density, higher than 1 Tbit/cm² [1]. These particles are coated by organic acids as oleic acid which act as surfactant layer and avoid coalescence and prevent possible growth of secondary particles [2]. Nevertheless, some technical problems should be overcome before actual use for applications. One of them is that as-prepared samples have a chemically disordered fcc structure, A1 phase, with low anisotropy. To achieve the phase transition from fcc to L1₀ in FePt nanoparticles, the samples have to be subjected to thermal treatments [1]. During such annealing, and before the structural transition, different reactions take place in the particle surface, and the surfactant protecting the FePt particles is thermally decomposed. The A1-L1₀ phase transformation is accompanied by a sintering process, since the steric barrier between particles is removed [3].

The A1-L1₀ transition of FePt nanoparticles 4 nm in size has been investigated in this work. For this propose, we have prepared three different materials from the initial colloidal suspension of Fe₅₀Pt₅₀ nanoparticles synthesised by the chemical procedure as described by Sun *et al* [1]: i) Self-organised nanoparticle arrays in superlattices by deposition of the colloidal suspension onto a substrate and slow evaporation of the carrier solvent (hexane), ii) Finely divided powder, constituted by many nanoparticles, and iii) Fe₅₀Pt₅₀ nanoparticles embedded in SiO₃ matrix. The evolution of the structural and magnetic properties of these materials with annealing at different temperatures, and the sinterised state have been studied. Whereas for the case of powders annealed at 825 K with sinterised particles, coercivity takes values of several kOe, the un-sinterised particles embedded in SiO₃ matrix and annealed at temperatures up to 1,075 K, exhibit values of coercivity much lower than expected (around several hundreds of Oe), indicating an incomplete L1₀-order. The results suggest that Fe₅₀Pt₅₀ particles smaller than 4 nm were not completely ordered to L1₀ structure by annealing at 1,075 K, whereas bigger particles (sinterised particles of annealed powders and self-organised arrays) at low temperature of annealing (825– 875 K) exhibit higher L1₀-order. A compromise between steric stability and structural order is thus analysed in view that nanoparticles larger than 4nm reach the L1₀-order at lower annealing temperatures.

[1] S. Sun, C. B. Murray, D. Weller, L. Folks and A. Moser. *Science* 287 (2000) 1989.

[2] C. Luna, M. P. Morales, C. J. Serna and M. Vázquez. *Materials Science & Engineering C* 23 (2003) 1129.

[3] Y. Ding, S. Yamamuro, D. Farrell and S. A. Majetich. *J. Appl. Phys.* 93 (2003) 7411.

G/PIII.40

SURFACTANT FREE FABRICATION OF POLYMERIC NANOPARTICLES BY COMBINED LIQUID-LIQUID PHASE SEPARATION AND SOLVENT/NONSOLVENT MIXING TECHNOLOGY

J.Y. Xiong(a), X.Y. Liu(b), P.D. Sawant(b), S.B. Chen(a), T. S. Chung(a), K.P. Pramoda(c), (a)Department of Chemical and Environmental Engineering, National University of Singapore, 10 Kent Ridge Crescent, Singapore 119260, Singapore, (b)Department of Physics, National University of Singapore, 2 Science Drive 3, Singapore 117542, Singapore, (c)Institute of Materials Research and Engineering, 3 Research Link, Singapore 117602, Singapore

It is generally agreed that, in most cases, surfactants are required to obtain stable polymeric nanoparticle dispersions. Here, we report a new method which can be used to produce surfactant free yet stable polymeric nanoparticle dispersions based on explored new mechanism of selective salvation of nanoparticles and EPD (electron pair donor)/EPA (electron pair acceptor) complexes among solvent and nonsolvent molecules. Using polyimids (P84 and Matrimid) as the model polymers, this new mechanism was successfully realized through a combined liquid-liquid phase separation and solvent/nonsolvent mixing technology. Surfactant free polyimide nanoparticles (<100nm) were produced for the first time. Experimental details and principles of this new technology were given based on the ternary diffusion, the liquid-liquid phase separation and the advanced nucleation and growth theory. Two types of methods (denoted as the forward titration (FT) method and the backward titration (BT) method) were examined. It was found that the BT method is extremely helpful to prepare polyimide nanoparticles smaller than 100nm. As another important aspect, explored stabilization mechanism of the resultant nanoparticle dispersion was supported by the comparative experiments, implying that selective salvation of nanoparticles and EPD (electron pair donor)/EPA (electron pair acceptor) complexes formed among solvent and nonsolvent molecules may be the key reasons for stabilization. Since BT method possesses its advantage in preparing very fine polymeric nanoparticles, it is very promising for the formation of nanoparticle-filled composite membranes and engineering biodegradable colloids for site-specific drug delivery.

G/PIII.41

STANDING WAVE NANOSENSOR

H. Stiebig(a), D. Knipp(b), E. Bunte(a), (a)Forschungszentrum Jülich, Institute of Photovoltaic, 52425 Jülich, Germany, (b)International University Bremen, Department of Science and Engineering, 28759 Bremen, Germany

A novel optical nano sensor for spectrometer and interferometer applications will be presented. The sensor concept based on the sampling of a standing wave by an ultra thin and partially transparent sensor. The absorption region is between 30nm and 40nm thick. The standing wave is created in front of a tunable mirror and can be sampled by the partially transparent sensor. The working principle of the sensors facilitates the realization of a new class of sensors. Due to the simple setup of the system the realization of 1D and 2D sensor arrays is feasible. Typical applications are vibration, velocity and acceleration sensors, profilometers, and multi spectral imaging systems.

The performance of the micro system is limited by the design of the nano sensor taking the interaction of the standing wave with the multi-layer stack into account. On the other hand the device performance is limited by the material properties. In order to sample a standing wave the active region of the sensor has to be distinctly thinner than the wavelength of the incident light. We investigated amorphous silicon and amorphous silicon carbon based pin diodes, which a transmissivity of 60% to 80% in the visible part of the spectrum. Despite extremely thin absorption layers the diodes (thickness of the diode <100nm) exhibit excellent diode characteristic with reverse currents as low as 1 nA/cm² up to Ó0.5V. The measured photocurrents using laser with different wavelengths were compared with simulations using an optical model of the micro system. The model was applied to investigate the optical generation within the thin film detector, the modulation of the photocurrent and the spectral sensitivity of the partly transparent sensor as a function of the position of the mirror.

PURE-SILICA BETA FILMS SYNTHESIZED FROM BASIC AND NEUTRAL PRECURSOR SOLUTIONS AND GELS

L. Tosheva(a), M. Hözl(b), T.H. Metzger(c), V. Valtchev(a), S. Mintova(b), (a)UMR-7016 CNRS, ENSCMu, UHA, 3 rue Alfred Werner, 68093 Mulhouse, France, (b)Department of Chemistry, LMU, Butenandtstr. 11, 81377 Munich, Germany, (c)European Synchrotron Radiation Facility, ESRF, BP 220, Grenoble, France

The present contribution reports on the synthesis of all-silica zeolite Beta films synthesized in basic (OH-) and close to neutral (F-) media. The standard approaches such as seed method and spin coating are used for the preparation of BEA films on silicon wafers and glass substrates; the zeolite seeds were deposited by either electrostatic adsorption or by spin coating. Generally, zeolites produced in fluoride media have large crystal sizes, often exceeding 10 μm , and a decreased number of structural defects. Thus, the thickness of the zeolite Beta films can be extended by performing the synthesis in a fluoride media. The growth parameters were varied in order to produce thin and homogeneous Beta films with thickness in the range of 20-500 nm from clear solutions. The number of structural defects and crystals orientation along the film thickness in the films synthesized in alkaline and fluoride media were studied by grazing incidence X-ray diffraction (GID). Other techniques such as grazing incident IR spectroscopy, ellipsometry, N₂ adsorption, mercury porosimetry and SEM were also used to characterize the zeolite Beta films.

Session XI

G-XI.01 09:10

AB INITIO STUDY OF THE GROWTH MODE FOR THIN Cu FILMS ON OXIDE SUBSTRATE

Yuri F. Zhukovskii and Eugene A. Kotomin, Institute for Solid State Physics, University of Latvia, Kengaraga str. 8, Riga 1063, Latvia, David Fuks, Materials Eng. Dept, Ben Gurion University, Beer-Sheeva 84105, Israel, Simon Dorfman, Dept. of Physics, Technion – Israel Institute of Technology, Haifa 32000, Israel

Controlled growth of thin metallic films on oxide substrates is important for micro- and nanoelectronic applications. Our ab initio study is devoted to periodic slab simulations of the regular 2D Cu superlattices on the MgO(001) substrate. Submonolayer and monolayer substrate coverages were modelled using periodic DFT-GGA calculations as implemented into the CRYSTAL98 code. The best description of the regular 2D Cu layer on the MgO(001) surface have been achieved using hybrid (DFT-HF) exchange-correlation functional B3LYP. The ab initio calculations have been combined with our thermodynamic theory of metal film growth on oxide substrates [1]. Our approach allowed one to predict the growth mode of metal thin films (spinodal decomposition vs. nucleation-and-growth mode) as a function of the metal coverage and the temperature, and to estimate metal density in clusters. We show that cluster formation is predominant starting with low coverages of Cu on MgO, in agreement with the experiment. Results are compared with available experimental data and corresponding simulations for the Ag/MgO(001) system.

[1] D. Fuks, S. Dorfman, E.A. Kotomin, Yu.F. Zhukovskii, and A.M. Stoneham, Phys. Rev. Lett., 85 (2000) 4333; Surf. Sci., 499 (2002) 24.

G-XI.02 09:25 -Invited-

ONION-LIKE GROWTH OF AND INVERTED MANY-PARTICLE ENERGIES IN QUANTUM DOTS

D. Bimberg, Institut für Festkörperphysik, TU Berlin, Germany, *in cooperation with F. Guffarth, K. Pötsche, S. Rodt and A. Schliwa

Growth of quantum dots by MOCVD can be now controlled such that the typical mode resulting in a large inhomogeneous, but continuous distribution of QD sizes and shapes switches to an onion-like one. A manifold of narrow distributions differing in size by exactly one monolayer results. Luminescence and excitation spectroscopy beautifully demonstrate this monolayer size-splitting by multimodal spectra whose peaks are in quantitative agreement with our numerical predictions based on 8 band k.p-theory implemented using the method of finite differences. Varying the number of shells of the quantum onion the number of bound states varies. In consequence the magnitude of many-particle energies like exchange and correlation calculated in the frame of configuration interaction changes dramatically resulting e.g. in a sign reversal of the biexciton binding energy. This sign reversal is directly observed in single dot spectroscopy using cathodoluminescence employing a shadow mask technique.

G-XI.03 10:00

SYNTHESIS AND CHARACTERIZATION OF PbSe/PbS CORE/SHELL NANOCRYSTALS

A. Kigel, A. Sashchiuk, M. Brumer, L. Amirav, E. Lifshitz, Dep. of Chem. and Solid State Institute, Technion, Haifa 32000, Israel

PbSe nanocrystals (NCs) exhibit strong size quantization effects and activity in the IR spectral regime and became recently interesting as useful components in telecommunication and opto-electronic application. In this report, we describe synthesis and characterization of the PbSe/PbS core/shell NCs using a single step procedure by injection Pb precursor together with trioctylphosphine:Se:S mixer into oleic acid-phenyl ether mother solution. As will be shown, the faster nucleation of PbSe NCs permit the creation of the core constituent, followed by the formation of the PbS shell, with <1 % crystalline mismatch. For comparison PbSe NCs without PbS shell were synthesized. HRTEM, SAED, X-ray diffraction crystallographic absorption and photoluminescence spectroscopy measurements were used to characterize prepared NCs. HTREM images and corresponding SAED diffraction patterns of PbSe/PbS core/shell NCs reveal a high crystallinity, indexed as a rock salt cubic phase [100] with interparticle spacing of 0.305 nm. Absorbance measurements show that each absorbance curve of PbSe/PbS core/shell NCs exhibits three distinct and sharp exciton bands between 1000 and 2000 nm, blue shifted with respect to the bulk energies and red shifted according to the same sized PbSe NCs. PL measurement of PbSe/PbS core/shell NCs shows the decreasing of Stock shift according to the same size PbSe NCs. The obtained results show higher stability by embedding these NCs in polymer matrices that are important for application

G-XI.04 10:15

SYNTHESIS AND PHOTOLUMINESCENCE OF PbS CLUSTERS IN LEAD-CONTAINING GLASSES

R. Espiau de Lamaestre and H. Bernas, CSNSM (UMR 8609), CNRS-Univ. Paris-Sud, 91405 Orsay, France
We have synthesized PbS clusters via S implantation into aluminosilicate glasses containing Pb. We show that a combination [1] of MeV ion irradiation and annealing allows us to shift the resulting intense, broad PbS photoluminescence (PL) peak in the 1.3-1.6µm wavelength range. No PL is observed in the absence of MeV ion irradiation. Two unexpected results emerge from systematic experiments. (1) Transmission electron microscopy shows that most of the PbS clusters are noncrystalline; (2) the MeV ion irradiation conditions leading to the intense PL differ significantly from those of Ref. 1. Several groups have shown that non-radiative carrier transfer may occur from amorphous (as well as from crystalline) silicon nanoclusters to Erbium ions, or from Ag-related clusters to Erbium. Experiments are under way to determine whether the same process might affect our noncrystalline PbS clusters.

[1] E. Valentin, H. Bernas, C. Ricolleau and F. Creuzet, Phys. Rev. Lett. 86, 99 (2001)

G-XI.05 10:30

INCORPORATION OF COBALT INTO ZINC OXIDE NANO-CLUSTERS

I. Ozerov, F. Chabre and W. Marine, CRMC-N UPR 7251 CNRS, Université de la Méditerranée, Case 901, 13288 Marseille cedex 9, France

Diluted magnetic semiconductors are attracting considerable attention for their applications in spin functional devices. However, the presence of magnetic aggregates may mask the magnetically ordered states mediated by free carriers.

We report a pulsed laser deposition of ZnO nanocrystalline films co-doped with cobalt and aluminium. The deposited films consisted of ZnO nanoclusters with a homogeneous size distribution of size (50nm). Neither x-ray diffraction nor transmission electron microscopy has detected cobalt precipitation. The deposited films are oriented with c-axis of the wurtzite structure perpendicular to the substrate surface. The optical transmission measurements show the absorption bands corresponding to divalent Co ions. The electron spin resonance spectra are attributed to Co ions in the crystalline field of axial symmetry. Both, optical transmission and electron spin resonance measurements showed that Co is incorporated mostly inside the nanoclusters. The charge state and axial symmetry of the local crystalline field indicate that cobalt substitutes zinc in the crystalline lattice. The dependence of magnetic susceptibility in the temperature range from 4.2 to 40 K follows Curie law which is characteristic for a paramagnetic material.

10:45

BREAK

Session XII

G-XII.01 11:10 -Invited-

NOVEL SEMICONDUCTOR NANO-DEVICES: CONTROL OF SINGLE CHARGES, SPINS AND PHOTONS

Gerhard Abstreiter, Walter Schottky Institut, TUM, 85748 Garching, Germany

Semiconductor nanostructures have attracted a lot of interest recently due to their possible applications in optoelectronics, nanoelectronics, quantum information processing and chemical/biological sensing. There are many different experimental approaches to realize well controllable nanostructure devices. In the past few years we have concentrated our efforts on the fabrication of such devices based on self-assembly of quantum dots as well as cleaved edge overgrowth. I will discuss selected examples of novel nano-devices based on these techniques which allow the control of individual charges, spins and photons. This includes the coherent control of a single dot photodiode and the related optically triggered electron turnstile device [1], the charge and spin storage in quantum dots and the concepts for the realization of efficient single photon sources. [1] A. Zrenner, E. Beham, S. Stufler, F. Findeis, M. Bichler, and G. Abstreiter, Nature, **418**, 612 (2002)

G-XII.02 11:45

"CONSTRUCTIVE NANOLITHOGRAPHY" - A HIERARCHICAL FABRICATION APPROACH TOWARDS THE CONTROLLED ASSEMBLY OF COMPLEX NANODIMENSIONAL CIRCUITS

S. Hoepfener, R. Maoz, J. Sagiv, Dept. of Materials and Interfaces, Weizmann Institute of Science, 76100 Rehovot, Israel

A main challenge in the fabrication of complex arrangements of different nanoobjects is their planned hierarchical assembly in a controllable manner. Thus metal nanowires and functional nanoobjects such as nanoparticles have to be reliably integrated into circuits that can be addressed via appropriate contact electrodes. Combining the SFM tip-mediated local electrochemical oxidation of terminal methyl groups of a self-assembled monolayer of n-octadecyltrichlorosilane (OTS) on silicon (which creates stable nanopatterns of chemically active surface groups) with further self-assembly and chemical derivatization routines provides generic tools towards the architecture of complex multicomponent assemblies. This approach, referred to as "Constructive Nanolithography", can be utilized to generate the required circuit components, such as nanoparticles positioned within conducting gap structures. The versatility and reliability of this approach originate from the high chemical selectivity of the derivatization procedures, that moreover allow the assembly of components consisting of different materials, such as metals and semiconductor particles, as well as from the structural and chemical stability of the resulting nanostructures. Examples will be presented demonstrating the hierarchical fabrication of well-defined metal nanogap structures with a controllable gap-size in the 10-100nm range and the subsequent integration of single semiconductor nanoparticles within the gap.

G-XII.03 12:00

OLIGOPEPTIDE GRAFTING ON NANOPATTERNED POLYSILOXANE SURFACES

C. Satriano and G. Marletta, Laboratory for Molecular Surfaces and Nanotechnologies, Department of Chemical Sciences, University of Catania, Viale Andrea Doria 6, 95125 Catania, Italy

Nanostructured 2D arrays of a polysiloxane were fabricated by using the "Colloidal Crystal-Assisted Capillary Nanofabrication" method (CCACN) [1]. Nanorings or nanopores of few nanometres of height and diameters ranging from ~50 to ~ 500 nm, as measured by AFM, were obtained by using different concentrations of the polymer solution. Surface irradiation by means of either cold plasma or low-energy ion beams was used to convert the patterned polysiloxane structures into SiO₂-like or SiO_xC_yH_x phases, respectively [2]. The grafting of various RGD-containing peptide sequences was preferentially obtained onto the irradiated nanoarrays.

[1] X.Chen, Z.Chen, N.Fu, G.Lu and B.Yang, *Adv. Mater.* **2003**, *15*, 1413-1417.

[2] C.Satriano, S.Carnazza, S.Guglielmino, G.Marletta, *Langmuir*, **2002**, *18*, 9469-9475.

DNA IMMOBILIZATION ON BIOFUNCTIONALIZED POROUS SILICON SURFACES

M. Arroyo-Hernández(a), R.J. Martín-Palma(a), J. Pérez-Rigueiro(b), J.P. García-Ruiz(c) and J.M. Martínez-Duart(a), (a)Departamento de Física Aplicada C-12, Universidad Autónoma de Madrid, 28049 Cantoblanco, Madrid, Spain, (b)Departamento de Ciencia de Materiales, ETSI Caminos, Canales y Puertos, Universidad Politécnica de Madrid, 28040 Madrid, Spain, (c)Departamento de Biología Molecular, Universidad Autónoma de Madrid, 28049 Cantoblanco, Madrid, Spain

Porous silicon (PS) was chosen as substrate to immobilize nucleic acids because of its high specific surface area, composition, nanostructural properties and biocompatibility. For this application, a well characterized interface between the PS surface and the biomolecules to be attached is needed. The PS surface needs the presence of functional groups such as aminos and carboxyls to covalently bond the DNA molecules. The covalent bond is activated by UV irradiation. In this paper, PS biofunctionalization was achieved by depositing amino groups by two different techniques, both using 3-aminopropyltriethoxysilane (APTS) as precursor. The first functionalization method was thermally activated CVD and the second one immersion in APTS solutions. The presence of amino groups was detected by Fourier Transform Infrared Spectroscopy (FTIR). Fluorescence microscopy, using fluoresceine isotiocyanate that reacts specifically with amino groups, was used to check the amino groups functionality. The last step was the immobilization of DNA by UV irradiation. DNA was detected by hybridation techniques. In this work, a comparison between these two biofunctionalization methods is made to establish the DNA detection capability of PS surfaces.