2014 Spring Meeting Lille, France – May 26th - 30th

SYMPOSIUM I

Solution processing and properties of functional oxide thin films and nanostructures

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PROGRAM VIEW : 2014 Spring
MY PROGRAM : 2014 Spring

Symposium : I

Solution processing and properties of functional oxide thin films and nanostructures

26 May 2014 | 27 May 2014 | 28 May 2014 | 29 May 2014 | 30 May 2014

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start at	Subject	Num.
	Synthesis I : Barbara Malic	
09:00	**Solution design for ReBCO CSD -MOD route.** **Authors :** S.Ricart1, X.Palmer1, E.Solano1,2, M. Nasui3, C. Pop3, C.F. Sanchez1, P.Cayado1, L. Ciontea3, J.Ros2, R. Yañez2, P.Roura4, J.Farjas,4 A.Palau1, R.Guzman1, J. Albiol 1, M. Coll1, X.Obradors1, T.Puig1 . **Affiliations :** 1) Institut de Ciencia de Materials de Barcelona (CSIC), Campus UAB, 08193 Cerdanyola, Spain. 2)Departament de Química, Universitat Autonoma de Barcelona, Campus UAB, Cerdanyola, Spain. 3) University of Cluj-Napoca,15, Cluj-Napoca, Romania 4) Departament de Fisica, Universitat de Girona, Girona, Spain. **Resume :** Chemical solution deposition is a competitive technique to obtain epitaxial films. In particular, metal-organic decomposition has been established as the versatile methodology to grow low cost, scalable, high performance epitaxial YBa2Cu3O7 films for coated conductors. In this context, new designed solutions are produced in accordance with the new requirements concerning environmental safety. Looking at these objectives we will present here our work in the preparation of precursor solutions with reduction or total elimination of fluorine content, which should be adapted to the requirements of Superconducting ReBCO layers production with enhanced single thickness deposition, leading to high production rates with optimal performance. Solutions with low and non-fluorine precursors (acetates, ethylhexanoates) in different amounts of additives (thriethanolamine, propionic acid) have been stabilized and their rheology modified for substrate wetability. Thermal decomposition analysis performed directly in films, have revealed differences in decomposition and growth steps. Upon optimization of growth process parameters, Tc and Jc(77K) of around 90 K and 3 MA/cm2 are obtained. Moreover, in recent years, research in functional oxides leaded a huge transformation by exploiting the capabilities of combining two materials with distinct functionalities, the so-called nanocomposites. Two new approaches to nanostructured ReBCO layers are presented here. In the one small amounts of different salts were added to the starting solutions (in-situ approach) and in the other preparation of colloidal solutions of nanoparticles adapted to form stable solutions with Re, Ba and Cur salts (ex-situ approach) have been achieved. The research leading to these results has received funding from EU-FP7 NMP-LA-2012-280432 EUROTAPES project and MAT2011-28874-C02 national project. add to my program (close full abstract)	I.1. 1
09:30	**Hydrophobic Nanoreactor Templating for Nanostructured Metal-Metal Oxide Nanocomposites Electrodes** **Authors :** Amandine Guiet (1), Tobias Reier (1), Nina Heidary (1), Michael Lublow(1), Benjamin Johnson (2), Ulla Vainio (3), Matthias Driess (1), Peter Strasser (1), Holger Dau (4), Helmut Schlaad (5) Jörg Polte (6), Anna Fischer(1) **Affiliations :** (1) TU Berlin, Germany (2) Fritz Haber Institute, Berlin, Germany (3) Helmholtz-Zentrum Geesthacht, Geesthacht,Germany (4) Humboldt University of Berlin, Germany (5) Max Planck Institute of Colloids and Interfaces, Golm-Potsdam, Germany (6) Free University Berlin, Germany **Resume :** The design of high surface area conducting metal oxide electrodes containing evenly dispersed and narrow sized metal nanoparticles (M NPs) is a crucial issue in electrocatalysis. Transparent conductive oxides (TCO) are promising electrode materials providing stability against corrosion and strong metal-support interactions. Many attempts have been made to incorporate high	I.1. 2

amounts of M NPs into mesoporous supports. However most fail in providing sufficient control over M NPs sizes, size distribution and dispersion, crucial parameters for the final catalysts activity. Herein we present a facile synthesis strategy denoted as Hydrophobic Nanoreactor Templating for the one-pot synthesis of mesoporous metal oxide electrodes with variable morphologies containing evenly dispersed and size controlled metal nanoparticles. This approach is first exemplified with the synthesis of mesostructured tin-rich ITO thin film electrodes remarkably loaded with one 7 nm gold NP per pore.1 Material templating and formation will be discussed as well as improved electrocatalytic performance for electrocatalytic CO oxidation demonstrated. Finally, the extension of this new one-pot synthetic approach to the synthesis of a variety of porous metal-metal oxide structures will be presented. (1) Guiet, A.; Reier, T.; Heidary, N.; Felkel, D.; Johnson, B.; Vainio, U.; Schlaad, H.; Aksu, Y.; Driess, M.; Strasser, P.; Thomas, A.; Polte, J.; Fischer, A. Chem. Mater. 2013, 25, 4645–4652.

add to my program (close full abstract)

09:45 **Employing basic tools to gain fundamental insight into the chemical nature of Methyltriethoxysilane and Dimethyldiethoxysilane sol-gel systems**

Authors : V. Vuillet-A-Ciles1, K. Lionti2, A. Brioude1, B. Toury1
Affiliations : 1 Lab. Multimatériaux et Interfaces, Université de Lyon, France ; 2 IBM Almaden Research Center, San Jose, USA

Resume : Over the past 30 years, sol-gel chemistry has been extensively studied and it is now common to see sol-gel materials in everyday life. A fundamental understanding of the sol-gel reactions is thus crucial to control the final sol-gel material properties. In this presentation, we will show how these reactions can be closely monitored by NMR and MS. Two different systems were studied, the first one being based on MTES and the second one on DMDEOS. The advanced characterization of these complex systems is not trivial but worth the effort as it brings new and rare knowledge about sol stability, network formation and structure, as well as reactions kinetics. Regarding the MTES based system, 1H, 13C and 29Si NMR spectroscopy was performed as a function of the sol aging in order to study the influence of the hydrolysis reaction kinetics on the precursor miscibility. Once the MTES was fully miscible with its surrounding liquid phase, the hydrolysis reaction kinetics was determined by integrating the –Si-CH3 proton signal. With regard to the polydimethylsiloxane system, the deconvolution of the –Si-(CH3)2 proton signals as a function of sol aging enabled us to get quantitative information about the actual precursor forms throughout the condensation reactions, and qualitative data on the polysiloxane chains lengths in solution. The latter were further confirmed by MS analyses and a relationship between the condensation rate and the amount of evaporated solvent could be established.

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add to my program (close full abstract)

10:00 **Coffee & tea**

Nanowires & sensing : Reinhard Schwarz & Thierry Gacoin

10:30 **All-solution Synthesis of Entangled ZnO Nanorods for Sensing Applications**

Authors : A.Resmini, I.Tredici, U.Anselmi-Tamburini
Affiliations : Department of Chemistry University of Pavia, Italy

Resume : ZnO nanostructures have been receiving a large attention in the last few years because of their combination of outstanding physical properties. In particular, nanostructured thin films and nanowires of ZnO have been actively investigated for gas sensing applications. Nanorods appear to be particularly interesting in this respect because of their large exposed area and their fast response time. However, sensing devices based on ZnO nanorods present generally a morphology that does not take full-advantage of their characteristics. Most of the times, in fact, an uniform layer of nanorods are grown on the surface of a thin seed layer covering the entire surface of the device. With this geometry the probing current is confined mostly in the basal seed layer. In order to remove this limitation we developed a device based on long ZnO nanorod grown on a 2D array of nanocrystalline ZnO micropillars obtained by soft-lithography of a metal-loaded hydrogel. This approach produces a 2D network of entagled and electrically connencted nanorods. The synthesis of this complex nanostructure is all obtained through solution processes and it can be realized using inexpensive simple chemicals and a very

I.2. 1

simple apparatus. The geometry is such that it can be adapted to any electrode geometry without any need of lithographic alignment.

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11:00 **Ultrathin urchin-like ZnO Nanowires**

Authors : A. Gokarna*, R. Parize, H. Kadiri, K. Nomenyo, G. Patriarche,1 P. Miska,2, G. Lerondel

Affiliations : LNIO, ICD, STMR (UMR 6279), CNRS - Université de Technologie de Troyes, 12 rue Marie-Curie BP2060, 10010 Troyes, FRANCE ; 1Laboratory of Photonics and Nanostructures, UPR-20, Site Alcatel de Marcoussis, Route de Nozay, 91460 Marcoussis, France ; 2 Institut Jean Lamour – CNRS UMR 7198 – Université de Lorraine, Faculté des Sciences et Technologies, BP 70239, F-54506 Vandoeuvre les Nancy, France.

Resume : Zinc oxide is one of the most promising electronic and photonic materials due to its wide direct band gap of 3.37eV and large exciton binding energy of 60meV. It has attracted attention as a luminescent material in various applications such as field emission displays, electroluminescent displays, UV-light-emitting diodes and laser diodes. Ordered arrays of 1D ZnO nanowires (NWs) are essential for applications in optoelectronic devices because of device performance improvement but they are also essential for advanced light-matter interaction control i.e. absorption and emission enhancement. The aim of this work was to demonstrate selective, patterned growth of ZnO using low cost, easy-to-fabricate templates by the bottom-up approach. The bottom-up approach combines the fabrication of self-organized templates of functionalized polysterene (PS) beads followed by the growth of ZnO using low temperature chemical bath deposition (CBD) method. ZnO nucleation layer is deposited on the PS beads prior to the synthesis of ZnO NWs. Formation of highly crystalline, luminescent ultra narrow NWs with diameter lower than 15 nm are observed to be formed around the PS beads leading to a new kind of urchin-like ZnO. Structural analysis and the low temperature optical properties of these urchin-like ZnO NWs will be discussed. These patterned samples will be further used for different applications and especially chemosensing. I.2. 2

add to my program (close full abstract)

11:15 **SiO2 nanowires-Au nanoparticles functional composites: physical fabrication and structural characterizations**

Authors : F. Ruffino, M. G. Grimaldi

Affiliations : F. Ruffino, M. G. Grimaldi Dipartimento di Fisica e Astronomia Università di Catania and MATIS-CNR, via S. Sofia 64, 95123 Catania, Italy

Resume : SiO2 nanowires (NWs) are gaining scientific and technological interest due to potential applications as new electronic devices, biosensors, and nanoscale optical devices. They have been produced by various methods such as thermal evaporation, chemical vapor deposition, laser ablation, and sol-gel. These methods require expensive deposition or ablation systems, the use of harmful gases, or complex multiple process with solution. Furthermore, are, also, investigated the properties of SiO2 NWs when they are surface-decorated by metal nanoparticles (NPs). In fact, when dielectric NWs are decorated by Au, Ag, Pt, Pd NPs, several of their performances are enhanced due to local plasmonic effects. In particular, decoration of SiO2 NWs by metal NPs leads to benefit in properties such as surface-enhanced-Raman-spectroscopy and optical wave-guiding. In this work, we propose a simple and low-cost three-steps methodology for the mass-production of Au NPs coated SiO2 NWs. It is based on: 1) production of the SiO2 NWs on Si surface by solid state reaction of a Au film with the Si substrate at high temperature; 2) sputtering deposition of Au on the SiO2 NWs to obtain the NWs coated by a Au film; 3) thermal processes to induce the Au film dewetting on the SiO2 NWs surface. We analyzed the change of the NPs/NWs sizes ratio as a function of the Au film thickness and dewetting temperature establishing a correlation that allow to tune the NPs/NWs sizes for desired applications. I.2. 3

add to my program (close full abstract)

11:30 **ZnO:Ca nano-powders: sol-gel synthesis, characterization and sensing properties**

Authors : R. Dhahri1*, M. Hjiri1, L. El Mir1,2, G. Neri3

Affiliations : 1 Laboratory of Physics of Materials and Nanomaterials Applied at Environment, Faculty of Sciences of Gabes, 6072 Gabes, Tunisia;2 Al Imam Mohammad Ibn Saud Islamic University (IMSIU), College of Sciences, Department of Physics, Riyadh 11623, Saudi Arabia;3 Department of Electronic Engineering, Chemistry and Materials Engineering, University of Messina, Messina 98166, Italy.

Resume : With increasing demand for better gas sensors of higher sensitivity and greater selectivity, intense efforts are being made to find more suitable materials with the required surface and bulk properties for use in gas sensors. I.2. 4

Oxide semiconductors such as SnO2, and ZnO, show high gas-sensing performance, which have been used to detect and monitor a huge variety of gases and vapors. However, to overcome the inherent limitations of the pure base material, doping with suitable dopant has a profound impact on the sensor performance. Here, Ca-doped ZnO (CZO) nanopowders have been prepared via a sol-gel route. The morphological and microstructural properties were investigated by scanning and electron electron microscopy (SEM and TEM), x-ray photoelectron spectroscopy (XPS), Raman and X-ray diffraction (XRD) analysis. The results demonstrate that the dopant was successfully incorporated into the nanostructure ZnO lattice. Chemoresistive devices consisting of a thick layer of CZO nanoparticles on interdigitated alumina substrates have been fabricated and their electrical and sensing properties were investigated. Electrical conductivity measurements were used to study the gas-sensing mechanism operating during monitoring of various gaseous species (CO, NH3, ethanol). The effect of UV-Light on gas sensing has been also studied and results obtained have been discussed.

add to my program (close full abstract)

11:45 **In situ observation of the replacement of Indium in ZnO nanowires via atomic diffusion**

Authors : Shau-Chieh Wang 1, Ming-Yen Lu 2, Manekkathodi Afsal 1,3, Pei-Hsuan Liu 1, Hung-Chiao Lin 1, Wun-Shan Li 1, Te-Chien Hou 1, Shangjr Gwo 3, Lih-Juann Chen 1
Affiliations : 1 Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan; 2 Graduate Institute of Opto-Mechatronics, National Chung Cheng University, Chiayi 62102, Taiwan; 3 Department of Physics, National Tsing Hua University, Hsinchu 30013, Taiwan.

Resume : Atomic diffusion is a fundamental process that dictates material science and engineering. This research presents a unique diffusion process of a metal to metal-oxide semiconductor nanowire (NW) and forming a crystalline metal NW by complete replacement of oxide semiconductor. Here we report the atomic diffusion of indium to ZnO NW and forming indium NW. A highly reactive metal is diffused through an oxide-semiconductor NW without oxidation with precise epitaxial metal-semiconductor atomic interface under controlled conditions. The in situ TEM analyses reveal that the diffusion and replacement behaviors strongly depend on the crystallographic lattice coherency at the hetero-interface between indium and ZnO. The diffusion is dominated by the obvious ledge migration with the surface diffusion at coherent interfaces while a continuous migration having slight/no ledges with the inner diffusion was observed at incoherent interfaces between indium and ZnO. Atomic coherency dependence of interface ledge propagation is explained based on thermodynamic evaluation and growth kinetics at the atomic scale. Moreover, we have observed the transition layer of InxZn1-xO between indium and ZnO NW. The compositional distributions of indium in the transition layer lead to the diffusion gradient of indium in ZnO NW. The governing science is fundamentally significant in material engineering and interface dynamics of hetero-junction to relevant metal-semiconductor systems.

I.2. 5

add to my program (close full abstract)

12:00 **Confined Sol-Gel route to epitaxial Octahedral Molecular Sieve nanowires with tunable compositions on silicon**

Authors : Adrián Carretero-Genevrier1*, Judith Oró-Solé2, Jaume Gázquez2, Teresa Puig2, Xavier Obradors2, Clément Sanchez3, Narcís Mestres2, Etienne Ferain4,Juan Rodríguez-Carvajal5
Affiliations : 1Institut des Nanotechnologies de Lyon (INL) CNRS- Ecole Centrale de Lyon, 36 avenue Guy de Collongue, 69134 Ecully, France. 2Institut de Ciència de Materials de Barcelona ICMAB, Consejo Superior de Investigaciones Científicas CSIC, Campus UAB 08193 Bellaterra, Catalonia, Spain 3Laboratoire Chimie de la Matière Condensée, UMR UPMC-Collège de France-CNRS 7574. Collège de France, 11 place Marcelin Berthelot, 75231 Paris, France. 4Institute of Condensed Matter and Nanosciences, Bio & Soft Matter (IMCN/BSMA), Université Catholique de Louvain, Croix du Sud 1,1348 Louvain-la-Neuve, Belgium, and it4ip s.a., rue J. Bordet (Z.I. C), 7180 Seneffe, Belgium 5Institut Laue-Langevin, 6 rue Jules Horowitz, BP 156, 38042 Grenoble Cedex 9, France

Resume : Manganese oxides octahedral molecular sieves (OMS) with mixed-valence frameworks have been widely used as bulk material in catalysis, semiconductor industry, and batteries. Monolithic direct integration of OMS with vertically oriented crystals on a semiconductor platform is challenging due to difficulties on preserving epitaxy, crystalline phase, and composition. Here, we developed a new strategy to produce vertical epitaxial single crystalline OMS nanowires with tunable composition and enhanced ferromagnetic properties on

I.2. 6

Si substrates by using a chemical solution deposition approach [1]. The nanowire growth mechanism involves the use of track-etched nanoporous polymer templates combined with the controlled growth of quartz thin films at the Si surface, which allowed the epitaxial stabilization and crystallization of OMS nanowires. α-quartz layers were obtained by thermally activated devitrification of the native amorphous silica surface layer assisted by a heterogeneous catalysis driven by alkaline earth cations (Sr^{2+}, Ba^{2+} or Ca^{2+}) present in the precursor solution [2]. Therefore, the combination of soft-chemistry and epitaxial growth opens new opportunities for the effective integration of novel technological functional tunneled complex oxides nanomaterials on Si substrates [3]. [1] A. Carretero-Genevrier et al. Chem.Soc.Rev. 10.1039/C3CS60288E (2013) [2] A. Carretero-Genevrier et al. Science 340, 827 (2013) [3] A. Carretero-Genevrier et al. Chem.Mater. 10.1021/cm403064u (2013)

add to my program (close full abstract)

12:15 **TiO2 nanowires by microwave hydrothermal synthesis**

Authors : E.Arcadipane, L. Romano, M. Zimbone, R. Sanz, G. Impellizzeri, M. A. Buccheri, M. Cantarella, M.G. Grimaldi, V. Privitera
Affiliations : Dipartimento di Fisica e Astronomia, Università di Catania and IMM-CNR MATIS, via S. Sofia 64, 95123 Catania, Italy.

Resume : Titanium Oxide (TiO2) is a well-known material, widely applied in different sectors due to its unique properties of photocatalytic activity, biological and chemical inertness, non-toxicity and environmental safety. One of the main challenge to enhance its photocatalytic efficiency is to increase its surface area, which can be achieved by synthetizing TiO2 nanostructures. In order to synthetize such nanostructures, different methods have been developed and the solution–based hydrothermal approach seems promising in terms of flexibility, production time, process simplicity and cost-effectiveness. In this work, we investigate the hydrothermal process to grow TiO2 nanowires (NWs) for photocatalytic applications. TiO2 powder was stirred in NaOH water solution and then heated by microwave oven at 450 W for about 10 minutes in a pressurized digestion vessel. A high uniform density of NWs with length of the order of few um was successfully obtained. The synthetized NWs were then morphologically characterized by transmission and scanning electron microscopies, Rutherford back scattering and X-ray diffraction; optical analysis of absorption were carried out by spectrophotometry; finally, photocatalytic and antibacterial properties were also investigated. Moreover, thermal oxidation process of Ti foils and wires at 700°C for few hours was also used to prepare TiO2 NWs, in order to provide a comparative growth method in terms of material quality and crystallinity.

I.2. 7

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12:30 Lunch break

Optoelectronic materials I : Umberto Anselmi-Tamburini & Jesus Ricote

14:00 **Transparent Oxide Conductors and Semiconductors. New Science and Potential Technologies**

Authors : Tobin J. Marks
Affiliations : Department of Chemistry and the Materials Research Center, Northwestern University Evanston IL 60208 USA

Resume : Control of metal oxide compositions and film growth parameters affords broad and sometimes surprising tunability of many useful electrical, optical, and mechanical properties. In this lecture, three topics are briefly surveyed: 1) Polycrystalline and amorphous oxide semiconductors for the fabrication of transparent, mechanically flexible transistor-based electronic circuitry, 2) Oxides as enablers of high-performance electro-optic phase modulators, 3) Oxides as electrodes and interfacial layers for high-efficiency photovoltaic cells.

I.3. 1

add to my program (close full abstract)

14:30 **Transparent conducting electrodes with a periodic porous architecture**

Authors : Kristina Peters, Ksenia Fominykh, Peter Zehetmaier, Dina Fattakhova-Rohlfing*
Affiliations : Department of Chemistry and Center for NanoScience (CeNS), Ludwig-Maximilians-University (LMU), Butenandtstr. 5-13 (E), 81377 Munich, Germany (*email: dina.fattakhova@cup.uni-muenchen.de)

I.3. 2

Resume : Transparent conducting oxides (TCOs) are indispensable as electrodes for optoelectrochemical and photovoltaic devices. TCOs have been known for a long time as dense flat layers, but only recently the fabrication of 3D-conducting TCO networks has been reported. The interest in 3D-electrode architectures is based on their large interface area enabling incorporation of large amounts of functional redox guests, the electrical conductivity enabling the direct electronic access to the incorporated species, and the optical transparency allowing interactions with light. We develop new systems for the fabrication of TCO electrodes with various types and dimensions of 3D-nanostructures by a directed self-assembly of corresponding nanoparticles [1-3]. Such transparent conducting matrices with defined porous architecture, high surface area and open accessible porosity can incorporate various redox moieties from small redox molecules to large proteins, which show the greatly enhanced electrochemical response proportional to the electrode surface area. We present a new approach to fabricate transparent conducting layers of antimony-doped tin oxide (ATO). Macroporous crystalline frameworks can be easily manufactured by a direct assembly of pre-formed ATO nanocrystals and latex beads. The high crystallinity of the nanoparticles serving as building blocks enables to obtain the fully crystalline porous transparent scaffolds with high electric conductivity and a defined macroporous morphology, which can be used as nanostructured current collectors for immobilization of bulky redox moieties. [1] V. Müller et al, Small 2010, 6, 633. [2] Y. Liu et al, ACS Nano 2010, 4, 5373. [3] Y. Liu et al, Chem. Sci. 2012, 3, 2367.

add to my program (close full abstract)

14:45 **Light Extraction Enhancement of Vertical LED by Growing ZnO Nano-rods on Tips of n-GaN Pyramids and Polarization Dependent Measurement of Nano-structure**

Authors : Yen-Ju Wu, Chin-Han Liao, Cheng-Yi Liu
Affiliations : Department of Chemical and Materials Engineering National Central University, Jhongli, Taiwan

Resume : Creating a textured pyramidal structure on the emitting n-GaN surface of the vertical GaN-based LED by wet-etching is considered to be the most effective approach for enhancing the light extraction efficiency of the vertical GaN-based light-emitting diodes (LEDs). The present study shows that the light extraction efficiency of the pyramidal n-GaN surface can be further enhanced by growing ZnO nano-rods on the n-GaN surface. In addition, we find that the growth location of the ZnO nanorods on the n-GaN surface by hydrothermal method is highly correlated with the polarity of the n-GaN surface. By manipulating the polarity of the pyramidal n-GaN surface and water-dissolution process, ZnO nanorods can be specifically grown on the tips of the pyramids. With the tip-only ZnO NRs on the pyramidal n-GaN emitting surface, the light-output power of LED with a pyramidal n-GaN surface can be remarkably further enhanced by 49.6% at 250 mA. The correlation between the ZnO nanorods and polarity of the growing surface is studied by X-ray absorption spectroscopy (XAS). Thus, using the XAS analysis, we will demonstrate the correlation between the growth and the dissolution of nanostructure of the ZnO with the polarity of the ZnO c-plane surface, surface termination, and surface activity. The detail optical characterization of the vertical thin-GaN LEDs with ZnO NRs and its polarization dependent measurement would be present and discussed in this talk.

I.3. 3

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15:00 **Luminescence Enhancement from Inverted Light-emitting Devices based on Zinc Oxide Nanorod Arrays**

Authors : Wei-Sheng Chen, Wei-Chi Chen, Sheng-Hsiung Yang*
Affiliations : Institute of Lighting and Energy Photonics, National Chiao Tung University

Resume : The goal of this research is to prepare zinc oxide (ZnO) nanorod arrays by hydro-thermal method for construction of hybrid optoelectronic devices with improved performance. To prepare ZnO nanorod arrays, two seed layers with different thickness of 20 or 48 nm were established, followed by growth of ZnO nanorods vertical to the surface of ITO substrates in a precursor bath. The growth time of ZnO nanorods was experimentally controlled to be 20, 30, and 45 min, forming ZnO nanorods with the lengths of 150, 200, and 300 nm, respectively. All ZnO nanorod arrays possess high transmittance up to 90% in the visible range, which are suitable for application in optoelectronic devices. Inverted light-emitting devices with configuration of ITO/ZnO nanorods/P1-BF4/MEH-PPV/PEDOT/Au were constructed, using ZnO nanorod arrays as electron transporting layer, P1-BF4 as wetting agent, and MEH-PPV as emissive layer. The best device performance was achieved using 48 nm seed layer and

I.3. 4

300 nm ZnO nanorods, showing max brightness and current efficiency of 10,620 cd/m2 and 0.25 cd/A at 10V, respectively. By inserting a tungsten trioxide (WO3) layer between PEDOT and Au electrode, the max brightness and current efficiency were further improved to 15,960 cd/m2 and 0.32 cd/A at 9.8V, respectively. A similar device based on 50 nm of ZnO thin film without nanostructure was fabricated for comparison. It showed max brightness and current efficiency of 4237 cd/m2 and 0.45 cd/A at 21.5V, respectively.

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15:15 **ZnO nanostructured films with tailored properties prepared by simple wet chemical methods**

Authors : C. Florica, N. Preda, I. Zgura, M. Socol, M. Enculescu, A. Evanghelidis, I. Enculescu
Affiliations : National Institute of Materials Physics, Magurele-Bucharest, P.O. Box MG-7, R-77125, Romania

Resume : The accuracy in designing ZnO nanostructured films with tailored morphology has become an important step towards their implementation into chemical sensors. The chemical deposition process is a technique suitable for fabricating large-area ZnO uniform films. The present study is focused on the growth of ZnO films on patterned silicon by two simple wet chemical routes: chemical bath deposition (CBD) using as reactants zinc nitrate and hexamethylenetetramine and electroless deposition (ELD) based on the nitrate ions reduction by dimethylamineborane in the presence of a metal as catalyst. Combining ELD and photolithography methods patterned ZnO nanostructures arrays were also fabricated. For a complex characterization of the ZnO nanostructured films their morphology, crystalline structure, optical, wetting and electrical properties were investigated. The ZnO films exhibit superhydrophobicity and low roll-off angle, properties very useful for self-cleaning applications. The shape of the nanostructures, rods and prisms, influences the current voltage measurements which vary from an asymmetrical behavior to a symmetrical one. Having a high surface/volume ratio the electric response of the ZnO nanostructured films was tested in the presence of an external factor (ammonia vapors) exhibiting high sensitivity as chemical sensor.

I.3. 5

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15:30 **Effect of Chemical Precursors On the Optical and Electrical Properties of p-Type Transparent Conducting Cr2O3:(Mg,N)**

Authors : Elisabetta Arca, Karsten Fleischer, Sergey Krasnikov, Igor Shvets
Affiliations : Trinity College Dublin, Dublin, Ireland.

Resume : Cr2O3:(Mg,N) has been reported as a p-type transparent conducting oxide. In this contribution the effect of each precursor used for the deposition by spray-pyrolysis, will be explored and their role in determining the optical and electrical properties of Cr2O3 will be outlined. A correlation between the structural, electrical, and optical properties upon introducing nitrogen precursors has been established. In particular it has been shown that the presence of ammonium salts in the deposition environment results in less absorbing films. By combining optical measurements and NEXAFS studies, a mechanism is proposed to explain the change in the optical properties. Moreover, it is shown that the presence of the nitrate moiety in the reaction environment is necessary to improve the electrical conductivity of the deposited films. The reaction of the nitrate moiety with the ammonium moiety has been proposed as the mechanism to explain the boost in conductivity.

I.3. 6

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15:45 **Direct Electrochemical Growth of Vertically-Oriented ZnO Nanorod Arrays on Transparent Al-Doped ZnO Electrodes**

Authors : Vlad-Andrei Antohe (a), Martin Mickan (a), Frédéric Henry (b) and Luc Piraux (a)
Affiliations : (a) Institute of Condensed Matter and Nanosciences (IMCN), Universite catholique de Louvain (UCL), Place Croix du Sud 1, B-1348 Louvain-la-Neuve, Belgium (b) Institute of Mechanics, Materials and Civil Engineering (IMMC), Universite catholique de Louvain (UCL), Place Sainte-Barbe 2, B-1348 Louvain-la-Neuve, Belgium

Resume : The fabrication of one dimensional ZnO nanostructures on transparent and conducting substrates (TCOs) has become lately a subject of intensive research, due to the wide range of applications requiring a large active surface for high device performance. We report a template-free electrodeposition method for preparing large arrays of ZnO nanorods (NRs), vertically-aligned on top of Al-doped ZnO (AZO) thin films deposited on glass. The DC-sputtered AZO layers were found to display enhanced electrical and morphological properties compared to other TCOs, facilitating the electrochemical growth of the ZnO nanostructures. Moreover, its intrinsic

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columnar nature strengthened the vertical orientation of the ZnO NRs. Further structural studies confirmed the excellent orientation along c-axis of the ZnO Wurtzite phase and have shown a polycrystalline nature of the NRs, with well-defined hexagonal symmetry of the crystallites. The one-step process has great potential to be used in the fabrication of modern optoelectronic devices, such as dye-sensitized or hybrid organic/inorganic photovoltaic structures. In this context, the process of developing AZO-supported ZnO NRs is particularly promising, because the inorganic material may borrow the crystalline structure from the collecting electrode. Consequently, the existing defects at the interface (due to lattice mismatches) are reduced and the electrical transport is locally enhanced, possibly resulting in an improved device efficiency.

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16:00 **Coffee & tea**

Optoelectronic materials II : Tobin Marks

16:30 **Highly birefringent thin Films by Shear-Oriented Assembly of Colloidal Nanorods** I.4. 1

Authors : JW Kim, K. Lahlil, JP Boilot, J. Peretti, T. Gacoin

Affiliations : Laboratoire de Physique de la Matière Condensée (PMC), CNRS – Ecole Polytechnique, UMR 7643, 91128 Palaiseau Cedex, France

Resume : Anisotropic particles in flowing liquids tend to orient along the direction of shear. Making use of this phenomenon is a possible strategy for the self-assembly of colloidal particles into organized solid structures. This method is nevertheless not straightforward since the orientation occurs only in the presence of shear in the liquid state which is hardly preserved during the solvent evaporation. We here show that tuning the colloidal nanorod suspension into a thixotropic rod gel provides a solution to avoid the relaxation of shear-oriented nanorods and then to make a uniformly aligned nanorod film structure by evaporating the solvent at a quiescent state. Using this approach, we report a fascinating example of a simple and scalable coating process to fabricate perfectly aligned lanthanum phosphate (LaPO4) nanorod thin films exhibiting a remarkable birefringence (□n = 0.13) associated with high transparency over a wide spectral range. Birefringence will be discussed in terms of the relative effect of shape birefringence as determined by the particles geometry and spatial arrangement associated with the intrinsic birefringence of the bulk material. Finally, we will described the luminescent properties of films made from europium doped particles, which are found to exhibit a sharply polarized fluorescence emission. JW Kim et al, Advanced Functional Materials, 22, 4949 (2012) JW Kim et al, Advanced Materials, 25, 3295 (2013)

add to my program (close full abstract)

17:00 **Photocapacitance and Photocurrent Spectroscopy in ZnO Nanowires** I.4. 2

Authors : P. Sanguino(a), R. Ayouchi(b), R. Schwarz(b), R. Igreja(c), and R. Franco(a)

Affiliations : (a) REQUIMTE, Departamento de Química, Faculdade de Ciências e Tecnologia Universidade Nova de Lisboa, 2829-516 Caparica, Portugal; (b) Departamento de Física and ICEMS, Instituto Superior Técnico, Lisbon, Portugal; (c) CENIMAT/I3N, Departamento de Ciência dos Materiais, Faculdade de Ciências e Tecnologia, FCT, Universidade Nova de Lisboa and CEMOP-UNINOVA, 2829-516 Caparica, Portugal.

Resume : Understanding the optoelectronic properties of ZnO nanowires is essential for its applications in the field of biosensors. In this work, ZnO nanowires with 80 to 100 nm diameter and 1 to 5 micrometer length, deposited by wet chemical process, show persistent photoconductivity after short UV irradiation. This effect was already reported in thin ZnO films. In nanowires, characteristic decay times of up to 60 seconds were encountered. We have compared those findings with spectrally-resolved photocapacitance measurements, performed at various temperatures, in order to test hypotheses of influence of deep traps inside the nanowires as compared to trap filling of surface states. The influence of ambient gas and moisture during the analysis is taken into account.

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17:15 **Tunning photolumencence wavelength by controlling the surface stoichiometry of ZnO Nanorods grown by microwave assisted and traditional water bath assisted aqueous solution synthesis** I.4. 3

Authors : Jie TANG1+, Chuan Beng TAY1, Jianwei CHAI2, Xuan Sang NGUYEN3, Soo-Jin CHUA3#

Affiliations : 1Electronics and Communication Engineering, National University of

Singapore, Singapore, 2Institute of Materials Research and Engineering, Agency for Science, Technology and Research (A*STAR), Singapore,3Singapore-MIT Alliance, National University of Singapore, Singapore

Resume : Zinc oxide (ZnO), is an attractive semiconductor with a wide range of properties for multi-functional applications, such as solar cells, varistors, LEDs, nanogenerators, chemical and gas sensors and spintronic devices due to its large bandgap (3.37eV) with high transparency in visible range, light emitting properties with large exciton binding energy (60meV), high electrical conductivity, large piezoelectric coefficient and promising magnetic properties. In order to fully realize the potential of ZnO for these applications, researchers have looked for many approaches of ZnO growth, such as MOCVD, PLD, MBE, Aqueous solution etc. Among these methods, aqueous solution growth is motivated for its low cost, simple setup, high energy efficiency and easy nanostructure synthesis. In addition, the microwave-assisted aqueous solution synthesis of ZnO has numerous advantages over conventional water bath assisted method such as localized instantaneous, rapid and homogenous heating, precise parameter control and energy saving which have already been reported and widely accepted. Up to date, the crucial differences in the context of the quality of ZnO nanorods have not been fully understood. In this paper, based on our previous thorough research on these two solution synthesis of ZnO nanostructures, microwave and water bath assisted synthesis have different effects on surface stoichiometry which attributes to both crystal quality as well as the growth mechanism of ZnO nanorods have been investigated and compared. The correlation between ZnO nanorods optical properties and its surface stoichiometry was systematically investigated through XPS, PL, LTPL. Explanations for the observations will be presented.

add to my program (close full abstract)

17:30 **Tunable Composition and Superlattice Structure of Single Crystalline In2-xGaxO3(ZnO)m Nanowires**

Authors : Yujie Guo1, Pieter L'hoëst1, Tom Van der Donck1, Vijay Shankar Rangasamy2, Savitha Thayumanasundaram2, Jean-Pierre Locquet2, Jin Won Seo1
Affiliations : 1 Department of Materials Engineering, KU Leuven, 3001 Leuven, Belgium; 2 Laboratory of Solid State Physics and Magnetism, KU Leuven, 3001 Leuven, Belgium

Resume : Single crystaline In2-xGaxO3(ZnO)m (IGZO) hold considerable technological promises for the electrical and optical applications owing to its superior properties especially high carrier mobility. An additional appealing feature of IGZO is the large flexibility to modulate its "natural superlattice" structure, which is directly related to its electrical performance. In this work we present a non-vacuum route to produce single crystalline IGZO nanowires with tunable structure and composition. As starting material, CVD-produced ZnO nanowires were coated with IGZO precursor solution, followed by the reactive solid-phase annealing. Nanowires' structural homogeneity strongly relies on the uniform deposition of solution-based precursor, as well as the precise annealing condition that drives the interdiffusion of In, Ga and Zn atoms. Detailed characterisation by means of SEM, EDX, TEM and XRD reveals highly periodic InGaO3(ZnO)x superlattice, with x depending on the composition of IGZO precursor. Cathodoluminescent(CL) measurements were used to determine the IGZO band-gap and to identify oxygen-related defects. The optical transparency has also been measured by Fourier transform infrared spectroscopy (FTIR).

I.4. 4

add to my program (close full abstract)

17:45 **Energy transfer between Ce end Tb ions in sol-gel synthesized YSO crystals.**

Authors : Chiriu D., Ricci P.C., Carbonaro C.M., Corpino R., Stagi L.
Affiliations : Department of Physics, University of Cagliari

Resume : Among the large family of inorganic luminescent materials, rare earth doped oxyorthosilicates (REDOs), with composition formula Re2SiO5, have attracted lot of attention because of their possible applications in photonics, in particular in imaging and display technology and in the scintillation field. The REDOs' appeal is mainly related to the efficient blending of the emission properties of the dopant rare earths, typically the three-valent Eu, Ce, Sm and Tb ions, and the chemical and thermal stability of the oxyorthosilicate host crystals, such as Gd2.SiO4/O (known as GSO), Y2.SiO4/O (YSO), Lu2.SiO4/O (LSO) and their solid solutions like, for example, LuxY1-x.SiO4/O (LYSO). In particular, the cited crystal structures possess a noteworthy mass adsorption coefficient which allows for a very high stopping power to be exploited, merged with the efficient emission of the RE dopant, in the gamma and ionizing radiation detection. Recently, interesting luminescence properties of Tb and Ce containing REDOs were studied in our laboratories in view of potential applications in LED and display technology. Indeed, as concerns the doping

I.4. 5

elements, Tb and Ce ions display emission properties in the visible range with an efficient luminescence whose spectral position largely depends on their concentrations. By increasing the dopant concentration, the luminescence profile changes from a blue to a green peaked emission spectrum because of the energy transfer among centers. A kinetic properties of the luminescence of optically excited Terbium-Cerium co-doped Y2SiO5 sol–gel synthesized crystal powders have been investigated as a function of the dopant concentration. The energy transfer mechanism was accounted for by considering the Inokuti-Hiramaya model for a dipole–dipole interaction among different Tb emitting centers and their relation with Ce centers was studied. An additional internal mechanism was considered as well to explain a residual quantum yield recognized in samples with vanishingly small concentrations. Internal and external energy transfer mechanisms have been included in a proper kinetic model which allows successful fitting of the photoluminescence decay curves and calculation of the critical concentration and efficiency of the energy transfer mechanism.

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Poster session 1 : An Hardy

18:00 **Elaboration of ZrO2 nanoparticles in sol-gel reactor for biofuel synthesis** I.P1.1

Authors : Sana Labidi, Fabien Volle, Mounir Ben Amar, Jean-Philippe Passarello, Andreï Kanaev
Affiliations : Laboratoire des Sciences des Procédés et des Matériaux, UPR 3407 CNRS, Institut Galilée, Université Paris13, Sorbonne Paris Cité, 93430 Villetaneuse, France

Resume : We report on preparation of novel zirconia coatings based on preformed monodispersed zirconium-oxo-alkoxy (ZOA) nanoparticles for applications in biofuel synthesis. ZrO2 nanoparticles were prepared in a sol-gel reactor by rapid micro-mixing (in turbulent flow) of two reactive fluids containing zirconium n-propoxide and water in n-propanol at 20°C and atmospheric pressure. The particle size measurement was carried out in-situ by Dynamic Light Scattering (DLS) technique using optical-fiber probe. The kinetics of nucleation-growth process of ZrO2 nanoparticles were studied at the hydrolysis ratio H=[Zr]/[H2O] between 1.5 and 2.7 and zirconium concentration between 0.100 and 0.150 mol/L. The kinetic study was conducted to determine the nucleation radius, induction time and fractal dimension for each value of H and zirconium precursor concentration. A quasi monodispersed size distribution of the condensed species has been obtained with the a mean nanoparticle size of 3.6±0.2 nm for H=2. The ZOA nanoparticles were deposited as monolayer coatings, dried and thermally treated at 600°C. Transmission Electronic Microscopy measurement confirmed the size of particle of zirconia, and ATG/ATD was employed to identify the materiael and temperature transitions. The obtained zirconia nanocoatings were used in esterification of oleic and palmitic acid with methanol to synthesize methyl esters (ME), which are considered for biofuel synthesis.

add to my program (close full abstract)

18:00 **Spray Langmuir-Blodgett deposition of oxide nanosheet films** I.P1.2

Authors : Huiyu Yuan, Johan E. ten Elshof
Affiliations : MESA+ Institute for Nanotechnology, University of Twente, P.O. Box 217, 7500 AE Enschede, the Netherlands.

Resume : Two dimensional (2D) oxides, known as nanosheets, are a novel source of functional materials. They are commonly used to make nanosheet thin films. One of most facile routes to make single and controllable multilayer nanosheet thin films is Langmuir-Blodgett (LB) deposition, which gives precise control over thickness and composition of thin films. However, the current LB deposition process faces several drawbacks: locally varying suspension concentrations and unreliable surface pressure. Here, we have been developing a new LB deposition method, called spray Langmuir-Blodgett (SPLB) deposition. This method can overcome the current LB deposition problems. We carried out SPLB deposition with Ti0.87O2 nanosheets and found that SPLB deposition does not result in stacked nanosheets. The saturation point of the surface pressure of Ti0.87O2 nanosheet suspensions is at ~20 mN/m. The new method showed a high reproducibility to fabricate high coverage monolayer thin films.

add to my program (close full abstract)

18:00 **Direct Access to Crystalline Mesoporous Transition Metal Oxides** I.P1.3

Authors : Limin Guo, Shintaro Ida, Takashi Daio, Hidehisa Hagiwara, Tatsumi Ishihara
Affiliations : International Institute for Carbon-Neutral Energy Research (WPI-I2CNER),

Department of Applied Chemistry and International Research Center for Hydrogen Energy, Kyushu University, 744 Motooka, Nishi-ku, Fukuoka 819-0395, Japan.
Resume : High-surface-area crystalline mesoporous d0 metal oxides such as Ta2O5, Nb2O5, and TiO2 were synthesized via a one-pot method using pluronic P-123 triblock copolymer as a structure directing agent. Mesostructure stability during metal oxide crystallization via high temperature calcination remains difficult to maintain in such synthesis. In this study, two heat treatments were proven to play key roles in achieving this goal. The first one is the intermediate heat treatment that preconsolidates the mesostructure and partially decomposes P-123 into carbon rich species. The second heat treatment relies on high temperature calcination under inert atmosphere to simultaneously form carbon wrapping on the metal oxides in situ and achieve crystallization of metal oxides. These two treatments successfully restricted the porous structure collapse and crystal size growth during high temperature crystallization. The as-synthesized crystalline mesoporous metal oxides show disordered mesoporous structures consisting of polycrystals. Notably, the commonly used P-123 surfactant without sp2-hybridized carbon forms amorphous carbon in situ, which effectively restricts mass transfer during crystallization and thus successfully prevents crystal size growth. The as-synthesized crystalline mesoporous Ta2O5, Nb2O5, and TiO2 displayed surface areas of 117.0, 125, and 76.2 m2/g, respectively, and pore sizes of 5.4, 8.1, and 13.9 nm, respectively. Crystal sizes amounted to 19, 28, and 34 nm for the mesoporous Ta2O5, Nb2O5, and TiO2, respectively. Porous and crystal structures of the as-synthesized samples are characterized using X-ray diffraction, thermogravimetric–differential thermal analysis, scanning electron microscopy, transmission electron microscopy, X-ray photoelectron spectroscopy, and N2 sorption techniques.

18:00 **Energy saving cool paints prepared with ceramic powder**

Authors : Jee Hye Shin1,2, Hee Jung Kim1,3 and Jung Whan Yoo1*
Affiliations : 1 Composite Materials Team, Korea Institute of Ceramic Engineering and Technology, Seoul, Korea ; 2 Department of chemical & biological engineering, Korea University, Korea ; 3 School of Advanced Materials Science & Engineering, Sungkyunkwan University, Korea
Resume : Many regions around the world often reach or exceed 40℃ during summer. So we often expend substantial amounts of energy to reduce the interior temperature of the building, e.g. air conditioning. One way to reduce energy consumption is to employ energy-saving paints on the building's exterior. In this study, we introduce new thermo-shielding paints to enable reduction of the building interior temperature in hot climates. Thermo-shielding paint mixed with different shaped ceramic powders such as pearl, mica, and hollow silica having reflectivity or insulation properties contributes to the reduction of the surface temperature due to high surface reflectivity and/or protection of heat transfer in solar spectra. The surface temperature of the thermo-shielding paint painted with 0.4mm thickness was reduced about 10℃ compared with conventional paints at same color. The painted samples were characterized by reflective index, thermal image, and cross-section SEM to understand ceramic powder role in efficient thermo-shielding paint.

I.P1.4

18:00 **Combination of metal oxalates coprecipitation and hydrothermal route for the synthesis of nanocrystalline metal oxides**

Authors : Paolo Dolcet [a,b], Stefano Diodati [a,b], Silvia Gross [a,b]
Affiliations : [a] Istituto per l'Energetica e le Interfasi, IENI-CNR and INSTM, UdR, via Marzolo, 1, I-35131, Padova, Italy; [b] Dipartimento di Scienze Chimiche, Università degli Studi di Padova, via Marzolo, 1, I-35131, Padova, Italy
Resume : The low temperature synthesis of crystalline nanosized functional oxides in an aqueous medium is a topic of great interest given the attention that environmentally friendly methods have recently attracted. In this framework, nanostructured cobalt (CoFe2O4), nickel (NiFe2O4), zinc (ZnFe2O4) and manganese (MnFe2O4) spinel ferrites were synthesised with high yields, crystallinity and purity through an easy, quick, reproducible and low-temperature hydrothermal assisted route starting from an aqueous suspension of coprecipitated metal oxalates [1]. The nanocrystalline powders were obtained as a pure crystalline phase already at the very low temperature of 75°C and no further thermal treatment or purification step was needed [1]. An analogous protocol allowed the synthesis of doped zinc oxide ZnO:M (M=Mn, Cu, Tb, Dy) at temperatures as low as 160°C. The structure and microstructure of the prepared materials was investigated by means of powder XRD, while XPS and ICP-AES analyses were used to gain information on the surface and bulk

I.P1.5

composition of the samples, respectively, confirming the expected stoichiometry. To investigate the effect of the synthesis protocol on the morphology of the obtained ferrites, TEM observations were performed on selected samples. Finally, functional magnetic characterisations were carried out on the ferrites, whereas photocatalytic activity measurements were carried out on the ZnO samples. [1] Diodati S. Ph.D. Thesis, University of Padova, Italy 2013

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18:00 **Structural and magnetic study of La0.7Sr0.3MnO3 nanotubes grown from chemical solutions in confined geometries**

Authors : Adrián Carretero-Genevrier1,2, C. Frontera2, A. Hassini2, Judith Oró-Solé2, C.Moreno2, Teresa Puig2, Xavier Obradors2, Narcís Mestres2

Affiliations : 1 Institut des Nanotechnologies de Lyon (INL) CNRS- Ecole Centrale de Lyon, 36 avenue Guy de Collongue, 69134 Ecully, France; 2 Institut de Ciència de Materials de Barcelona ICMAB, Consejo Superior de Investigaciones Científicas CSIC, Campus UAB 08193 Bellaterra, Catalonia, Spain

Resume : Compared with solid nanowires [1], metal oxide tubular nanostructures have attracted significant research interest because of their large specific surface areas, very narrow inner pores, and enhanced surface catalytic properties. Furthermore, 1D nanotubes (NTs) have showed improved performance in gas sensors, field-emission, photovoltaics, and batteries. However, the development of facile, mild and effective approaches for generating size controllable 1D NTs of complex oxides remains a significant challenge. We demonstrate that self standing La0.7Sr0.3MnO3 (LSMO) NTs with diameters ranging from 80 to 200nm can be successfully synthesized by template assisted chemical solution deposition using nanoporous anodized alumina membranes of varying pore size. The template synthetic strategy provides almost monodisperse size distribution in the fabricated NT dimensions. A sol-gel based polymer precursor route was used allowing a good control of the viscosity and stability of the precursor solution, which are crucial parameters for template aided synthesis. The porous membranes were filled with the precursor solution and subsequently heated at high temperature (700-900°C) for phase formation. We prove that the synthesized LSMO NTs are polycrystalline and ferromagnetic with a Curie temperature above 350K. These 1D nanostructures are good candidates to study the magnetic properties of reduced dimensionality systems. [1] A. Carretero-Genevrier et al. Chem.Soc.Rev. 10.1039/C3CS60288E (2013)

I.P1.6

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18:00 **Sol-gel based hydrophobic antireflective coatings on organic substrates: a detailed investigation of Ammonia Vapor Treatment (AVT)**

Authors : Mickael Boudot, Vincent Gaud, Mélanie Louarn, David Grosso

Affiliations : Mickael Boudot : Laboratoire Chimie de la Matière Condensée de Paris (LCMCP), UMR-7574 UPMC-CNRS, Collège de France, 11, place Marcelin Berthelot, 75231 Paris Cedex 05, France. Polyrise SAS, F-33607 Pessac, France. ; Vincent Gaud : Polyrise SAS, F-33607 Pessac, France. ; Mélanie Louarn : Polyrise SAS, F-33607 Pessac, France. ; David Grosso : Laboratoire Chimie de la Matière Condensée de Paris (LCMCP), UMR-7574 UPMC-CNRS, Collège de France, 11, place Marcelin Berthelot, 75231 Paris Cedex 05, France.

Resume : Development of Ammonia Vapor Treatment (AVT) appears as an alternative of usual low temperature techniques (selective reactive etching, dry deposition …) to prepare at room temperature hydrophobic, antireflective mesoporous silica-based films on polymer substrates such as PMMA. The association between the sol gel versatility and AVT permits the creation of functionalized inorganic thin films without usual thermal curing to consolidate the siliceous framework. Chemical and processing conditions investigation on either pure and methyl-functionnalized silica systems showed that ammonia vapors catalysis of silica moieties requires the presence of water from humidity to locally generate OH-. Local pH increase induced the Ostwald-ripening-type structural modification for both type of film. Depending on the inorganic/organic nature of the mesoporous coating, the dissolution/condensation associated to the Ostwald ripening mechanism has a limited range of action and can easily be controlled to tune the mesostructure organization and prevent the complete destruction of porosity by an over treatment. Optical and mechanical properties are compared for various coatings prepared in different conditions. Optimized films exhibit maximum transmittances up to 99.6% in the visible range. They are resistant to water dissolution and are sufficiently mechanically stable so that the failing is caused by the substrate cohesion or by adhesion with the coating.

I.P1.7

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18:00 **Adhesion and Morphology Enhancement of SiO2 Aerogel Films Grown on Silicon Substrate Using SiO2 Buffer Layer**

Authors : X.Y. Sun, C.G. Wu, W.B. Luo[* corresponding author: luowb@uestc.edu.cn]*, P. Li, X.Y. Chen, J. Meng, W. Y. Fu, X. Qing, Y. Shuai, W.L. Zhang
Affiliations : University of Electronic Science and Technology of China

Resume : The effects of SiO2 buffer layer on adhesion and morphology of SiO2 aerogel films deposited on silicon substrate were studied. 500nm thick SiO2 film was grown using thermal oxidization method. SiO2 aerogel made by sol-gel method were spining-coated on silicon substrates with and without SiO2 buffer layers. Microscope and SEM images show that the surface morphology of SiO2 aerogel films with SiO2 buffer layer were rough and irregular, while there were lots of gaps and voids on surfaces of sample without SiO2 buffer layer. The phenomenon was attributed to the hydrophilic property difference between Si and SiO2. The uniform, flat and intact SiO2 aerogel films deposited on thermal oxidization SiO2 buffered silicon substrate has promising application in OLED, Cerenkov detectors and acoustic impedance matching devices.

I.P1. 8

add to my program (close full abstract)

18:00 **Ultrahigh Density Sub-10 nm TiO2 Nanosheet Arrays Using Si-Containing Block Copolymer Lithography and Atomic Layer Deposition**

Authors : Chang-Hong Bak, Se Jin Ku, Gyeong Cheon Jo, Soo Young Choi, Jae Wook Ha and Jin-Baek Kim*
Affiliations : Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Yuseong-gu, Daejeon, 305-701, Korea

Resume : A novel approach for fabricating ultrahigh density sub-10 nm TiO2 nanosheet arrays with high aspect ratios by incorporating the spacer-defined double-patterning process with a nanoline template via atom layer deposition (ALD) was demonstrated. A nanoline template can be fabricated readily by pattern transfer from a thin silicon-containing block copolymer film into a thick cross-linked organic polymer layer. The excellent thermal stability of the cross-linked organic template allowed a high-temperature ALD process to deposit crystalline TiO2 thin films conformally on each surface of the nanoline template. After the template was removed using dry etching and calcination, highly crystalline anatase TiO2 nanosheet arrays with a length of several micrometers remained that were deposited conformally on both sides of the walls of the organic template. The width of the resulting TiO2 nanosheet could be controlled below half the space of the original lithographically defined nanoline template by incorporating the spacer-defined double-patterning process using ALD. This facile and scalable method could be a useful technique for fabricating ultrahigh-density arrays of various inorganic nanosheets with uniform sizes and high aspect ratios.

I.P1. 9

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18:00 **Fabrication of Freestanding Titanium Oxide Nanotube Arrays Using Si-Containing Block Copolymer Lithography and Atomic Layer Deposition**

Authors : Gyeong Cheon Jo*a, Se Jin Ku*a, Chang-Hong Bak*a, Su Min Kim*a, Yu Ri Shin*b, Kwang Ho Kim*b, Se Hun Kwon,*b and Jin-Baek Kim*a
Affiliations : *a; Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Yuseong-gu, Daejeon, 305-701, Korea *b; National Core Research Center for Hybrid Materials Solution, Pusan National University Busan, 609-735, Korea

Resume : Highly ordered freestanding TiO2 nanotube arrays with atomic layer control of wall thickness were fabricated using an organic-inorganic hybrid nanoporous template and atomic layer deposition (ALD). The hybrid nanoporous template with a high-aspect-ratio cylindrical nanopore array can be readily fabricated by pattern transfer from a thin silicon-containing block copolymer film into a thick crosslinked organic polymer layer. The template exhibited excellent thermal stability and thus allowed the high-temperature ALD process to conformally deposit TiO2 thin films on the inner surface of cylindrical nanopores. The ultrafine thickness tunability of the ALD process made it possible to develop TiO2 nanotubes with various wall thicknesses. After the template was removed using a dry etch followed by calcination, vertically aligned and highly crystalline anatase TiO2 nanotube arrays were produced without collapse or bundling. We also fabricated the highly uniform freestanding arrays of multi-component nanotubes composed of TiO2/Al2O3/TiO2 nanolaminate and Ti-Al-O mixed-phase films with precisely controlled thickness and composition.

I.P1. 10

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18:00 **Fabrication of Dually Functionalized Surfaces on an Au Substrate Using a Si-Containing Negative Photoresist**

Authors : Soo Young Choi, Seung A Woo, Se Jin Ku, Jae Wook Ha, Kyoung Ok Jung and

I.P1. 11

Jin-Baek Kim*
Affiliations : Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Yuseong-gu, Daejeon, 305-701, Korea
Resume : A novel patterning technique is proposed here that combines a top-down approach based on photolithography and a bottom-up strategy through self-assembly of multifunctional molecules. In this study, we fabricated dually patterned self-assembled monolayers (SAMs) by patterning a silicon-containing negative photoresist and oxygen plasma treatment on a gold substrate. The substrate was chemically and topographically patterned to give silicon oxide and gold surfaces. The two types of surfaces allow two different chemical functionalities, in this case, silane and thiol compounds, to be reacted to silicon oxide and gold surfaces, respectively. We can control the surface properties by changing the functional groups of SAMs. These patterned functional groups can be able to position various molecular components selectively on the patterned surfaces. These functional groups on dually patterned SAMs are very suitable for the selective adsorption of various materials from nanoparticles to biomolecules. This patterning strategy will be useful for the development of high-throughput platforms for molecular electronics, nanolithography, and sensors.

add to my program (close full abstract)

18:00 **Fabrication of Functional Nanostructure Arrays Using Dual Responsive Nanoporous Templates**

Authors : Kyoung Ok Jung, Chang Hong Bak, Gyeong Cheon Jo, Seung Min Shin and Jin-Baek Kim
Affiliations : Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Yuseong-gu, Daejeon, 305-701, Korea
Resume : High density arrays of conducting polymer nanodots and gold nanorods are fabricated by an electrochemical polymerization and deposition with a dual responsive nanoporous template. Templates are prepared by self-assembly of silicon-containing block copolymers and a lithographic bilayer system. We introduced a dual responsive photoresist bottom layer into which the nanopatterns of block copolymer are transferred by oxygen reactive ion etching. Because the dual responsive layer becomes cross-linked by heating, it can be used as a hard template during the etching process. It becomes soluble again by chain scission upon exposure to light. Therefore, it can be easily removed by the lift-off process. Then, high density arrays of polypyrrole nanodots and gold nanorods are successfully obtained.

I.P1. 12

add to my program (close full abstract)

18:00 **UV-curing hybrid resists for nanoimprint lithography using a diazoketo functionalized POSS**

Authors : Seung Min Shin, Seung A Woo, Kyoung Ok Jung and Jin-Baek Kim*
Affiliations : Department of Chemistry, Korea Advanced Institute of Science and Technology (KAIST), Yuseong-gu, Daejeon, 305-701, Korea
Resume : Nanoimprint lithography (NIL) is one of the promising nanolithographic techniques due to its low cost, simple process, and great precision. We propose novel hybrid resists containing diazoketo groups for high performance of the NIL process. Polyhedral oligomeric silsesquioxane (POSS) which induces high thermal stability and good mechanical property is modified with diazoketo derivatives for photosensitivity. The obtained hybrid resists possess a variety of characteristics desirable for UV-NIL, such as high sensitivity, low volumetric shrinkage, good release property, and excellent dry-etch resistance. In addition, the photo-polymerization can be performed under UV irradiation in normal atmosphere without any additives. Based on these characteristics, the optimized components are evaluated for the UV-NIL test.

I.P1. 13

add to my program (close full abstract)

18:00 **Kinetics and purity of ultraporous Al2O3 monoliths grown from poly- and mono-crystalline metallic aluminium**

Authors : Hang Nga Nguyen*, Mohamed Amamra*, Andrei Kanaev* Alexei P. Shcherban, Vladimir D. Virich, Anatoly D. Solopichin, Gennnady P. Kovtun
Affiliations : *Laboratoire des Sciences des Procédés et des Matériaux (LSPM)-UPR 3407 CNRS 99, av. Jean-Baptiste Clément, Université Paris-Nord, 93430 Villetaneuse, France NSC "Kharkov Institute of Physics & Technology", Institute of Solid State Physics, Materials and Technology, 1 Academic str., 61108 Kharkov, Ukraine
Resume : Keywords: monolithic ultraporous alumina, nanoparticulate composites, growth kinetics, ultrahigh purity. We describe our recent experimental studies of monolithic ultraporous alumina (UPA) elaboration by an original method of by oxidation of aluminum plates through a liquid mercury-silver layer in humid atmosphere and room temperature [1]. These UPA matrixes appear to be a promising support for nanoparticles (NP), being capable

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providing nanocomposites with suppressed NP aggregation at their loading as high as 30 wt% [2-4]. The macroscopic response of the UPA-NP composites can be equal to that of the constituting single NP and can be tailored and optimised. The purity of the supporting material is of the key importance, since even a small NP contamination by the support may cause drastic non-controllable changes of electronic and related functional properties. In particularly, such undesirable contamination can take place during thermal treatment required to adjust the NP crystallinity. In this communication we report on the UPA purity grown from different metallic aluminium plates, including poly- and mono-crystalline aluminium. The monocrystalline aluminum was obtained by horizontal zone melting using the method described in Ref. [5]. The sample composition was analysed by laser mass spectrometry method using with the detection limit of 10-6 wt%. We show that the thin mercury-silver layer responsible for the growth process serves to be an efficient filter for atomic impurities. As a result, the impurity content (for main Si, S, K, Na, Fe, P, Ca and other minor impurities) was found as low as 10-4 wt% or lower. A weak contamination of UPA raw monoliths by Hg was found, which explains the depletion of the liquid layer and affects the UPA growth and limit monolith size. These traces of mercury can be easily removed by a heating at moderate temperatures. A thermal treatment at much higher temperatures (900-1300 °C) is then applied in order to reinforce the matrix (resulting in crystallization transitional γ, δ, θ alumina polymorphs) before impregnation of the nanocomponent. We discuss the impregnation of functional oxide NPs and properties of the UPA-NP nanocomposites. References: 1. J-L. Vignes, C. Frappart, T. di Costanzo, J-C. Rouchaud, L. Mazerolles, D. Michel, J. Mater. Sci. 43 (2008) 1234. 2. M. Bouslama, M. C. Amamra, S. Tieng, O. Brinza, K. Chhor, M. Abderrabba, J.-L. Vignes, A. Kanaev, Appl. Catal. A 402 (2011) 156. 3. M. Bouslama, M. C. Amamra, Z. Jia, M. Ben Amar, O. Brinza, K. Chhor, M. Abderrabba, J-L. Vignes, A. Kanaev, ASC Catal. 2 (2012) 1884. 4. O. Khatim, M. Amamra, K. Chhor, T. Bell, D. Novikov, D. Vrel, A. Kanaev, Chem. Phys. Lett. 558 (2013) 53. 5. G. P. Kovtun, Zone refinement technologies, In.: Inorganic Materials, Naukova Dumka, Kyiv, 2008, pp. 347-357.

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18:00 **Atomic layer deposition of holmium titanium oxide thin films and nanolaminates**

Authors : Kaupo Kukli (a,b), Marianna Kemell (a), Mukesh Chandra Dimri (c), Joosep Link (c), Jun Lu (d), Esa Puukilainen (a), Aile Tamm (b), Roland Hoxha (b), Raivo Stern (c), Lars Hultman (d), Mikko Ritala (a) Markku Leskelä (a)
Affiliations : (a) University of Helsinki, Department of Chemistry, Finland; (b) University of Tartu, Institute of Physics, Estonia; (c) National Institute of Chemical Physics and Biophysics, Tallinn, Estonia; (d) Linköping University, Department of Physics, Sweden

Resume : Holmium titanium oxide films were grown in the form of 1) holmium-doped TiO2 films, 2) mixtures of holmium and titanium oxides, and 3) nanomultilayers constisting of ca. 2 nm thick TiO2 and 4.5 nm thick Ho2O3 films by atomic layer deposition at 300 °C on silicon substrates. The precursors used were Ho(thd)3, Ti(OCH(CH3)2)4 and O3. The composition of the films was varied via changing the holmium-titanium ratio by variation of relative amounts of the sequential deposition cycles of constituent oxides, i.e. Ho2O3 and TiO2 and/or the sequence of the alternating Ho(thd)3 and Ti(OCH(CH3)2)4 pulses.The work was carried out in order to investigate the effects of Ho2O3:TiO2 growth cycle ratio and the chemical film composition on the growth rate, morphology, phase content and magnetization properties of the films. After mixing or nanolaminating the Ho2O3 or TiO2 layers the films were smooth, flat and X-ray amorphous but crystallized after annealing at 800-1000 °C, mostly transforming into the Ho2Ti2O7 phase, as revealed by X-ray diffraction and electron microscopy. The crystallization temperature tended to increase with the Ho:Ti ratio in the films. Magnetometry revealed that saturation magnetization could be observed in the very softly magnetic films formed and containing relatively low amounts of holmium compared to titanium and after annealing in the partially crystallized Ho2Ti2O7 as well. Potential applications of Ho-Ti-O films as multiferroic materials are discussed.

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18:00 **Mechanism of low temperature, aqueous solution deposition of conductive Al-doped ZnO**

Authors : P. Fuchs*, H. Hagendorfer, Y.E. Romanyuk, A.N. Tiwari
Affiliations : Laboratory for Thin Films and Photovoltaics, Empa, Swiss Federal Laboratories for Materials Science and Technology, 8600 Duebendorf, Switzerland

Resume : Aluminum doped zinc oxide (AZO) thin films were prepared by a low temperature, aqueous solution deposition method so that the process

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temperature did not exceed 150 °C at any step [1]. A post deposition UV treatment was applied to improve the opto-electronic performance of the as-deposited films. Various compounds of zinc in the precursor solution (such as zinc oxide powder, zinc nitrate) were compared with respect to their influence on the film growth rate, microstructure and opto-electronic properties. Independent of the choice of zinc precursor, film growth was governed by the retrograde solubility of zinc-ammonia complexes at basic conditions (pH > 10.5). Furthermore, different routes of aluminum dopant supply were investigated, enabling control over the AZO thin film morphology and aluminum doping profile. Highly transparent (>85% between 400 and 1000 nm) AZO thin films with sheet resistances in the range of 20-30 Ohm/sq were fabricated and applied to temperature sensitive polymer substrates as well as thin film solar cells. Literature: [1] H. Hagendorfer et al., "Highly Transparent and Conductive ZnO:Al Thin Films from a low Temperature Aqueous Solution Approach", Adv. Mater., (2013), DOI: 10.1002/adma.201303186 *corresponding author: peter.fuchs@empa.ch, phone: +41 58 765 6124

add to my program (close full abstract)

18:00 **Study of optical, morphological and electrical properties of TiO2 and TiNbO2 oxides obtained by thermal oxidation**

Authors : L. Ion1, Sorina Iftimie1,2, A. Radu1, R. Mallet2, S. Antohe1, Mihaela Girtan2
Affiliations : 1Faculty of Physics, University of Bucharest, Romania 2LPHIA Laboratory, LUNAM - Angers University, France

Resume : Titanium (TiO2) and niobium doped titanium (TiNbO2) oxide thin films were obtained by direct thermal oxidation of metallic layers deposited by magnetron sputtering in two configurations, parallel and perpendicular to the plasma flow. The optical investigations (transmission spectra) revealed a very good transmittance in the visible range for the prepared oxide thin films. The morphological features were investigated using atomic force microscopy (AFM) and scanning electron microscopy (SEM). The root-mean-square and roughness average parameters were determined for both metallic and oxide thin films, and compared. Hall measurements were performed in 300K – 6K range to determine the electrical properties. Taking into account the good electrical and optical properties of the obtained thin film oxide we conclude that the direct thermal oxidation of metallic thin films is an appropriate and cheap technique to prepare good quality thin film oxides used in transparent electronics and optoelectronics applications. Keywords: oxide, Hall measurements, PV Acknowledgments: S.I. is grateful to the Pays de la Loire and Angers University for the post-doc fellowship No 2012-12029 financial support.

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18:00 **Microjet: A New Tool in the Continuous Wet Chemical Production of Nanoparticles**

Authors : Annika Betke, Guido Kickelbick
Affiliations : Saarland University, Inorganic Solid State Chemistry, Am Markt Zeile 3, 66125 Saarbrücken, Germany

Resume : The continuous and reproducible wet chemical production of nanoparticles would be beneficial for their mass production. One potential method is the fast mixing of two liquids in a small reactor cavity and the immediate removal of the mixed fluid from this cavity. This allows to separate nucleation and growth of the particles and thus a high control over their size and size distribution. For this purpose we use a microjet reactor, in which two jet streams of precursor solutions converge under high pressure in a focal point and are removed by a gas stream from this location. We proved that this method can be used for the production of various metal oxide and phosphate particles with a small particle size distribution. Systematic studies on the influence of the different process parameters such as precursor type, flow rate, process temperature, and growth kinetics revealed that the particle size can be influenced in various ways. Upscaling of this process allows production of particle suspensions in a multiple kg scale per day.

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18:00 **Liquid exfoliated 2D MoO3 nanostructures for biosensing**

Authors : Sivacarendran Balendhran, Sumeet Walia, Jian Zhen Ou, Sharath Sriram, Madhu Bhaskaran, and Kourosh Kalantar-zadeh
Affiliations : Functional Materials and Microsystems Research Group, School of Electrical and Computer Engineering RMIT University, Melbourne, Australia.

Resume : Electrical based biosensing platforms offer ease of fabrication and simple sensing solutions in comparison to their optical alternatives. This work exploits the desirable electronic properties of two dimensional (2D) molybdenum trioxide (α-MoO3) in realizing a facile field effect biosensing sensing platform.

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Here, a high yield liquid phase exfoliation process is adopted to obtain a suspension solution of 2D α-MoO3 nanoflakes. The nanoflakes revealed a minimum thickness of ~1.4 nm corresponding to a fundamental double layer of α-MoO3. The drop casted, large area thin films acquired from this suspension were composed of highly crystalline 2D α-MoO3 nanoflakes, suitable for establishing an electron conduction channel with large carrier mobility. Field effect biosensors fabricated from such nanostructured thin films were tested, using bovine serum albumin (BSA) as a model protein. The sensor response time is impressively low (less than 10 s) which can be related permittivity of the 2D MoO3 nanoflakes. The sensor detection limit achieved was as small as 250 µg/ml. The biocompatibility, high permittivity, ease of scalable synthesis and biosensing capabilities of 2D MoO3, marks it favorable for a plethora of future nanoelectronics and sensor applications.

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18:00 **Effect of titanium on the formation of nanostructured oxide films in Ti-based metals by means of wet corrosion process** I.P1.20

Authors : So Yoon Lee 1, Jean-Pierre Locquet 2, Jin Won Seo 1

Affiliations : 1 Department of Metallurgy and Materials Engineering, School of Engineering, KU Leuven, Belgium; 2 Laboratory of Solid State Physics and Magnetism, KU Leuven, 3001 Heverlee, Belgium

Resume : Although potassium (K) incorporated nanostructured titanium oxide films (nTOFs) have gained much interest due to their remarkable structural and physical properties, there are still limitations for various applications. One of the main obstacles remains the nanostructures fabrication, which generally involves complicated process, low reproducibility and high cost for chemical modification. Hence, simple method to synthesize and tune the desired morphology and property is a key issue. In this contribution, we demonstrate wet corrosion process (WCP) as a simple one-step method for nanostructures fabrication using various Ti-based materials. We have systematically investigated the relation between the Ti content of the initial metal and the condition of WCP to control the structural- and physical properties. Ti-6Al-4V alloy (TAV), Ti-Ni (TN) alloy and pure Ti were used to validate the effect of the type and amount of alloying species on nanostructures fabrication. For WCP, various concentration of KOH solution were used. Ti- and TAV metals which consist of more than 50% of Ti yielded nanotubulars of K-incorporated nTOFs (diameter: about 10 to 100 nm, length: several tens of micrometers) using 10-20 mol/L-KOH solution. In contrast, TN metal with 50% of Ti content could be treated with > 20 mol/L-KOH solution. In these conditions (10 mol/L-KOH treated Ti & TAV and 20 mol/L -KOH treated TN), optical property showed a blue-shift in the UV-vis due to quantum confinement effects. These results indicate that the morphology and optical property can be tuned with the Ti content and condition of KOH solution in this system.

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18:00 **Elaboration and characterization of thin films by Spray Pyrolysis technique** I.P1.22

Authors : L. Boudaoud1,2, N.Benramdane1, A. Bouzidi1, A. Nekerela1

Affiliations : 1 LECM :Laboratoire D'élaboration et caractérisation des matériaux, Université Djillali Liabes Sidi Bel Abbes 2 Unité de Recherche en Energies Renouvelables au Milieu Saharien, Centre de Développement des Energies Renouvelables d'Alger, B.P 478, Route Reggane, Adrar

Resume : The thin films trioxide of molybdenum and pentoxide of vanadium were prepared on glass substrates by Spray Pyrolysis technique at a substrate temperature of 423 K. The precursor solutions were obtained by varying the concentrations of MoCl5 and VCl3 in bi-distilled water. The structural investigation conducted by X-ray diffraction showed that the films were polycrystalline with orthorombic structure for MoO3 and V2O5. The optical properties studies in range 300-2500 nm suggested that the behaviour of these thin films are related to bound electronic states. We have been measured the transmittances and the reflectivity, where the optical gaps have been determined.

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18:00 **New approach to solution deposition of nanocrystalline smooth thin films of Y2O3 and Al2O3** I.P1.23

Authors : Martynova I., Tsymbarenko D., Kamenev A., Amelichev V., Vasiliev A., Molodyk A., Samoilenkov S., Kuzmina N., Kaul A.

Affiliations : Lomonosov Moscow State University, Leninskie Gory, 1/3, Moscow, Russia, 119991; Lomonosov Moscow State University, Leninskie Gory, 1/3, Moscow, Russia, 11999; SuperOx, Nauchnyi proezd, 20, bilding 2, Moscow, Russia, 117246; SuperOx, Nauchnyi proezd, 20, bilding 2, Moscow, Russia, 117246; National Research Centre

"Kurchatov Institute", pl. Akad. Kurchatova, 1, Moscow, Russia, 123182; SuperOx, Nauchnyi proezd, 20, bilding 2, Moscow, Russia, 117246; SuperOx, Nauchnyi proezd, 20, bilding 2, Moscow, Russia, 117246; Lomonosov Moscow State University, Leninskie Gory, 1/3, Moscow, Russia, 119991;Lomonosov Moscow State University, Leninskie Gory, 1/3, Moscow, Russia, 119991

Resume : The special interest in nanocrystalline smooth oxide films of Y2O3 and Al2O3 is connected with successful use of their deposition as simple alternative process of long-length metal tape polishing. To deposit smooth (roughness < 1 nm) Y2O3 and Al2O3 films we have suggested new metal organic (MO) precursors on based M(Carb)3 (M = Al, Y; HCarb = aliphatic carboxylic acids) and different N- and/or O-donor ligands (2-ethanolamines, N,N -ethyleneamines, glymes), which can act as solvents too. This approach to precursor design allows to vary concentration, viscosity of the solutions, their surface wettability and thermal stability in required ranges. The composition of the new precursors in both solutions and thin films and their thermal stability were characterized by 1H NMR and Simultaneous Thermal Analysis with evolved gas mass spectrometry. The most suitable MO precursors were chosen and tested in deposition experiments. Nanocrystalline films were deposited on long-length (~ 60 m) Hastelloy C276 tapes by drain coating techniques followed by annealing at 400-500 oC in air and than were characterized by EDX, XRD, SEM, AFM, TEM, their thicknesses were measured on cross section SEM images. The smoothing surface effect was achieved. So, the deposition of nanocrystalline oxide films with thickness ~ 300 nm on Hastelloy C-276 tape reduced the surface roughness by 11 times (from 9 to 0.8 nm on area 5x5 μm2). The correlations between the composition of MO precursors, deposition and anne

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18:00 **One-pot synthesis of WO3 nanostructures at 95 oC using NaOH and HCl**

Authors : K. Christou1, D. Louloudakis2,3*, D. Vernardou3, N. Katsarakis3,4,5, E. Koudoumas3,4

Affiliations : 1 Mechanical Engineering Department, School of Applied Technology, Technological Educational Institute of Crete, 710 04 Heraklion, Crete, Greece 2 Department of Physics, University of Crete, 710 03 Heraklion, Crete, Greece. 3 Center of Materials Technology and Photonics, School of Applied Technology, Technological Educational Institute of Crete, 710 04 Heraklion, Crete, Greece 4 Electrical Engineering Department, School of Applied Technology, Technological Educational Institute of Crete, 710 04 Heraklion, Crete, Greece 5 Institute of Electronic Structure and Laser, Foundation for Research & Technology-Hellas, P.O. Box 1527, Vassilika Vouton, 711 10 Heraklion, Crete, Greece *corresponding author, e-mail:dimitr17@yahoo.gr Tel: 30 2810 379774 I.P1. 24

Resume : This paper examines the effect of pH solution using various concentrations of NaOH and HCl on the hydrothermally grown WO3 nanostructures. The nanostructured coatings were deposited on ITO glass substrates at 95 oC using WO3 powder and water as precursors. The structural and morphological properties of the samples were evaluated by X-ray diffraction, Raman spectroscopy and scanning electron microscopy respectively. The electrochemical characterization of the coatings was performed in a three-electrode electrochemical cell using 1 M LiClO4/propylene carbonate solution as an electrolyte for a scan rate of 10 mV s-1. All samples were scanned for 1, 100 and 250 times through the voltage range of -1000 mV to 1000 mV. The importance of the pH solution to modify the oxide coverage of the samples and consequently control their final characteristics is highlighted.

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18:00 **Syntheses of Zinc Oxide and Zinc Hydroxide Nanosheets and the Photoluminescent Properties of their Layered Materials**

Authors : Özge Sağlam1, Takaaki Taniguchi2,3, Yasumichi Matsumoto2,3

Affiliations : 1)Physik-Department, Technische Universität München, James-Franck-Str., D-85748 Garching, Germany; 2)Graduate School of Science and Technology, Kumamoto University, 2-39-1 Kurokami, Kumamoto 860-8555, Japan; 3)JST, CREST, 5 Sanbancho, Chiyoda-ku, Tokyo 102-0075, Japan

Resume : Inorganic/organic hybrid multilayer structures have great interest due to their potential applications. Among them zinc oxide (ZnO) lamellar hybrids are promising materials in which ZnO having wide band gap of 3.37 eV is used in different applications such as spintronics, photo electronics and solar cells. In this work, syntheses of ZnO and zinc hydroxide (Zn(OH)2) single nanosheets and photoluminescent behavior of layered ZnO and layered Zn(OH)2 were performed. Cathodically electrodeposited layered ZnO film was delaminated to obtain single ZnO nanosheets. On the other hand, preparation of single nanosheet of Zn(OH)2 was carried out by the delamination of layered Zn (OH)2 synthesized with a soft solution process. Thicknesses of ZnO and Zn(OH) I.P1. 25

2 nanosheets are almost 0.7 and 1.0 nm, respectively. According to the results of TEM and SAED , ZnO nanosheet has wurtzite orientation whilst the Zn(OH)2 nanosheet has Zn(OH)2 orientation. In addition, the synthesis of layered ZnO films intercalated with dodecyl sulphate ions was demonstrated by simple soft solution process. The presence of potassium (K+) and lithium (Li+) ions in the starting solution of layered Zn(OH)2 resulted in lamellar hybrid ZnO films instead of layered Zn(OH)2. The zinc hydroxide host layers exhibited intense blue emission when nickel phthalocyanine (NiPC) molecules were introduced into the interlayer domain. The blue emission was also promoted by K+ and Li+ ions.

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18:00 **Hydrothermal growth of bilayered rutile-phased TiO2 nanorods / micro-size TiO2 flowers in highly acidic solution**

Authors : M. K Ahmad1, V.M Mohan2, and K. Murakami2
Affiliations : 1Microelectronics and Nanotechnology-Shamsuddin Research Centre (MiNT -SRC) Universiti Tun Hussein Onn Malaysia 86400 Batu Pahat, Johor, Malaysia 2Research Institute of Electronics Shizuoka University 432-8011 Hamamatsu, Shizuoka, Japan

Resume : Aligned rutile-phased TiO2 (r-TNRs) nanorods and micro-size rutile-phased TiO2 flowers (r-TFs) films were prepared on Fluorine doped Tin Oxide (FTO) substrate using highly acidic solution by two steps hydrothermal process. The hydrothermal was done at 150°C for 5 hours for first step and 2 hours for second step. These films were used as a photoelectrode in Dye-Sensitized Solar Cell (DSC) application. Aligned r-TNRs and r-TFs were prepared using one-step and two-step hydrothermal processes, respectively. At the end of second step hydrothermal process, micro-size rutile-phased TiO2 flowers (r-TFs) were observed on top of r-TNRs (FTO/r-TNRs/r-TFs). Power conversion efficiencies for both aligned r-TNRs and r-TNRs/r-TNFs were compared. From the results, DSC made of r-TNRs only produced energy conversion efficiency of 1.52% and r-TNRs/r-TFs made DSC gave excellent energy conversion efficiency (η) of 4.27 %

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18:00 **Fabrication of nanocomposite cobalt oxide-silica thin films by sol-gel technique for gas sensing applications**

Authors : Atif Mossad Ali 1,2
Affiliations : 1 Department of Physics, Faculty of Science, King Khalid University, Abha, Saudi Arabia 2 Department of Physics, Faculty of Science, Assiut University, Assiut, Egypt

Resume : Preparation of metal oxide thin films by sol–gel technique has attracted much attention because this method allows transfer of pre-prepared nanostructures on to a substrate. In addition, sol–gel technique is cost effective, scalable and reproducible. The silica-based nanocomposites are considered the most challenging system for the quantum confinement of semiconductor nanocrystallites for a better control of shape, size and properties. In addition, systems based on cobalt oxide nanoparticles dispersed in amorphous silica matrix are receiving growing interest as catalysts and/or gas sensors. Therefore, there is great interest for the study of new synthesis procedures of these materials as well as for the study of the interactions between the active phase and the silica matrix. In order to contribute such devices, cobalt oxide-silica (CoO:SiO2) nanocomposite thin films fabricated by sol-gel technique. The morphology of the films was investigated by high-resolution transmission electron microscopy, field emission-secondary electron microscope and atomic force microscopy. The structure was studied by X-ray diffraction and Raman scattering. The vibrational spectra were measured by Fourier transform infrared spectrometer . Furthermore, the optical properties of the films were evaluated by measurements of the optical absorption and photoluminescence. The effects of microstructural change on the optical properties have been investigated at different contents of CoO in CoO:SiO2 composite ratio and annealing temperatures.

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18:00 **Novel Materials and Processing for Printed Metal Oxide Devices**

Authors : Jinwang Li [1,2,*], Phan Trong Tue [1,2], Yoshitaka Murakami [2,4], Tadaoki Mitani [1,2], Eisuke Tokumitsu [1,2,3,5] & Tatsuya Shimoda [1,2,3]
Affiliations : [1] Japan Science and Technology Agency (JST), ERATO, Shimoda Nano-Liquid Process Project, 2-5-3 Asahidai, Nomi, Ishikawa 923-1211, Japan; [2] Green Devices Research Center, Japan Advanced Institute of Science and Technology (JAIST), 2 -13 Asahidai, Nomi, Ishikawa 923-1211, Japan; [3] School of Materials Science, Japan Advanced Institute of Science and Technology, 1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan; [4] JSR Corporation, Yokkaichi Research Center, 100 Kawajiri-cho, Yokkaichi, Mie 510-8552, Japan; [5] Precision and Intelligence Laboratory, Tokyo Institute of

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Technology, 4259-R2-19 Nagatsuta, Midori-ku, Yokohama 226-8503, Japan. * Email: lijw@jaist.ac.jp.

Resume : Compared with organics and silicon, oxide materials are advantageous for their high thermal stability and processability in ambient atmosphere. We have been developing metal oxide materials for use in electronic devices from solution precursors aiming at an all-solution-processed and moreover all-printed one. Very recently, we have developed a new direct printing method, namely nano-rheology printing, which allows us to fabricate sub-micron oxide patterns of well-defined shapes with high fidelity to be mould. Excellent, all-oxide, all-solution-processed, and all printed thin-film transistors (TFTs) with a channel length of 500 nm were demonstrated. In order to apply this technology to a wide range of application, various kinds of oxide materials are required. It is fortunate enough for oxide materials to be able to realize many different kinds of features ranging from rigorous insulating properties to excellent semiconducting ones to highly conductive ones like a metal. Here, we introduce some of our results on the innovation of materials and processing for solution-processed oxide conductors, semiconductors, and insulators (dielectrics): a serious of new p-type amorphous oxides, low temperature processing of oxide conductors (240 – 300°C) and insulators (amorphous dielectrics ~400°C, ferroelectric lead titanate zirconate (PZT) at 450°C), and all-oxide, all-solution-processed TFTs achieved at low temperatures having performances comparable to vacuum-processed ones.

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18:00 **Large-scaled Growth of High Sensitive and Non-enzymatic Glucose Sensing Cu2O Nanocubes**

Authors : Yin-Jie Pan, I-Chung Chang, Hsin-Tien Chiu, Chi-Young Lee
Affiliations : National Tsing Hua University, National Tsing Hua University, National Chiao Tung University,

Resume : The uniform and various sized Cu2O nanocubes were synthesized via sodium citrate assisted reduction using CuSO4 as the precursor in alkaline solution by ascorbic acid, which is simple, easy to mass production and cost-effective. The edge length of the Cu2O nanocubes ranges from 45 to 550 nm. There are two steps in this reaction. Firstly, Cu(OH)2 precipitated from CuSO4 in alkaline solution and then was reduced by ascorbic acid. In the present of sodium citrate, chelating by citrate retards precipitation of Cu(OH)2, lessening nuclei site, which leads to obtain large Cu2O nanocubes. These Cu2O nanocubes were further used as working electrode in non-enzymatic glucose sensor without supporting materials. The small sized Cu2O nanocubes exhibits a high sensitivity of 1.6 mA mM-1 cm-2, low detection limit of 1 μM and wide linear range between 0.001- 2.7 mM (R2=0.9953), due to large active surface area. The Cu2O nanocubes also show a high selectivity to glucose, which can be strongly suggested as potential candidate for non-enzymatic glucose sensor.

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18:00 **Photochemical deposition of the plasmonic silver nanostructures**

Authors : Zbigniew Starowicz(1),Katarzyna Berent(1), Robert P. Socha(2), Justyna Dziedzic(2), Marek Lipinski(1),
Affiliations : (1) Institute of Metallurgy and Materials Science, Polish Academy of Sciences, 25 Reymonta St., 30-059 Cracow, Poland, phone + 48 12 2952808, fax: + 48 126372192, e-mail: zbigniew.starowicz@gmail.com (2) Jerzy Haber Institute of Catalysis and Surface Chemistry Polish Academy of Sciences, 8 Niezapominajek St. 30-239 Cracow

Resume : The Ag NPs found application in many fields of science and technology. There is a great interest in plasmonic structures application for the photovoltaic purposes. The localized surface plasmons arising on Ag NPs result in strong light scattering or near fields enhancement depending on the their size. Therefore, the plasmonic nanostructures can be used for this purpose in different kinds of the solar cells. To utilize plasmonic properties of the particles, high density at the surface is necessary. The appropriate nanostructures are formed by particle deposition from colloids or metal films dewetting process. A novel concept based on photochemical deposition of silver on titanium dioxide will be presented. So far, this method has been used for formation below 20nm NPs and relatively low coverage. Our approach has been focused on synthesis 70-200nm diameter NPs. Two different titania substrate were obtained by sol-gel method on Si substrate from two precursors i.e. tetra 2-propoxy titanium and tetraethoxy titanium. The deposits were optically characterized as well as the XRD phase analysis was performed. The Ag NPs deposition was realized by 405nm laser irradiation of the substrate immersed in silver salt solution. SEM and AFM characterisation of nanoparticle sizes, distribution and morphology was performed in respect to Ag solution concentration, light source intensity and

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illumination time. The Ag NPs showed hemispherical shape with high diameter to height ratio which resulting in changes of the plasmonic properties. The light source intensity influenced the particle shapes from oval to irregular ones. The general aim of presentation is to show features of Ag NPs obtained in different conditions and indicate possible applications in PV.

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18:00 **Simple synthesis of 0D and 2D single phase Fe3O4 nanoparticles by co-precipitation method**

Authors : Andris Sutka, Santa Lagzdina, Mihael Maiorov, Rainer P?rna, Tanel K??mbre, Vambola Kisand

Affiliations : Institute of Silicate Materials, Riga Technical University, Azenes 14/24, Riga, LV-1048, Latvia; Institute of Physics, University of Latvia, Miera 32, Salaspils, LV-2169, Latvia; Institute of Physics, University of Tartu, Riia 142, 51014 Tartu, Estonia; Estonian Nanotechnology Competence Center, Riia 142, 51014 Tartu, Estonia;

Resume : Single phase 0D and 2D nanoparticles were precipitated successfully from a pure aqueous ferrous salt solution in an air atmosphere. Fe3O4 was obtained from single Fe2 salt in ambient air at room temperature. 2D nanostructures were obtained by regulating synthesis conditions as molarity, molar ratio between metal salt and co-precipitation agent, solution temperature, precipitation agent addition or stirring rate. By regulating these conditions it was possible to obtain other iron compounds such as FeOOH, α-Fe2O3 or γ-Fe2O3, as well. Synthesized materials were characterized by using scanning electron microscopy, X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and X-ray absorption spectroscopy (XAS), as well as BET specific surface area and magnetic properties were studied. XRD analysis showed that under optimal synthesis conditions it is possible to obtain single phase magnetite. XPS and XAS measurements showed that the bulk of the nanoparticles is stoichiometric magnetite, while a certain amount of iron site vacancies is present only in the outermost few surface (atomic) layers. Specific surface area of 2D Fe3O4 nanoparticle powders was remarkably higher than that of 0D. Saturation magnetisation was higher for 0D nanoparticles, what could be attributed to enhanced oxygen adsorption on 2D Fe3O4 nanoparticle surface thus creating higher amount of cation vacancies.

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18:00 **Synthesis of TiO2 thin film with embedded Au nanoparticles**

Authors : V. Scuderi (a), G. Impellizzeri (a), L. Romano (a), M. Scuderi (b), MV. Brundo (c), K. Bergum (d), M. Zimbone (a), R. Sanz (a), MA. Buccheri (a), F. Simone (a), G. Nicotra (b), BG. Svensson (e), V. Privitera (a)

Affiliations : (a) CNR-IMM MATIS and Department of Physics and Astronomy, University of Catania, Via S. Sofia 64, I-95123 Catania, Italy; (b) CNR-IMM, Z.I. VIII Strada 5, 95121 Catania, Italy; (c) Department of Biological, Geological and Environmental Sciences, University of Catania, Via Androne 81, 95124, Catania, Italy; (d) Oslo University, Ctr Mat Sci & Nanotechnol, Dept Chem, N-0315 Oslo, Norway; (e) Oslo University, Department of Physics/Centre for Materials Science and Nanotechnology, N-0318 Oslo, Norway;

Resume : In the last years, the synthesis of a wide range of advanced inorganic materials (nanocomposite thin films, patterned surfaces and nanostructures) was extensively studied. In particular, the semiconducting oxide TiO2 has attracted remarkable interest, for its outstanding applications: from solar cells to self-cleaning and water purification. In this work, we investigate the photoactivation of TiO2/Au nanosystem. The material was originally synthesized by covering Au nanoparticles (20 nm in diameter) with a thin layer of TiO2 (4 nm thick) obtained by atomic layer deposition. The system was structurally characterized by scanning and transmission electron microscopy, x-ray diffraction. The optical band gap of TiO2 was evaluated by transmittance and reflectance measurements. The photocatalytic efficiency of the TiO2/Au nanosystem was tested by methyl blue photo-degradation measurements and resulted to be 10% higher than a reference flat film of TiO2. In addition, the photocatalytic activity showed an excellent stability, in contrast with conventional Au nanoparticles on TiO2 systems, essentially due to the removal of Au nanoparticles in the liquid environment. The non-toxicity of TiO2/Au nano-system was established by testing the effect of the material on the reproductive cycle of Mytilus galloprovincialis in aquatic environment. The obtained results demonstrate that the originally-synthesized TiO2/Au nanosystem is a promising photoactive material.

I.P1. 32

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18:00 **Zirconia and zirconia-alumina coatings deposited by plasma enhanced aerosol-gel method**

Authors : Sebastian Miszczak, Bozena Pietrzyk, Zbigniew Gawronski
Affiliations : Institute of Materials Science and Engineering Lodz University of Technology

Resume : The sol-gel method is well known and widely used in manufacturing of bulk materials as well as coatings. One way of coatings producing is an aerosol-gel method, which is a modification of classic sol-gel process. Preparation of coatings by this method involves the formation of an aerosol and its deposition on the coated surfaces, where the aerosol droplets merging into a continuous layer. In this work aerosol-gel method, enhanced with low temperature plasma discharge, was used to producing of zirconia and alumina coatings on different substrates. Low temperature plasma was used for pre-activation of substrates surfaces prior to the sol deposition, and for treatment of deposited layers. Obtained coatings were characterized using an optical, electron (SEM) and atomic force (AFM) microscopes, contact angle device, scratch-tester, X-ray diffraction (XRD) and infrared spectroscopy (FTIR). The results showed a significant influence of substrates surfaces activation on the formation and morphology of sol layers during deposition. It was also shown a noticeable effect of low-temperature plasma treatment on the structure and properties of the obtained coatings. This allows to predict application of this method for the preparation of oxide coatings on temperature sensitive substrates.

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18:00 **Investigation of electrical and sensing properties of ZnO:Al thin films prepared by PLD**

Authors : R. Dhahri1*, M. Hjiri1, A. Alyamani2, L. El Mir1,3, D. Aloisio4, M. Latino4, N. Donato4, G. Neri4
Affiliations : 1 Laboratory of Physics of Materials and Nanomaterials Applied at Environment, Faculty of Sciences of Gabes, 6072 Gabes, Tunisia;2 National Nanotechnology Research Centre, KACST, Riyadh 11623, Saudi Arabia;3 Al Imam Mohammad Ibn Saud Islamic University (IMSIU), College of Sciences, Department of Physics, Riyadh 11623, Saudi Arabia;4 Department of Electronic Engineering, Chemistry and Industrial Engineering, University of Messina, Messina 98166, Italy.

Resume : Pulsed layer deposition (PLD) is a deposition technique very useful in preparation of high quality thin films for optical applications. Here, we demonstrate the utility of this technique in the deposition of thin films on alumina substrate provided with Pt interdigitated electrodes for sensing applications. The morphological and microstructural properties of the as-deposited and thermal treated Al-doped ZnO (AZO) thin films (about 300 nm) were investigated by scanning electron microscopy (SEM) analysis and X-ray diffraction (XRD). The electrical properties of the thin films have been studied. It has noted the remarkable low resistance of the Al-doped thin films, which allowed an easy interfacing with conventional electronics and the fabrication of a sensor device characterized by a low noise. The sensor performances of the AZO thin films for O2 and for monitoring trace levels of pollutant gases like NOx, CO, NH3, H2 etc., in the ambient atmosphere were reported. The results indicated that the sensors developed exhibited good response and quick response/recovery dynamics. The effect of UV-Light on gas sensing has been also studied and discussed.

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18:00 **Water stress corrosion in direct oxide bonding mechanism**

Authors : Chloé MARTIN-COCHER, Frank FOURNEL, Céline BOUT, Anne ROULE, Vincent LARREY
Affiliations : CEA, LETI, Minatec Campus, 38054 GRENOBLE, France

Resume : Direct wafer bonding consists in joining two surfaces smooth and clean enough to create a spontaneous adhesion at room temperature, without any additional materials. This technique is now well used in many applications for microelectronics, microtechnology, such as MEMS, NEMS or three dimensional integration systems and optic applications. The aim of this work is to study the wafer bonding mechanism in the case of hydrophilic silicon dioxide thin film or silicon surface using the bonding energy characterization obtained by double cantilever beam technique (DCB). It consists in measuring the debonding length induced by a razor blade insertion. But, because both Si/SiO2 and SiO2/SiO2 direct bonding involve siloxane Si-O-Si bonds at the bonding interface, these bonding types are strongly impacted by water stress corrosion. While extrinsic water, coming from the measurement atmosphere, can be greatly reduced using anhydrous atmosphere, we will demonstrate how intrinsic

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water which is trapped at the bonding interface could also influence this measurement. Intrinsic stress corrosion kinetics have then been studied and we will explain how it could participate to the direct bonding mechanism. Moreover using different oxide thin films, the influence of the material properties can also be highlighted. More generally, it will be shown these results to be very helpful in the understanding of fracture mechanism in such materials which are used in a lot of applications.

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18:00 **A novel approach to realize optoelectronic devices exploiting Block Copolymers self-assembly** I.P1. 36

Authors : Claudia Diletto (a), Pasquale Morvillo (b), Finizia Auriemma (a), Claudio De Rosa (a)
Affiliations : (a) Department of Chemical Sciences University of Napoli "Federico II" (b) ENEA-Italian National Agency for New Technologies, Energy and Sustainable Development-Portici Research Center

Resume : Block copolymers (BCPs), where chemically distinct macromolecules are joined together by covalent bonds, are subject of intensive worldwide research due to their potential applications in organic electronics. The dissimilar blocks tend to segregate, due to their mutual repulsion, into distinct microdomains resulting in the spontaneous formation of periodic nanostructures. Microdomains of BCPs that form spontaneously by self-assembly may act as hosts for sequestering nanofillers of appropriate chemical affinity according to prefixed periodic geometries producing long-range order in the positioning of nanoparticles. In this work a poly(styrene-b-methylmethacrylate) (PS-b-PMMA) amorphous BCP was employed. Thin films of PS-b-PMMA was obtained by spin-coating on ITO (Indium Thin Oxide) substrate. The ITO glass substrate allows the obtainment of the desired vertical orientation of lamellae where the microdomains are disorderly dispersed. By applying an external electric field the lamellae were aligned side by side realizing a periodic structure with a long range order. Finally, a nanocomposite was made using PS-b-PMMA and PCBM; the self-assembly of the BCP generated the nanotemplate to selectively control the spatial locations of the PCBM molecules, in which the apolar properties of PS block provided the physical stabilization for achieving uniform PCBM distribution. These innovative approaches were utilized as a tool to realize memory devices.

add to my program (close full abstract)

18:00 **Evaluation and control of adhesive and bulk properties of performing functional hybrid coatings on polycarbonate.** I.P1. 37

Authors : K. Lionti3, V. Vuillet-A-Ciles1, N. Lebail2, S. Benayoun2, W. Volksen3, G. Dubois3, B. Toury1
Affiliations : 1 Lab. Multimatériaux et Interfaces, Université de Lyon, France 2 Lab. Tribologie et Dynamique des Systèmes, Ecole Centrale de Lyon, France 3 IBM Almaden Research Center, San Jose, USA

Resume : Transparent polymer materials are widely used in many applications. Among them, polycarbonate (PC) is very much appreciated due to its low density, excellent optical clarity, exceptional impact resistance and its low price. Unfortunately, PC shows some limitations: poor scratch and abrasion resistance. It is also known to be permeable to O2 and H2O and in such conditions PC can release one of its basic components: bisphenol A, which has been proved to be toxic for human beings. Our strategy consists in the deposition of a functional coating on the PC to overcome the above-mentioned restrictions. Since this polymer has a quite low Tg, the sol-gel route is very promising. We have chosen the use of GPTES, as basic precursor, allowing a covalent link through PC since the epoxy group can be opened and react with a plasma-treated PC. Different systems were prepared adjusting the composition (alkoxysilanes/colloidal silica ratio and Zr based precursor) and the nature of the surface treatment prior sol deposition in order to tailor the coatings properties. First, based on the results obtained by double cantilever beam, chemical analyses and scratch tests, adherence was evaluated. Second, coating hardness and density, evaluated, respectively, by nanoindentation and XRR were correlated with respect to the coating composition. In conclusion, we have demonstrated that the bulk properties and the interfacial adhesion of PC protective coatings based on sol gel chemistry can be independent

add to my program (close full abstract)

18:00 **Influence of unit cell design on the piezoelectric response of ZnO nanowire based sensors** I.P1. 38

Authors : Edgar León Pérez [1], Mireille Mouis [2], Sven Salomon [1], Gustavo Ardila [2], Emmanuelle Pauliac-Vaujour [1]

Affiliations : [1] CEA, Leti, Systems Department, F-38054 Grenoble, France. [2] IMEP-LAHC, Minatec, 3 Parvis Louis Néel, 38016 Grenoble, France.
Resume : We will present the results of finite element (FEM) simulations of individually contacted nanowires that represent the unit cell (pixel) of a matrix-based sensor. The considered pixel configuration includes a silicon substrate, a ZnO seed layer, a vertical ZnO NW and metallic electrodes placed at the base of the NW. The potential generated upon NW bending can thus be collected through the electrodes. Past studies have demonstrated the potential of such configurations for high sensitivity sensors and energy harvesters [Hinchet et al., IEDM 2012]. This work aims at providing realistic design elements of NW pixels for optimized piezoelectric charge collection by studying the influence of technologically tunable parameters. The evolution of the piezopotential generated in the NW (VNW) and in the adjacent electrodes (ΔVc) was analyzed as a function of the seed-layer thickness (eZnO) and the distance between the electrodes and the NW (δ). We show that the collection efficiency (ΔVc/VNW) is higher for thinner seed layers (up to 69% for eZnO=5nm). It drops from 64 to 33% when δ increases up to 3 nm and slowly stabilizes for larger values of δ. The chosen parameters relate to technologically plausible conditions inherent to selective growth on a pre-patterned substrate, e. g. by low-cost, scalable, chemical routes. The model provides extremely valuable design guidelines for piezoelectric response optimization of the sensor pixel, with account for growth and patterning constraints.

18:00 **7 nm natural products functionalized iron oxide nanostructures thin films prepared by MAPLE for improved resistance to microbial colonization of medical surfaces**

Authors : Valentina Grumezescu1,2, Ecaterina Andronescu2, Alina Maria Holban3, Laurentiu Mogoanta4, George Dan Mogosanu5, Alexandru Mihai Grumezescu2, Gabriel Socol1, Bogdan Stefan Vasile2, Anton Ficai2, Roxana Trusca6, Florin Iordache7
Affiliations : 1Lasers Department, National Institute for Lasers, Plasma & Radiation Physics, P.O. Box MG-36, Magurele, Bucharest, Romania 2Department of Science and Engineering of Oxidic Materials and Nanomaterials, Faculty of Applied Chemistry and Materials Science, University Politehnica of Bucharest, 1–7 Polizu Street, 011061 Bucharest, Romania 3Microbiology Immunology Department, Faculty of Biology, University of Bucharest, 1–3 Portocalilor Lane, Sector 5, 77206 Bucharest, Romania 4 Research Center for Microscopic Morphology and Immunology, University of Medicine and Pharmacy of Craiova, 2 Petru Rareş Street, 200349 Craiova, Romania 5 Department of Pharmacognosy & Phytotherapy, Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova, 2 Petru Rareş Street, 200349 Craiova, Romania 6S.C. Metav-CD S.A., 31Rosetti Str., 020015 Bucharest, Romania 7Institute of Cellular Biology and Pathology of Romanian Academy, "Nicolae Simionescu", Department of Fetal and Adult Stem Cell Therapy, 8, B.P. Hasdeu, Bucharest 050568, Romania I.P1. 39
Resume : Nanostructured thin films based on 7 nm magnetite nanoparticles and usnic acid were prepared by Matrix Assisted Pulsed Laser Evaporation (MAPLE) technique. Our nanoparticles were well individualized and homogeneous in size. The presence of magnetite nanoparticles was confirmed by High Resolution Transmission Electron Microscopy (HR-TEM) while structural properties and uniformity of the nanostructured thin films was evaluated by Infrared Microscopy (IRM), Differential Thermal Analysis (DTA) and X-ray Diffraction (XRD). Antimicrobial efficiency of fabricated thin films was tested with respect to the biofilm development of Gram-positive and Gram-negative reference strains. The obtained results demonstrated that thin films based on iron oxide nanoparticles and usnic acidexhibit efficient antimicrobial activity against adherent cells, especially on Gram-positive strains. The in vivo experiments, performed on holoxenic mice demonstrated their low cytotoxic impact. This report opens new perspectives in anti-infective therapy by creating surfaces with improved resistance to microbial colonization.

18:00 **Preparation, Structure, and Magnetic Properties of CuxNi1-xFe2O4 Nanoparticles for Biomedical Applications**

Authors : Nurca Dogan Bingobali, Zerin Yesil, Ayhan Bingobali, Meltem Asilturk
Affiliations : Gebze Inst. of Tech., Science Faculty, Dep. of Physics, 41400 Gebze-Kocaeli, Turkey Akdeniz Uni., Faculty of Arts and Sciences, 07058, Antalya, Turkey Yıldız Teknik University, Depart. of Bioengineering, 34220,Esenler-Istanbul,Turkey Akdeniz Uni., Materials Science and Engineering, 07058, Antalya, Turkey I.P1. 40
Resume : Abstract In the last few years, nanomaterials have emerged with interesting properties for new applications in nearly all areas of life. Particularly, SPIONs, i.e. nanosized superparamagnetic particles based on iron oxide,

became more and more interesting in medicine. For instance, SPIONs have successfully been used in cancer therapy and for contrast enhancement in magnetic resonance imaging (MRI). In this work, we were synthesized multicomponent of CuxNi1-xFe2O4 nanoparticles (where x = 0-1) by Pechini Method. CuxNi1-xFe2O4 nanoparticles were tried to observe effects of Cu/Ni ratios on magnetic and structural proper¬ties. The crystal structure of nanoparticles was characterized using X-Ray Diffraction (XRD) technique. The particle sizes of the samples were measured by Malvern Instruments Zeta Sizer Nano-ZS instrument. Magnetic properties of CuxNi1-xFe2O4 nanoparticles were carried out using Quantum Design Vibrating sample magnetometer (QD-VSM) and Jeol Electron Spin Resonance (ESR) systems.

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18:00 **Fabrication of Direct ZrO2 Nano to Micro Patterns for UV Roll-to-Roll Imprint Stamp**

Authors : Soyoung Choo, Hak-Jong Choi, Ju-Hyeon Shin, Gyutae Kim, Bit-Na Go, Seok Hyun, Pil-Hoon Jung, Heon Lee*
Affiliations : Department of Materials Science and Engineering; Korea University

Resume : Roll-to-roll imprint lithography is one of the most promising next-generation patterning technology with various advantages, such as simple process, high throughput, low cost, and large-area fabrication. In order to be adopted to the mass production industry, several problems, including fabrication of roll stamp for nanopatterning, and optimized resist, need to be solved. Especially, fabrication of nanoscale roll stamp is important to produce the nanoscale devices using roll-to-roll imprint technology. However, it is difficult to fabricate the roll stamp with nanocale features due to their inherent curvatured surface. Several research groups have fabricated the roll stamp by attaching the flexible mold, consisted of thin metal foils or patterned polymer films on cylinderical roll surface. This method has adhesion and stitch mark issue and has limited endurance. The other method is direct patterning on cylindrical roll surface by e-beam or laser interference lithography, but it is high-cost procedure and took a long fabrication time. Therefore, new method to fabricate the roll stamp with low cost and high quality, is required. Herein, we introduce a methodology for fabrication of nanostructures on roll stamp using nanoimprint lithography. In this study, we used the polydimethylsiloxane(PDMS) as an polymeric mold. PDMS mold have some advantages such as high fidelity patternability, flexibility and high gas permeability. As an imprint resist, ZrO2 nanoparticle dispersed solution is used to form the ZrO2 nano-structures on the cylindrical roll surface. Due to optical band-gap of approximately 5.4 eV, ZrO2 can be used as roll mold for UV roll-to-roll imprint lithography. Besides, ZrO2 is well known as material with high mechanical hardness and elastic modulus, which enable to use at high pressure. In order to fabricate ZrO2 nano-pattern on the cylindrical roll, first, ZrO2 nanoparticle dispersed solution was spin-coated on the PDMS mold and it was attached onto quartz cylinder with conformal contact. Then, the cylinder is heated in order to evaporate solvent while the chamber is under vacuum to remove solvent. After detaching PDMS mold, ZrO2 nano-structure was formed on the quartz cylinder. The ZrO2 nano-structure was observed by scanning electron microscopy and hardness is investigated using nano-indentation method, before and after annealing. The hardness of ZrO2 nanostructure was 1.1 GPa and 6.8GPa, before and after annealing, respectively. In addition, as high as 91.8 % of transmittance was observed by UV-Vis spectroscopy, at 500nm. In particular, transmittance at the wavelength of 365 nm was as high as 92.3 %. According to measurement of mechanical and optical properties of ZrO2 nanostructure it can be used for roll stamp for UV roll-to-roll imprint lithography.

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18:00 **Direct Printing of Spin on Glass(SOG)/ZrO2 Composite Materials on Cylindrical Substrate for Roll-to-Roll Process**

Authors : Sang-Woo Ryu,Joong-Yeon Cho, Yang-Doo Kim,Sang-Jun Park,Ju-Hyuk Huh,Young-Hoon Seong, Heon Lee*
Affiliations : Department of Materials Science and Engineering; Korea University

Resume : Recently, large area and low cost are important issue in the field of optoelectronic devices and flexible optoelectronic devices are highly required in the sciences and industries due to their high usefulness. In order to fabricate these devices, photolithography is used as a patterning process, but this process has some limit for large area process because of equipment size. Consequently, to overcome these problems, new types of technologies should be suggested to form pattern in large area. Roll-to-roll process is one of the most attractive technologies to implement mass production. To commercialize roll-to-roll

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process, it needs a proper resist, optimized system and fine patterned Roll stamp. In order to fabricate Roll stamp which has fine pattern, laser beam machining was used conventionally. However laser beam machining has a limitation of resolution which can be micro meter scale. In this study, we demonstrate the direct printing technique in order to fabricate the robust roll stamp. To fabricate roll stamp, HSQ which is called Spin on glass (SOG) material and ZrO2 nanoparticle dispersed in Methyl isobutyl ketone(MIBK) resin were used. By using flexible Polydimethylsiloxane(PDMS) as a mold, it is possible to pattern on cylindrical substrate. SOG/ZrO2 composite materials were spin-coated on PDMS mold. Then, cylindrical substrate is rolling on the PDMS mold. During the rolling process, solvents were absorbed and patterns were printed on curved surface. Next, UV/ozone was used to rigidify by oxidation of the surface on pattern. Then, patterns were annealed to covert from HSQ to SiO2. After annealing process, characteristic analysis was done by Scanning electron microscopy(SEM), Energy-dispersive X-ray spectroscopy(EDX) Nanoindentor test, pencil test, Scanning Auger Microscopy, and refractive index test. Analysis of patterned fidelity by SEM, it has 250nm height and 600nm pitch of line pattern is formed. At nanoindentation test, value of hardness HSQ with ZrO2 nanoparticle thin film had increment with the annealed temperature increased. The highest hardness value is 1.394GPa, at 700℃ annealed. At the pencil test which can evaluate adhesion of thin film HSQ with ZrO2 stamp shows 6H adhesion on glass substrate. By using direct printing technique, it is acknowledged to use as cylindrical mold on Roll-to-Roll process.

add to my program (close full abstract)

18:00 **TiO2 oxide-based gas sensor on random PAN fibremesh**

Authors : Kathriin Utt, Kati Kongi, Urmas Joost, Marko Eltermann, Sven Lange
Affiliations : Institute of Physics, University of Tartu, Riia 142, 51014, Tartu, Estonia

Resume : The gas sensing properties of TiO2 are attractive for preparing inexpensive solid state sensor for a wide variety of gases via electric or more lately by optical or photoluminescence (PL) response [1]. As a gas sensor 3D matrices composed of 1D nanostructures like fibres have the advantage of high surface-to-volume ratio over conventional planar materials like thin films. Electrospinning is a cost effective and versatile method for producing uniform polymer fibre meshes in large quantities with typical fibre diameter below 1 micron. In the present work the preparation and oxygen sensing properties of Sm3+ doped TiO2 coated polymer fibre meshes are investigated. Electrospun polyacrylonitrile (PAN) nanofibre meshes with the average fibre diameter of ~500 nm were prepared and successfully coated with a thin layer sol-gel preparedTiO2 film doped with Sm3+ions.The prepared PAN fibre meshes were treated with oxygen plasma prior to the coating to increase the surface hydrophilicity for better wetting of the polymer fibre surface by the TiO2 precursor solution. SEM analysis equipped with energy dispersive X-ray detector (EDS) was used to qualitatively identify the effectiveness of the coating process. XPS was used to characterize the surface chemistry of the plasma-treated polymer fibres to optimize the plasma pre-treatment.The sensory response of the materials was characterized by PL intensity of the Sm3+dopant ion. 1.T. Tachikawa, et al., Angew Chem Int Ed 2008, 47, 534

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add to my program (close full abstract)

18:00 **High-angle annular dark field (HAADF) electron microscopy studies on mixed oxide nanoparticles**

Authors : M. Albu 1); U. Brossmann 2); F. Hofer 1); R. Würschum 2)
Affiliations : 1) Institute for Electron Microscopy and Nanoanalysis, Graz University of Technology, Steyrergasse 30, 8010 Graz, Austria; 2) Institute of Materials Physics, Graz University of Technology, Petersgasse 16, 8010 Graz, Austria

Resume : Nanostructured mixed oxide materials based on Y2O3 and ZrO2 are of great interest for basic research and technical applications both in view of tailoring their microstructural and functional properties, as, e.g., luminescence [1]. A key question concerns the characterization of the structure and composition of these materials on the nano-scale of individual particles. Advanced electron microscopes, which combine high-resolution STEM and high angle annular dark field imaging, provide an ideal tool for these studies. Nano-particulate powders of Eu2O3-doped Y2O3 and Al2O3:ZrO2 composites with a low degree of agglomeration, a mean size well below 10 nm and a narrow size distribution were synthesized from metal organic precursor using a microwave plasma process. The specimen were ultrasonically redispersed and studied – in condition as made or after additional annealing at 650°C in air - by HR-TEM using a FEI Titan microscope. In case of the Eu2O3:Y2O3 specimen, our analytical TEM studies confirm the formation of mixed oxide nano-crystals with a

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cubic lattice structure. The Al2O3:ZrO2 samples show a composite structure dominated by generally ZrO2-rich grains (d ≤ 5 nm) with a cubic crystal structure embedded in an amorphous matrix. Structural analyses on the nano-scale of individual grains show, that also monoclinic grains of both constituents and two-phase grains are formed. [1] A. Kautsch, U. Brossmann, H. Krenn, F. Hofer, D.V. Szabó, R. Würschum: Applied Physics A 105 (2011) 709-712.

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18:00 **Nanopatterning of a copper surface.**

Authors : S.Nedilko, S.Rozouvan.
Affiliations : Taras Shevchenko National University of Kyiv, Physics Dept. pr. Acad. Glushkova 2, Kyiv, Ukraine

Resume : Scanning microscopy proved to be not only a basic experimental technique for surface nanogbjects studies but also allows to perform samples nanopattening. In this paper conducting contact atomic force microscopy (AFM) was applied by us to etch a raster nanostructure on a polished copper surface. Microscope INTEGRA NT-MDT, allowed us to conduct measurements in atomic force microscopy and tunneling microscopy regimes and has been used for precise surface topology study. By applying needles covered by a metal we were able to perform nanolithography in contact AFM mode. The fabricated pattern at the nanometer scale was studied by semicontact atomic force microscopy and high resolution scanning tunneling microscopy. The latter was performed with spatial resolution 4 nm. The nanoislands forming the raster structure and measured by STM were filled with products of copper oxidation. STM measurement determined the type of nanoislands conductivity by registering tunneling electrons emitted from the nanoislands bottom parts.

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18:00 **Hydrothermal preparation of labyrinth shaped WO3 microcrystals**

Authors : Éva Karácsonyi-1, Zsolt Pap-1,2,3 , Gábor Kovács-2,3, Lucian Baia-3, Virginia Danciu-2, András Dombi-1, Klára Hernádi-4
Affiliations : 1-Research Group of Environmental Chemistry, Institute of Chemistry, University of Szeged, H-6720, Szeged, Tisza Lajos krt. 103, Hungary; 2-Faculty of Chemistry and Chemical Engineering, Babes-Bolyai University, Arany János 11, RO-400028 Cluj-Napoca, Romania; 3-Faculty of Physics, Babes-Bolyai University, M. Kogălniceanu 1, RO-400084 Cluj-Napoca, Romania; 4-University of Szeged, Applied and Environmental Chemistry Department, H-6720 Szeged, Rerrich B. tér 1, Hungary;

Resume : Nowadays the synthesis of photocatalytic materials is a major research field in materials science. There are many semiconductor oxides and composites, which it can be successfully applied as a highly active photocatalysts. Labyrinth shaped tungsten oxide nanoparticles were obtained by hydrothermal crystallization, where the precursors were AMT (ammonium metatungstate) and sodium-tungstate. FMWCNTs (functionalized multiwall carbon nanotubes) were used as a crystallization promoter, while the time of the crystallization was adjusted to1, 5 and 24h. These photocatalysts were used successfully for degradation of organic pollutants in water. The oxalic acid and phenol degradation mechanisms were investigated in the liquid phase. The WO3 crystals' structure was studied by SEM, TEM, XRD, DRS. To achieve the best and the most accurate information about degradations mechanism, XPS was used for studying photocatalysts' surface chemistry. Acknowledgements: The authors express their gratitude to project number PN-II-ID-PCE-2011-3-0442. and to the Swiss Contribution (SH/7/2/20) for providing financial support. Éva Karácsonyi: „This research was realized in the frames of TÁMOP 4.2.4. A/2-11-1 -2012-0001 „National Excellence Program – Elaborating and operating an inland student and researcher personal support system convergence program" The project was subsidized by the European Union and co-financed by the European Social Fund."

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18:00 **MAPLE fabricated magnetite@eugenol and poly lactic acid - chitosan coated surfaces with anti-staphylococcal properties**

Authors : Alexandru Mihai Grumezescu1, Ecaterina Andronescu1, Alina Maria Holban2, Laurentiu Mogoanta3, George Dan Mogosanu4, Gabriel Socol5*, Valentina Grumezescu1,5, Bogdan Stefan Vasile1, Anton Ficai1, Roxana Trusca6, Florin Iordache7
Affiliations : 1Department of Science and Engineering of Oxidic Materials and Nanomaterials, Faculty of Applied Chemistry and Materials Science, University Politehnica of Bucharest, 1–7 Polizu Street, 011061 Bucharest, Romania 2Microbiology Immunology Department, Faculty of Biology, University of Bucharest, 1–3 Portocalilor Lane, Sector 5, 77206 Bucharest, Romania 3 Research Center for Microscopic Morphology and Immunology, University of Medicine and Pharmacy of Craiova, 2 Petru Rareş Street, 200349 Craiova, Romania 4Department of Pharmacognosy & Phytotherapy, Faculty of

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Pharmacy, University of Medicine and Pharmacy of Craiova, 2 Petru Rareş Street, 200349 Craiova, Romania 5Lasers Department, National Institute for Lasers, Plasma & Radiation Physics, P.O. Box MG-36, Magurele, Bucharest, Romania 6S.C. Metav-CD S.A., 31Rosetti Str., 020015 Bucharest, Romania 7Institute of Cellular Biology and Pathology of Romanian Academy, "Nicolae Simionescu", Department of Fetal and Adult Stem Cell Therapy, 8, B.P. Hasdeu, Bucharest 050568, Romania

Resume : The prepared magnetite@eugenol (Fe3O4@E) nanostructures have been embedded into poly lactiac acid - chitosan (PLA-CS) microspheres by oil-in -water emulsion technique. Functionalized PLA-CS-Fe3O4@E microsphere coatings have been fabricated by Matrix Assisted Pulsed Laser Evaporation (MAPLE). Thin films have been characterized by Transmission Electron Microscopy (TEM), Scanning Electron Microscopy (SEM) and Infrared Microscopy (IRM). Their anti-microbial effect was quantified on Staphylococcal biofilm formation by viable count technique. Their biocompatibility has been established in vitro by analyzing the phenotypic changes of cultured eukaryotic cells and in vivo by testing their effects on holoxenic mice. Besides their excellent anti-adherence and anti-Staphylococcus biofilm formation, these MAPLE-deposited thin films presented the advantages of using bioactive natural compounds, which are being less toxic and easily biodegradable than synthetic antibiotics. This approach could be a successful method to control and prevent microbial biofilms associated infections and may be also used as an alternative strategy to limit the consumption of synthetic anti-microbial drugs in order to decrease the rates of microbial resistance to antibiotics.

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18:00 **Synthesis of ZnO/ZnS core shell structures from sulfurization of ZnO nanorod arrays for new superstrate solar cells architectures**

Authors : J. López-García 1, W. Ohm 2, X. Fontané 1, V. Izquierdo-Roca 1, W. Riedel2, S. Gledhill 2, E. Saucedo 1, M. Ch. Lux-Steiner 2, A. Pérez-Rodriguez 1,3.
Affiliations : 1 Catalonia Institute for Energy Research (IREC), C. Jardins de les Dones de Negre 1, 08930 Sant Adrià de Besòs (Barcelona), Spain; 2 Fachbereich Physik, Freie Universität Berlin (FUB), Arnimallee 14, 14195 Berlin, Germany; 3 IN2UB, Department of Electronics, University of Barcelona, C. Martí i Franquès 1,08028 Barcelona ,Spain

Resume : Development of new cell architectures and concepts is essential to increase the thin film solar cell performance to be competitive with other technologies. In this way, nanostructured materials like ZnO nanorod arrays (NRA) for higher efficiency devices have revealed to be a very promising alternative. Besides, it is well know that the development of Cd-free buffer layers in CIGS-based solar cells is a main objective from the industrial point of view. In this framework, this work reports on the ZnS layer formation by the partial chemical conversion of ZnO nanorod arrays (NRA) by a simple sulfurization with elemental sulfur to be used as buffer layer in superstrate devices. ZnO nanorod arrays with different nanorod length have been electrodeposited on fluorine-doped tin oxide (FTO) coated soda lime glass substrates (SLG). The effect of sulfurization time has been studied and the sulfurized samples have been characterized by Raman Spectroscopy, X-Ray Diffraction, optical measurements and Scanning Electron Microscopy. ZnS buffer coatings were synthesized on ZnO nanorod arrays by a simple chemical conversion with elemental sulphur, preventing the total sulfurization of the ZnO NRA. The ZnS coating thickness can be estimated by Raman Spectroscopy and increases with sulfurization time with estimated grain sizes between 7-20 nm. The process seems to be kinetically limited, allowing for an accurate control of the ZnS thickness. The methodology allows obtaining ZnS/ZnO core shells structures for new cells architectures.

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18:00 **Poly(lactic-co-glycolic) acid/ chitosan microsphere thin films functionalized with stabilized Cinnamomi aetheroleum and magnetite nanoparticles for preventing the microbial colonization of medical surfaces**

Authors : Valentina Grumezescu1,2, Ecaterina Andronescu2, Gabriel Socol1, Alina Maria Holban3, Laurentiu Mogoanta4, George Dan Mogosanu5, Alexandru Mihai Grumezescu2, Bogdan Stefan Vasile2, Anton Ficai2, Roxana Trusca6, Florin Iordache7
Affiliations : 1Lasers Department, National Institute for Lasers, Plasma & Radiation Physics, P.O. Box MG-36, Magurele, Bucharest, Romania 2Department of Science and Engineering of Oxidic Materials and Nanomaterials, Faculty of Applied Chemistry and Materials Science, University Politehnica of Bucharest, 1–7 Polizu Street, 011061 Bucharest, Romania 3Microbiology Immunology Department, Faculty of Biology, University of Bucharest, 1–3 Portocalilor Lane, Sector 5, 77206 Bucharest, Romania 4 Research Center for Microscopic Morphology and Immunology, University of Medicine and Pharmacy of Craiova, 2 Petru Rareş Street, 200349 Craiova, Romania 5 Department of

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Pharmacognosy & Phytotherapy, Faculty of Pharmacy, University of Medicine and Pharmacy of Craiova, 2 Petru Rareş Street, 200349 Craiova, Romania 6S.C. Metav-CD S.A., 31Rosetti Str., 020015 Bucharest, Romania 7Institute of Cellular Biology and Pathology of Romanian Academy, "Nicolae Simionescu", Department of Fetal and Adult Stem Cell Therapy, 8, B.P. Hasdeu, Bucharest 050568, Romania

Resume : Poly(lactic-co-glycolic)acid (PLGA)/chitosan (CS) microsphere coatings functionalized with stabilized Cinnamomi aetheroleum (CA) essential oil and magnetite (Fe3O4) nanoparticles were deposited by Matrix Assisted Pulsed Laser Evaporation (MAPLE),in order to improve the surface resistance to microbial colonization. The chemical composition of CA was investigated by Gas Chromatography-Mass Spectrometry (GC-MS) analysis. (PLGA-CS-Fe3O4@CA) were obtained by an oil-in-water emulsion solvent evaporation technique. Microsphere thin films were characterized by Transmision Electron Microscopy, Scanning Electron Microscopy, Infrared Microscopy and Differential Thermal Analysis-Thermogravimetric Analysis. In vitro biocompatibility of MAPLE-deposited thin coatings has been tested by phenotypic assays for up to five days by qualitative and quantitative tests. In vivo tests were performed on holoxenic mice in order to evaluate the biodistribution of prepared microspheres. SEM and TEM analyses revealed the uniform morphology of thin films, while IRM has proved their homogeneity as well as their functional groups integrity. DTA-TG analysis has estimated the Cinnamomi aetheroleum content in the samples. Our results demonstrated that the (PLGA-CS-Fe3O4@CA) bioactive coatings significantly stabilized the esential oil and inhibited the microbial colonization on the medical surfaces, features that together with their high in vivo viability recommend these compounds for the development of anti-infective coatings for biomedical applications.

add to my program **(close full abstract)**

18:00 **Deposition of functional MgO films on ZrO2 microtubes**

Authors : Marko Part, Aile Tamm, Jekaterina Kozlova, Hugo Mändar, Tõnis Arroval, Tanel Tätte, Kaupo Kukli
Affiliations : Institute of Physics, University of Tartu, Estonia

Resume : Sol-gel chemistry and atomic layer deposition (ALD) are both very promising methods in materials science, one for solution-based synthesis of nanostructured ceramic materials and another for very accurate deposition of different metals and oxides. In recent years combining of those different disciplines have attracted considerable scientific interest as a promising candidates for preparation of multifunctional nanocomposite materials. In this study we describe ALD of MgO films on the basis of surface modification of nanocrystalline yttria stabilized zirconia (YSZ) microtubes.The films were grown from β-diketonate-type precursor Mg(thd)2 at 250 and 300 °C on the surface of YSZ microtubes prepared by sol-gel processing. Mg(thd)2 was evaporated at 104 °C from an open boat inside the reactor. Nitrogen was used as both carrier and purging gas and O3 was used as oxygen precursor. The cycle times used for the growth of MgO were 5-2-5-5 s for the sequence Mg(thd)2 pulse-purge-O3 pulse-purge. The tubes were obtained by novel route via hydrolysis of zirconium butoxide (Zr(OBu)4) with large excess of water. MgO was used because of its high chemical and thermal stability and secondary electron emission properties with the intention to use MgO-covered microtubes for plasma chamber applications.

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add to my program **(close full abstract)**

18:00 **Synthesis and Magnetic Studies on Sol-gel derived NaFe(WO4)2¬ Sub-micron Rods**

Authors : A.Durairajan a, b, E. Venkata Ramana b, M.A. Valente b* and S. Moorthy Babu a
Affiliations : a) Crystal Growth Centre, Anna University, Chennai- 600025, India b)I3N-Aveiro, Department of Physics, University of Aveiro, Aveiro 3810 193, Portugal

Resume : The double molybdates and tungstates have a general formula of A+B3+(XO4)2 , where A+ is a alkali-metal ion, B3+ is a rare-earth or transition -metal ion, and X is molybdenum or tungsten. They are used for the fabrication of white light-emitting diodes (WLEDs) showing high chemical stability, energy-saving and safety. In this group of materials NaFe(WO4)2 (NFW) belongs to the monoclinic structure with a space group P2/c. As NFW serves as a host material to introduce rare-earth ions for laser generation, it is important to study detailed physical properties. Here, we present details on synthesis, structural and magnetic properties NFW. NaFe(WO4)2 sub-micron rods were synthesised by sol -gel method at lower temperatures compared to the conventional solid state reaction method. Differential thermal analysis (DTA), powder X-ray diffraction (XRD), field emission scanning electron microscopy (FE-SEM), Raman analysis

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and vibration magneto meter studies (VSM) were used to characterize the obtained powder. The crystallization temperature and melting points were premeditated in DTA. XRD analysis confirmed the formation of single phase NFW with monoclinic structure. The rod shaped surface morphology was seen in FE-SEM. The formation of tungsten band and its vibrations were observed in Raman analysis. Temperature (2-300K) and magnetic field (10T) dependent magnetization of NFW indicate a paramagnetic nature at room temperature and antiferromagnetic order below 10 K.

add to my program (close full abstract)

18:00 **New easy two step process for iron oxides nanorods elaboration**

Authors : N. Ballot A. Gaul F. Schoenstein S. Mercone Ph. Boullay N. Jouini
Affiliations : Laboratoire des Sciences des Procédés et des Matériaux, CNRS, LSPM – UPR 3407, Université Paris 13, PRES Sorbonne-Paris-Cité, 99 Avenue J.-B. Clément, 93430 Villetaneuse, France Laboratoire de Cristallographie et Sciences des Matériaux, CRISMAT - UMR6508 CNRS / ENSICAEN, 6 Bd du Maréchal JUIN 14050 Caen Cedex 4 - FRANCE

Resume : We focus on the development of a easy and low coast " two-step-process " allowing to obtain single crystal iron oxides nanorods. The originality of the project is to combine a soft chemistry technique assisted by a high magnetic field (up to 1Tesla) with calcination under hydrogen. The first step allows the elaboration of an iron intermediate nanometric phase presenting a one-dimensional morphology. The second one allows the reduction of the intermediate phase to iron oxides nanorods. The first goal of this work is to control the morphology, size and magnetic anisotropy of iron-based phase by the magnetic field assisted polyol synthesis. The second goal is to obtain iron oxides nanorods with controlled morphology and size at a nanometric scale. We will show structural and magnetic properties of the β-FeOOH intermediate phase and their peculiar one-dimensional organisation obtained using the magnetic field assisted polyol elaboration. We then present how the soft reduction conditions (300°C during 6h in hydrogen atmosphere) lead to mono-disperse iron oxides nanorods showing single crystal structure and homogeneous size distribution. In order to confirm the magnetic behaviour of the iron oxides phase, we studied the nanorods static magnetic behaviour by VSM measurements.

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18:00 **Biomimetic synthesis and characterization of silica-coated ceria nanospheres**

Authors : I.Kitsou, A. Tsetsekou, School of Mining and Metallurgical Engineering N.T.U.A, Iroon Polutexneiou 9, 157 80 Athens
Affiliations : I. Kitsou; A. Tsetsekou School of Mining and Metallurgical Engineering N.T.U.A, Iroon Polutexneiou 9, 157 80 Athens

Resume : Core-shell nanomaterials are of great interest in many applications, such as, for improving the chemical stability of colloids, for band structure engineering, biosensing, and drug delivery. They can be also employed to reduce the cost of an expensive material as only a small amount of the expensive material can be used to cover a cheap core. In this work silica-alumina nanospheres, consisting of silica cores and alumina nanoshells were prepared via a novel hybrid sol-gel templating route employing hyperbranched polymers. First, organic-inorganic silica cores were prepared through the hydrolysis-condensation reaction of silicic acid in the presence of hyperbranched polyethylenimine followed by repeating washing and centrifugation steps. To create the core-shell structure, the as-received silica cores were redispersed in ammonia/acetic acid buffer at pH 4,5 and a second Ce-containing solution was added drop-wise under continuous stirring. The latter was prepared by dissolving cerium nitrate in water. The final sol was kept under stirring for 5 minutes and then it was centrifuged, washed with water and dried at 40oC. The hybrid material was characterized by Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM), X Ray Diffraction Analysis (XRD), Fourier transform infrared spectroscopy (FTIR), z-potential and N2 adsorption measurements. The analysis revealed the formation of homogeneous core-shell nanoparticles with uniform particle size distribution.

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18:00 **Polyimide Nanocomposite: Synthesis, properties and applications**

Authors : A. A. Ebnalwaled
Affiliations : Electronics & Nano Devices Lab., Physics Department, Faculty of Science, South Valley University, Qena, 83523 Egypt Corresponding author: e-mail: kh_ebnalwaled@yahoo.com

Resume : Polyimide play very important role in many new products (e.g. electronic components, optical films, aircraft engines, aerospace and

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automobiles) and applications, (e.g. biomedical, electrical/electronic/optoelectronic and fuel cell applications). In this paper, the thermal imidization method was used for synthesis of polyimide nanocomposits; different types of nanoparticles (CuS, CdS, TiO2, CuS/ TiO2 and CdS/ TiO2) have been studied to understand the interaction between nanoparticles and polyimide matrix. Morphology, microstructural, thermal and optical properties of the polyimide nanocomposits were monitored by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), X-ray diffraction (XRD), Thermogravimetric analysis (TGA), and UV-visible spectrophotometry. The effects of the used nanoparticles in different properties were evaluated, and the suitable applications were suggested

add to my program (close full abstract)

18:00 **Growth of LaxSr(1-x)MnO3 thin films on insulating substrates by means of a sol -gel process**

Authors : an Lettens, Pia Homm, Mariela Menghini, Vijay Shankar Rangasamy, Savitha Thayumanasundaram and Jean-Pierre Locquet
Affiliations : 1Dept. of Physics and Astronomy, KU Leuven, Leuven, Belgium

Resume : Lanthanum strontium manganite is an oxide ceramic perovskite. It has been shown to be a ferromagnetic halfmetal which also displays a colossal magnetoresistance effect, depending on its structure and composition. This study aims to explore the deposition of thin films of LaxSr(1-x)MnO3 via a sol-gel process. Sol-gel does not require expensive deposition equip-ment nor extreme reaction conditions and is able to control the stoichiom-etry of the material precisely. We aim to thoroughly examine and identify promising combinations of precursor (inorganic, metal organic) and polymer (assists the deposition process). More specifically, we study the sol-gel process by varying an array of parameters such as spin coat parameters, process temperatures, substrate surface treatments, sol pH, concentration, viscosity etc. Because of the large amount of parameters, the first methods to quickly assess the quality of fabricated films focus on gauging the density, ordering, thickness, phases and stoichiometry. SEM, XRD and EDS will be mainly used to assess these properties. Next the magnetoresistance and the magnetization of the films are determined as a function of temperature and magnetic field.

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18:00 **Synthesis and Characterization of TiO2: Pt thin films by Sol-Gel method**

Authors : Erik R. Morales, Diaz-Flores L.L. , D.Martinez-Hernandez. , G.Perez-Hernandez, N.R Mathews,*, F. Paraguay-Delgado, Omar S.Martinez , J.Pantoja-Enriquez.
Affiliations : 1 Universidad Juarez Autanoma de Tabasco, Avenida Universidad S/N, Col. Magisterial, Villahermosa, Tabasco 86040, Mexico. 2 Instituto de Energias Renovables, Universidad Nacional Autanoma de Mexico, 62580, Temixco, Morelos, Mexico: 3 CIMAV, Chihuahua, Mexico, 4 Centro del Cambio Global y la Sustentabilidad en el Sureste, Villahermosa Tabasco Mexico, 86080,5Centro de Investigacion y Desarrollo Tecnologico en Energias Renovables, UNICACH, Libramiento Norte No. 1150, Tuxtla Gutierrez, Chiapas 29039, Mexico

Resume : Thin films of TiO2 and TiO2:Pt were deposited by sol-gel dip coating technique. The sol was prepared with different concentrations of Pt: 0, 0.2, 0.5, and 1 wt%. The films were characterized for its optical, morphological and electrical properties The electrical resistivity in the dark and light were measured. The results from XRD analysis showed that the as-deposited films are amorphous and after annealing at 550oC in air for 1 hour, the films changed to anatase phase. The crystalline size was in the range of 16-20 nm. The resistivity of the films was observed to decrease considerably with the incorporation of Pt, however, no change in band gap was observed due to the incorporation of Pt. The incorporation of Pt was confirmed with the TEM analysis of TiO2: Pt films. The surface roughness of TiO2 and TiO2:Pt films were estimated at 3.37 and 2.87 nm respectively.

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18:00 **Crystallization of titania sol-gel coatings on different substrates**

Authors : Bozena Pietrzyk, Sebastian Miszczak
Affiliations : Institute of Materials Science and Engineering, Lodz University of Technology, Poland

Resume : Titanium dioxide (TiO2) is an important material because of its photocatalytical, self-cleaning, anti-corrosion, optical, and biomedical applications. TiO2 can be synthesized as amorphous or as two main polymorphs: metastable anatase and stable rutile. The properties of titanium dioxide strongly depend on the kind of phases. The transformation temperature between phases is influenced by a lot of factors like method of preparation, impurities, size of grains etc. One of them may be the type of substrate under

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TiO2 film. In the present work, thin films of TiO2 were deposited by sol-gel method. Silicon (Si), austenitic stainless steel (304) and Co-Cr-Mo alloy (Vitallium) were used as substrates. The temperature of crystallization as well as temperature of anatase-rutile phase transformation were investigated by X-Ray Diffraction (XRD) studies of films on different substrates. The results were compared with transformations temperature of TiO2 powders obtained by analogous sol-gel process. It was found that crystallization of anatase phase occurred in all investigated cases at the similar temperature. On the other hand, the temperature of anatase-rutile phase transformation changed from 600-700oC for sol-gel powder to more then 1000oC for film deposited on Si. Thus, the temperature of anatase-rutile phase transformation strongly depends on kind of substrate, which should be taken into account in the design and use of titania coatings.

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PROGRAM VIEW : 2014 Spring
MY PROGRAM : 2014 Spring

Symposium : I

Solution processing and properties of functional oxide thin films and nanostructures

26 May 2014 | **27 May 2014** | 28 May 2014 | 29 May 2014 | 30 May 2014

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start at	Subject	Num.
	Synthesis II: Low temperature synthesis : Narcis Mestres	
08:30	**Very low temperature wet-chemistry colloidal routes for mono- and polymetallic nanosized crystalline inorganic compounds** **Authors :** Stefano Diodati[a,b], Paolo Dolcet[a], Maurizio Casarin[a], Silvia Gross[a,b]* **Affiliations :** aDipartimento di Scienze Chimiche, Università degli Studi di Padova, via Marzolo, 1, I-35131, Padova, Italy bIstituto per l'Energetica e le Interfasi, IENI-CNR and INSTM, UdR, via Marzolo, 1, I-35131, Padova, Italy **Resume :** The use of low temperature and sustainable processes based on cheap and safe chemicals and not toxic solvents is a challenging issue in modern inorganic chemistry, and the obtainment of crystalline functional nanostructures at low or even room temperature is the goal of many synthetic efforts [1]. In this framework, in these last years, in our group we have developed different low temperature (T<150°C) wet chemistry routes to prepare different inorganic functional nanomaterials, ranging from i) ferrites [2] to pure and doped ii) metal oxides [3-5], sulphides [6] and halogenides, to iii) metal/metal oxide nanocomposites [7]. The adopted wet chemistry routes ranged from 1) miniemulsions [3-4, 7] to 2) coprecipitation combined with hydrothermal route [2] to 3) more classical colloidal routes [5-6]. This contribution provides an overview of the pros and cons of the proposed routes for the obtainment of targeted inorganic systems for applications in optical bioimaging or in energetics. [1] Cushing et al. Chem. Rev. 2004, 104, 3893-3946 [2] Diodati S. Synthesis and characterization of nanostructured ferrites Ph.D. Thesis, University of Padova, Italy 2013 [3] Dolcet et al. J. Mater. Chem. 2012, 22, 1620-1626 [4] Dolcet et al. Eur. J. Inorg. Chem. 2013, 13, 2291-2300 [5] Famengo et al. Eur. J. Inorg. Chem. 2009, 5017–5028 [6] Armelao et al. J. Nanosci. Nanotechnol. 2006, 6, 401-408 [7] Heutz et al. Nanoscale 2013, 5, 10534-10541	I.5. 1
	add to my program (close full abstract)	
09:00	**Low Temperature Deposition of NbOx/TiO2 Bi-Layer Films for Solar Cells Using Atmospheric Atomic Layer Deposition** **Authors :** Claire L. Armstrong (1), Kevin P. D. Musselman (2), David Munoz-Rojas (1,3), Judith L. MacManus-Driscoll (1) **Affiliations :** (1) Department of Materials Science and Metallurgy, University of Cambridge, 27 Charles Babbage Road, Cambridge, CB3 0HS, U.K.; (2) Department of Physics, University of Cambridge, JJ Thomson Avenue, Cambridge, CB3 0H3, U.K.; (3) Instituto de Ciencia de Materiales de Barcelona, ICMAB-CSIC, Campus de la UAB, Bellaterra, 08193, Spain **Resume :** Metal oxides are promising candidates for low cost photovoltaic applications as they can be prepared in a variety of morphologies through a wide range of low temperature processing methods. One such method is atmospheric atomic layer deposition (AALD), a novel adaptation of the conventional ALD technique. Instead of separating each precursor stage in time, AALD separates them spatially, whereby a 'head' containing distinct channels for different precursors scans across the substrate, essentially 'printing' an oxide film. A variety of metal oxide films can be deposited by AALD, with this study having focused on the use of a niobium oxide (NbOx) interlayer to enhance the photovoltaic performance of hybrid organic-inorganic and colloidal quantum dot solar cells. Both the NbOx (~20 nm) and TiO2 (~70 nm) films were deposited in under 10 minutes in a scalable manner. By introducing the NbOx interlayer,	I.5. 2

improvements in the open circuit voltage and the short circuit current of the cells were observed. Such an enhancement illustrates the potential of AALD as a low temperature processing technique for the fabrication of low cost solar cells.

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09:15 **Low temperature solution combustion deposition of crystalline n-type doped ZnO**

Authors : H. Damm1,2, C. De Dobbelaere1, J. D'Haen3, A. Hardy1,2, M. K. Van Bael1,2
Affiliations : 1 Hasselt University, Institute for Materials Research, Inorganic and Physical Chemistry, and Imec Division Imomec, Agoralaan building D, 3590 Diepenbeek, Belgium 2 SIM (Flemish Strategic Initiative on Materials), SoPPoM program 3 Materials Physics, Institute for Materials Research, Hasselt University, Wetenschapspark 1, 3590 Diepenbeek, Belgium

Resume : N-type doped zinc oxide has been the subject of extensive research for the fabrication of transparent conductor applications. Within this field of transparent conductive oxides, solution based synthesis may provide mass production at a reasonable cost. Combustion processing is a possible candidate to enable even low temperature processing. Unlike conventional precursor systems, no external energy input is necessary in order to induce the endothermic oxide formation process. Combustion synthesis self-generates high local temperatures inside the decomposing precursor system. Here, different combustion precursors are developed either in 2-methoxyethanol or in water-based systems. Extensive thermogravimetric analyses are performed, optimizing the precursor systems to compositions resulting in an intense exothermic reaction, enough to drive the reaction rapidly to completion. Different fuels such as acetylacetone, citric acid, glycine and urea are explored to study their influence on the formation of doped ZnO transparent conducting oxides. Not only the influence of different reactants is being evaluated, but also different trivalent element doping with Al, Ga and In is related to the morphology and the formation of the film. In the end, crystalline films of doped ZnO are obtained at temperatures of 200°C or lower. C. De Dobbelaere is a postdoctoral fellow of the Fund for the Scientific Research Foundation Flanders (FWO).

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09:30 **Low-Temperature Processed Ga- and Al-Doped ZnO Coatings from Colloidal Inks**

Authors : Enrico Della Gaspera (1), Michela Cittadini (2), Alberto Salleo (3), Alessandro Martucci (2)
Affiliations : (1) CSIRO - Clayton - Australia; (2) Università di Padova - Italy; (3) Stanford University - USA

Resume : In this paper we present a new colloidal approach to synthesize zinc oxide doped with aluminum (AZO) or gallium (GZO) nanocrystals (NCs) showing transparency in the visible range and absorption in the near infrared. Doped ZnO colloids are synthesized through hot injection of suitable precursors in a mixture of organic amines. Substitutional trivalent ions (Al3+ or Ga3+) inside the ZnO wurtzite crystals trigger a plasmonic resonance promoted by the increase in free electrons concentration. These NCs can be dispersed in both polar and non polar solvents by using proper surface ligands, and deposited by spin coating, drop casting and spray coating resulting in homogeneous and high quality thin films. The effect of dopant type and concentration has been investigated analyzing the colloids morphology, the optical properties of the nanoparticles, and the optical and electrical properties of the deposited films. The optical transmission of the films in the visible is greater than 90%, and at the same time, the near-infrared absorption of the NCs is maintained in the films as well. Several strategies to improve the films performances are presented and discussed. The electrical resistance of the nanoparticle assemblies is about 30 kΩ/sq for the as-deposited and it drops down to 300 Ω/sq after annealing in forming gas at 450 °C, comparable with state of the art tin-doped indium oxide coatings deposited from NC inks. These NC inks can be used to prepare active films for a variety of a

I.5. 4

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09:45 **Aqueous growth of ZnO thin films as a replacement for sputtered layers for inorganic photovoltaics**

Authors : Enrico Della Gaspera, Joel van Embden, Jacek J. Jasieniak
Affiliations : CSIRO Materials Science and Engineering, Bayview Ave, Clayton, VIC 3168 Australia

Resume : Solution processing of functional materials can provide a cheap, scalable and industrially viable alternative to vacuum-based depositions, provided that the quality and properties of the prepared materials are comparable. In this view, we show how dense ZnO thin layers can be deposited using an aqueous bath method: films with thickness down to 100 nm and

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porosity within only 4% difference compared to sputtered dense coatings are obtained. Despite the low-temperature, solution-based deposition method, these layers possess a morphology comparable to sputtered films, with vertically oriented crystalline grains. We present a detailed investigation of the parameters involved in the growth of oriented and packed ZnO pillars, and a complete characterization of the dense films, which show bulk-like optical properties and absence of organic contaminants or dopants; on the contrary, other solution processed ZnO coatings (from nanoparticles or sol-gel solutions) are porous, contain carbon contaminants and are inherently n-type doped. These ZnO films are tested as buffer layers within inorganic CZTSSe solar cells prepared using a nanocrystal ink route, obtaining identical performances compared to devices incorporating sputtered ZnO: this aqueous deposition method constitutes a step forward towards the realization of fully solution processed inorganic solar cells using earth abundant materials, with low-cost and low-toxicity processes.

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10:00 **Coffee & tea**

Electronic materials : Silvia Gross & Barbara Malic

10:30 **Solution Processed Metal-Oxides for Organic Electronics**

Authors : Thomas Riedl
Affiliations : Institute of Electronic Devices, University of Wuppertal, Rainer-Gruenter-Str. 21, 42119 Wuppertal, Germany

Resume : Metal-oxides have evolved as powerful interface materials that facilitate charge injection/extraction into/out of organic devices. E.g., transition metal oxides like WO3, MoO3, V2O5 etc., with extremely deep lying electronic levels and a work function (WF) of up to 7 eV can make a favorable electronic match even to organic materials with very deep HOMO levels. Thereby, substantially enhanced device characteristics of organic light emitting diodes, organic solar cells (OSCs), and organic field-effect transistors have been achieved along with a significant improvement in lifetime. On the cathode side, metal oxides with a lower WF, like ZnO, TiOx and SnOx can be used. Some recent progress to prepare metal-oxides from solution at low temperatures will be highlighted. Aside from fundamental studies of their electronic structure, their application especially in OSCs will be presented. Furthermore, the realization of In-free transparent conductive layers based on composites of silver nanowires and solution processed conductive metal-oxides will be shown. The metal-oxide conductively joins the wires and also to 'glues' them to the substrate. As a result, a low sheet resistance down to 5.2 Ohm/sq. is achieved with a high average transmission of 87%. These In- and PEDOT:PSS-free hybrid layers are successfully implemented as transparent top-electrodes in efficient all -solution-processed semitransparent OSCs.

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add to my program (close full abstract)

11:00 **Solution synthesis of metal oxide nanoparticles for ex-situ pinning in YBa2Cu3O7-x (YBCO) superconductors**

Authors : Katrien De Keukeleere, Jonathan De Roo, Hannes Rijckaert, Jonas Feys, Isabel Van Driessche
Affiliations : Ghent University, Department of Inorganic and Physical Chemistry, Krijgslaan 281 S3, 9000 Ghent, Belgium

Resume : The solution processing of YBa2Cu3O7-x (YBCO) coated conductors is already extensively studied, but the critical current density Jc remains too low for applications in high magnetic fields. This can be circumvented by the incorporation of inert metal oxide nanoparticles (NPs) in the layer. However, it is very challenging to synthesize these inert metal oxides (ZrO2, HfO2, BaZrO3 …) as monocrystalline and monodisperse NPs (d < 10 nm) in a reproducible manner. We compared two different synthesis routes for ZrO2 nanocrystals for the incorporation in an YBCO coated conductor. Firstly, we make use of a microwave method using benzyl alcohol and ZrCl4, similar to the microwave-assisted synthesis of HfO2 NPs.[1] Aggregates of monoclinic ZrO2 NPs (4.5 nm) are obtained after 4 hours at 220°C. Post-modification of the NPs with dodecanoic acid and oleylamine breaks the aggregates into individual NPs, rendering them dispersible in nonpolar solvents. Secondly, we make use of a heating-up method using ZrCl4 and Zr(OiPr)4 as precursors and trioctylphosphine oxide as ligand and solvent. Here, a higher temperature (340°

I.6. 2

C) and lower reaction time (2h) are used. Cubic ZrO2 NPs (3-4 nm) are synthesized, agglomeration-free and readily dispersible in nonpolar solvents. Both methods gives rise to crystalline ZrO2 NPs, but to a different surface chemistry. This diversity allows us to adopt different strategies for the transfer to a YBCO precursor solution. [1] J. De Roo, J. Nanopart. Res. (2013)

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11:00 **Solution-processed TFTs with aqueous based Al2O3 gate dielectric obtained by auto-combustion synthesis** I.6. 3

Authors : Rita Branquinho, Daniela Salgueiro, Pedro Barquinha, Luís Pereira, Rodrigo Martins, Elvira Fortunato
Affiliations : CENIMAT/I3N, Departamento de Ciência dos Materiais, Faculdade de Ciências e Tecnologia (FCT) Universidade Nova de Lisboa (UNL) and CEMOP/UNINOVA, Campus de Caparica, 2829-516 Caparica, Portugal

Resume : Solution processing has been recently developed towards the fabrication of low-cost and low temperature flexible electronics. In this context many research efforts have been applied to solution processible semiconductors while solution processed dielectrics are now at the beginning. Recently, solution-based combustion synthesis has been applied for the production of indium, tin and zinc oxide thin films. This synthetic method takes advantage of the chemistry of the solution precursors as a source of energy for localized heating. The exothermic reaction generates energy that can convert precursors into oxides which reduces the processing temperature. Theoretically this reaction mechanism can be applied to any metal ion to produce the desired oxide. In this work report the aqueous solution combustion synthesis of aluminium oxide using urea as oxidant and study the influence of the synthetic parameters on the thin films properties. Chemical, morphological, structural and electrical characterizations were performed the produced aluminium oxide thin films. Optimized films demonstrated high capacitance and permittivity of 7.1. Solution processed TFTs produced with optimized aqueous-based Al2O3 thin films as gate dielectric and solution processed GZTO semiconductor thin films yielded good performance at low working voltages. The properties of these devices and the influence of precursor solution's characteristics are presented and will be discussed.

add to my program (close full abstract)

11:30 **Effect of Film Thickness on Microstructure and Dielectric Properties of Ba0.5Sr0.5TiO3 Thin Films Prepared by Chemical Solution Deposition** I.6. 4

Authors : Tanja Pecnik1,2, Sebastjan Glinšek3, Brigita Kmet1,4, Barbara Malic1,2,4
Affiliations : 1Electronic Ceramics Department, Jožef Stefan Institute, Ljubljana, Sloveni; 2Jožef Stefan International Postgraduate School, Ljubljana, Slovenia; 3School of Engineering, Brown University, Providence, USA; 4Centre of Excellence SPACE-SI, Ljubljana, Slovenia

Resume : Barium strontitum titanate BaxSr1-xTiO3 with the compositions in the paraelectric phase at the operating temperatures, but nevertheless close above the Curie temperature, exhibits high dielectric permittivity and high tunability but also low dielectric losses at microwave frequencies. Ba0.5Sr0.5TiO3 thin films were prepared from solutions based on earth-alkaline acetates and Ti-alkoxide in organic solvents. The films were deposited on alumina substrates by spin-coating and heated after each deposition at 900 °C. For investigation of dielectric properties in the kHz range, co-planar capacitors were patterned by lift-off photolithography and sputtering of Cr/Au and the split-post dielectric resonators were used for measurements in the GHz range. According to the XRD, the films with thicknesses from 90 nm to 170 nm crystallized in a randomly oriented perovskite phase. With increasing film thickness the grain size increased from ~ 40 nm to ~ 80 nm as revealed by FE-SEM and AFM. The dielectric permittivity of the films increased with increasing film thickness, from 650 to 1300 at 100 kHz for 90 nm and 170 nm thick films, respectively. The permittivity and losses of the 170 nm thick films at 15 GHz were 1200 and 0.15. In the contribution we discuss the relation between the microstructure and dielectric properties of the films. Acknowledgements: This work was supported by the Slovenian Research Agency (PR-05026 and P2-0105) and by the European Space Agency (Project FERRO-PATCH).

add to my program (close full abstract)

11:45 **Structure and properties of solution processed hafnium oxide gate dielectrics for their applications in high mobility ZnO based thin film transistors** I.6. 5

Authors : M. Esro, D. Afouxenidis, G. Vourlias and G. Adamopoulos*
Affiliations : M. Esro; D. Afouxenidis Lancaster University, Engineering Department, Lancaster LA1 4YR, United Kingdom. G. Vourlias; Physics Department, Aristotle

University of Thessaloniki, 54124 Thessaloniki, Greece G. Adamopoulos; Lancaster University, Engineering Department, Lancaster LA1 4YR, United Kingdom.
Resume : In recent years a wide variety of soluble precursors have been investigated as potential alternatives for the fabrication of oxide-based TFTs using large area deposition methods including spin casting, dip coating and spray pyrolysis. The ever increasing demand for high performance thin film transistors based on metal oxide channels has given a boost to the development of alternatives to SiO2 gate dielectrics with desirable characteristics in terms of thermal stability, band offset, interface quality and ability to control the FET's gate threshold voltage. Among these, ZrO2, HfO2, Y2O3 and Al2O3 are the most studied dielectrics and are widely considered to be excellent candidates because of their high dielectric constants, good thermal stability and large band gaps. This work reports on the structure and properties of spray pyrolysis-grown HfO2 thin films and their implementation in ZnO-based TFTs. The HfO2 films were found to be of monoclinic crystal structure with a band gap of 5.7 eV, dielectric constant as high as 19, very low leakage currents and dielectric breakdown in excess of 2.7 MV/cm. The related ZnO based TFTs exhibit excellent electron transport characteristics with negligible hysteresis, operating voltages in the range between 5-6 V, high electron mobility on the order of 40 cm2 V−1 s−1 and high current on/off ratio of about 10^7.

add to my program (close full abstract)

12:00 **Chemically improved high performance Solution processed indium gallium zinc oxide thin-film transistors**

Authors : Mohammed Benwadih*, Jan Chroboczek, Gerard Ghibaudo, Romain Coppard, Dominique Vuillaume.
Affiliations : CEA GRENOBLE IEMN-CNRS IMEP-LAHC
Resume : Amorphous oxide semiconductors (AOS) have attracted great attention for thin film transistors (TFTs) due to characteristics such as high mobility, device stability, and transparency [1,2]. Indium-Zinc based AOS (In-α-Zn0) have been synthesized with sol-gel methods and limited thermal budget (≤ 450°C) compatible with plastic substrates. We investigated, for a given In/Zn ratio of 0.5 in weight, the influence of the additional material, α, on TFT parameters. The best results were obtained using Ga and Sb (2% in weight) with a charge carrier mobility of 8.5 cm2v-1s-1and 7.8 cm2v-1s-1, respectively, a low Ioff current (10-11A), turn-on voltages of V0 = 0V and -3V and subthreshold swings of 0.4 and 0.6 V.dec-1(respectively). Additional experiments were performed to study the influence of the In/Zn ratio (from 0.5 to 4) on the TFT performances. The highest mobility is obtained by increasing the In concentration up to In/Zn =4, but Ioff and V0 tend to degrade to 10-4A and -8V [3]. The best compromise for optimal TFTs performances is obtained for In/Zn = 2.5, with a charge carrier mobility of 12 cm2V-1s-1 for α = Ga, Ioff = 10-11A and V0 = -2V. For all the α materials investigated here, we established general trends for the TFT parameters as function of the composition of the metal oxide. [1] Dongjo Kim et al, App. Phys. Lett. 95, 103501 (2009) [2] Sunho Jeong et al, J. Mater. Chem., 2012, 22, 1243 [3] J. Kang et al., Applied Surface Science 258, 3509– 3512 (2012).

I.6. 6

add to my program (close full abstract)

12:15 **Effect of Si on the electrical performance of Zn-Sn-O solution processed thin film transistors**

Authors : Jun Young Choi, SangSig Kim,Sang Yeol Lee
Affiliations : Microdevice Engineering, College of Engineering, Korea University, Seoul, 136-701 Republic of Korea
Resume : The improved performance of the oxide thin film transistors (TFTs) using silicon zinc tin oxide (SZTO) as active channel layer fabricated by solution process method has been reported and the electrical performance of SZTO TFTs were investigated depending on the silicon doping concentration in active channel layers. Silicon which has high binding energy with oxygen suppresses the creation of oxygen vacancy which can act as trap state in stability test. As incorporating Si atom in ZTO, the off-current was decreased and the threshold voltage was shifted toward positive direction. When silicon is doped in the SZTO TFTs, the characteristics exhibits enhanced threshold voltage shift of 7.8, while ZTO TFTs exhibit the threshold voltage shift of 24.6. The electrical properties of SZTO exhibit a mobility of 1.74 cm2 /V s, a threshold voltage of 0.98 V, an Ion/off ratio of 4.06 ? 107 and a subthreshold swing of 0.167

I.6. 7

add to my program (close full abstract)

12:30 **Lunch break**

Ferroelectric materials : Thomasz Riedl & Masahiro Yoshimura

14:00 **SYNTHESIS STRATEGIES IN SOLUTION FOR THE LOW TEMPERATURE PROCESSING OF COMPLEX OXIDE FERROELECTRIC THIN FILMS. OPPORTUNITIES OF FERROELECTRICS IN FLEXIBLE ELECTRONICS**

Authors : M.L.Calzada,* I.Bretos,* R.Jiménez,* J.Ricote,* D.Perez-Mezcua,* A.J.Perez-Rivero,* N.Salazar** and R.Sirera***
Affiliations : *Instituto de Ciencia de Materiales de Madrid (ICMM). Consejo Superior de Investigaciones Científicas (CSIC). Cantoblanco. E-28049 Madrid (Spain) **Nanotec Electrónica S.L., Tres Cantos, E-28760 Madrid (Spain) ***Departamento de Química y Edafología, Facultad de Ciencias, Universidad de Navarra, E-31008 Pamplona, Navarra (Spain)

Resume : Solution processable metal oxides come out as an enabling technology for the low-temperature preparation of high-performance layers on flexible plastic substrates. Major efforts are focused on semiconductors, where synthetic solution methods are investigated to reduce the temperature of formation of the oxide. Crystallinity improves the electric characteristics of the semiconductor oxides in comparison with amorphous ones. But, this is mandatory for the properties of some oxides. It is for inorganic ferroelectrics, where a non-centrosymetric crystal structure is responsible for the functional response. The handicap is their high crystallization temperature. However, the use of ferroelectrics in flexible devices would make real applications not possible before (e.g. smart skin, flexible sensitive displays) associated to their intrinsic multifunctionality. In this scenario, solution techniques offer the unique advantage of tailoring the solution chemistry to decrease the Gibbs free energy barrier for the formation of the oxide. Synthetic methods in solution will be shown in this talk to stabilize non-equilibrium phases at room temperature or to reduce the formation temperature of electronic oxide films (mostly ferroelectrics) directly on flexible plastic substrates. The properties of these films will be compared with those of the materials already used in flexible electronics (amorphous/nanocrystalline oxides and organic dielectrics). Financed by Spanish Project MAT2010-15365

I.7. 1

add to my program (close full abstract)

14:30 **Structure and dielectric properties of solution derived lead-free K0.5Na0.5NbO3 - SrTiO3 thin films**

Authors : Alja Kupec , Andreja Eršte, Vid Bobnar, Barbara Malič
Affiliations : Jožef Stefan Institute, Ljubljana, Slovenia

Resume : Sodium potassium niobate K0.5Na0.5NbO3 (KNN) is a promising candidate for environment friendly, lead free piezoelectric materials. Solid solutions of KNN with SrTiO3 (STO) in bulk ceramic form have been reported to exhibit ferroelectric or relaxor behavior, depending on the amount of the two constituent phases. In this work we report on the study of (1-x)KNN–xSTO, x = 0.025, 0.05, 0.075, 0.1, 0.15 and 0.25 thin films. The about 250 nm thick films were deposited from the acetate-alkoxide-based precursor solutions on Pt (111)/TiO2/SiO2/Si substrates. The formation of perovskite solid solutions was confirmed in all developed films. Increasing STO content decreased the monoclinic distortion, the volume of the unit cell and the degree of preferential (100) orientation in the films. We connect the latter to the differences in the average surface charges of the KNN and STO end-members. The microstructures of KNN-STO films consisted of small, equiaxed grains. The temperature of the dielectric permittivity maximum decreased with the increasing STO content in the films, but the respective dielectric permittivity maximum values were lower than those reported for bulk. Dielectric spectroscopy and polarization vs. electric field dependence revealed the relaxor behavior in the 0.85KNN–0.015STO thin film.

I.7. 2

add to my program (close full abstract)

14:45 **The effect of porosity on the functional properties of lead titanate thin films**

Authors : Paula Ferreira,1 Alichandra Castro,1 Brian Rodriguez,2 Paula M. Vilarinho1
Affiliations : 1Department of Materials and Ceramic Engineering, Centre for Research in Ceramics and Composite Materials, CICECO, University of Aveiro, Aveiro, Portugal 2Conway Institute of Biomolecular and Biomedical Research, University College Dublin, Dublin, Ireland

I.7. 3

Resume : Porous ferroelectric thin films can be attractive platforms for the construction of multifunctional composite materials. Recently, we have shown that porous barium titanate and lead titanate thin films present piezo- and ferroelectric local properties.[1] In this work we differentiate the structure and morphology of dense and porous thin films of lead titanate and identify the role of those differences on the local electric properties assessed by Piezoresponse Force Microscopy and Piezoresponse Force Spectroscopy. From our results, the crystallization and formation of tetragonal ferroelectric phase seems to be favored by the presence of pores. Explanations for this behavior can be related to the low density of the films that facilitates the crystallization or even the increase of the local energy during the block-copolymer decomposition, thus allowing the nucleation and crystallite growth at low temperature, with the formation of high amount of tetragonal phase. ACKNOWLEDGMENTS The authors thank FCT and FEDER (QREN ? COMPETE) for funding the project PTDC/CTM/098130/2008 and to the FCT for the Doctoral fellowship SFRH/BD/67121/2009. We thank the COST Action MP0904 SIMUFER for funding. [1] P. Ferreira, R. Z. Hou, A. Wu, M-G Willinger, P. M. Vilarinho, J. Mosa, C. Laberty-Robert, C. Boissi?re, D. Grosso, C. Sanchez, Langmuir 2012, 28 (5), 2944.

add to my program (close full abstract)

15:00 **Chemical solution deposition of true single phase, room temperature multiferroic oxides**

Authors : Lynette Keeney1, Tuhin Maity1, Michael Schmidt1, Andreas Amann1 ,2, Nitin Deepak1, Nikolay Petkov1, Saibal Roy1, Martyn E. Pemble1,3 and Roger W. Whatmore1,3,4
Affiliations : 1Tyndall National Institute, University College Cork, Cork, Ireland; 2School of Mathematical Sciences, University College Cork, Cork, Ireland; 3Department of Chemistry, University College Cork, Cork, Ireland; 4Department of Materials, Royal School of Mines, Imperial College London, South Kensington Campus, London SW7 2AZ

Resume : With the seemingly inexorable increase in the use of devices designed to access the internet for an ever increasing series of applications there is a constant need for data storage technologies with higher densities, non -volatility and lower power consumption [1]. Single-phase, room temperature magnetoelectric multiferroic materials are of considerable interest for such applications [2]. However, materials that are both multiferroic and magnetoelectric at room temperature are very unusual [3]. By inserting magnetic ions into Aurivillius phase, layer-structured ferroelectric materials , we have synthesised thin films of average composition Bi6Ti2.8Fe1.52Mn0.68O18 (B6TFMO) by a chemical solution deposition process on c-plane sapphire substrates [4]. Piezoresponse force microscopy (PFM) demonstrates room temperature ferroelectricity. Superconducting quantum interference device (SQUID) magnetometry reveals a distinct room temperature ferromagnetic signature (Ms = 0.74emu/g, Hc = 7mT at 300K) in the films. The results of a careful microstructural analysis of the materials will be discussed. This investigation, coupled with the use of a statistical analysis of the data, allows us to conclude that ferromagnetism does not originate from unobserved second phase ferromagnetic inclusions, with a confidence level of 99.5%. Direct PFM evidence of the switching and formation of a ferroelectric polarisation induced by a change in magnetic field within individual Aurivillius phase grains will be presented [4]. This is the first report of such an effect occurring in a genuine single-phase material at room temperature in thin film form. This room temperature single phase magnetoelectric multiferroic material is currently being optimised and assessed for device-level performance and could find application in a wide range of new or improved devices to potentially meet future industry requirements in high density memory applications. The support of SFI under the FORME SRC Award number 07/SRC/I1172 and the TIDA Award number 13/TIDA/12728 is gratefully acknowledged. [1] "Assessment of the Potential and Maturity of Selected Emerging Research Memory Technologies Workshop & ERD (Emerging Research Devices) /ERM Working Group Meeting (April 6-7 2010)," (2010). [2] "Emerging Research Materials, INTERNATIONAL TECHNOLOGY ROADMAP FOR SEMICONDUCTORS, 2009 Edition," (2009). [3] N. A. Hill, "Why Are There so Few Magnetic Ferroelectrics?," J. Phys. Chem. B, 104 [29] 6694-709 (2000). [4] L. Keeney, T. Maity, M. Schmidt, A. Amann, N. Deepak, N. Petkov, S. Roy, M. E. Pemble, and R. W. Whatmore, J. Am. Cer. Soc., 96 [8], 2339-2357 (2013).

I.7. 4

add to my program (close full abstract)

15:30 **Synthesis of ferromagnetic and ferroelectric thin films over large areas by Polymer Assisted Deposition**

I.7. 5

Authors : José Manuel VILA-FUNGUEIRIÑO, Beatriz RIVAS-MURIAS, Francisco RIVADULLA
Affiliations : Centro de Investigación en Química Biolóxica e Materiais Moleculares (CIQUS), Campus Vida, Universidade de Santiago de Compostela, 15782, Santiago de Compostela, Galicia, Spain
Resume : We will present a chemical deposition method, based on aqueous polymeric/metal solutions, for the fabrication of epitaxial thin-films of different oxides. The method is able to produce ultrathin films of very high quality, with an exceptional homogeneity in their chemical composition, thickness and physical properties, over cm2 areas. The thickness can be well controlled in the range from 4 nm to 40 nm. To demonstrate the versatility of this method, we will show the results of the synthesis and characterization of different materials, such as ferromagnetic manganites and cobaltites (including misfit cobalt oxides) with different compositions, multiferroic BiFeO3, doped ZnO, etc. We will also show that epitaxial bilayers of different oxides can be fabricated with this method, introducing new functionalities due to interface coupling. All these results demonstrate that chemical deposition methods of ultrathin films are competitive for the fabrication of high quality ultrathin films and multilayer oxides, as required for fundamental studies or highly demanding applications.

add to my program **(close full abstract)**

15:45 **Ferroelectric multilayer composite films based on the solid solution (Bi1/2Na1/2)TiO3-BaTiO3**

Authors : A. Pérez-Rivero, R. Jiménez, I. Bretos, M. García-Hernández, M.L. Calzada, J. Ricote
Affiliations : Instituto de Ciencia de Materiales de Madrid, CSIC. Cantoblanco, 28049 Madrid, Spain
Resume : The integration of ferroelectric oxides in microelectronic devices is usually hampered by the degradation of their properties in thin film form. For example, films based on solid solutions with excellent piezoelectric properties around their Morphotropic Phase Boundaries, such as Pb(Mg1/3Nb2/3)O3–PbTiO3 (PMNT) or the lead free (Bi1/2Na1/2)TiO3-BaTiO3 (BNBT), show a drastic decrease of the remnant polarization respect to their bulk counterparts. The decrease of the grain size associated to the reduced thickness has been reported as the main cause of this effect in polycrystalline films. The stabilization of relaxor-like domains in submicrometric grains reported in ceramics makes that, as it happens in relaxor ferroelectrics, the removal of the electric field results in the disappearance of the polarization, which reduces drastically all remnant properties. A solution is the combination of the low remnant film with hard ferroelectric layers in multilayer composite films. The hard ferroelectric layers, when poled, induce an internal bias in the low remnant film, which therefore maintains the good properties of this film when the electric field is removed. In this work a study of the properties of BNBT and BiFeO3 (BFO) multilayer composite films is shown. Not only it allows taking advantage of the excellent properties of BNBT, but also solves part of the problem of the large leakage currents of multiferroic BFO, which supports a possible magneto-electric functionality.

I.7. 6

add to my program **(close full abstract)**

16:00 **Coffee & tea**

Synthesis III : Marlies Van Bael

16:30 **Soft Processing of Advanced Ceramic Materials for Various Applications**

Authors : Masahiro YOSHIMURA
Affiliations : Promotion Center for Global Materials Research, Dept of Mater.,Sci. and Eng., National Cheng Kung University, Tainan,Taiwan: yoshimur@mail.ncku.edu.tw Prof. Emeritus. Tokyo Institute of Technology, Japan :yoshimura@msl.titech.ac.jp
Resume : As well as organic and/or bio- materials, advanced inorganic (ceramic) materials have been used in wide area of applications like structural, mechanical, chemical, electrical, electronic, optical, photonic, biological, medical, etc. They have generally been fabricated by so-called high-technology, where high temperature, high pressure, vacuum, molecule, atom, ion, plasma, etc. have been used for their fabrications, because inorganic materials are difficult in shape forming and fixing due to their intrinsic rigidity and brittleness. Even though nano-sized particles of inorganic materials could be synthesized by low-energetic route, i.e."soft chemistry" or "green chemistry", their shape forming

I.8. 1

and fixing cost energetically and environmentally. We have challenged to fabricate those advanced inorganic materials with desired shape/size/location,etc. directly in low energetic ways using aqueous solutions since 1989 when we found a method to fabricate BaTiO3 film on Ti substrate in a Ba(OH)2 solution by Hydrothermal Electrochemical[HEC] method at low temperatures of 60-200 C. We proposed in 1995 an innovative concept and technology, "Soft Processing" or "Soft Solution Processing," which aims low energetic (=environmentally benign) fabrication of shaped, sized, located, and oriented inorganic materials in/from solutions. It can be regarded as one of bio-inspired processing, green processing, or eco-processing.1,2) When we have activated/stimulated interfacial reactions locally and/or moved the reaction point dynamically, we can get patterned ceramic films directly in solution without any firing, masking or etching. They can be called Direct Patterning methods which differ from previous patterning methods consisting of multi-step processes. The notable feature of Direct Patterning is that each reactant reacts directly on site, at the interface with the substrate. Therefore, the chemical driving force of the reaction, A+B=AB, can be utilized not only for synthesis but also for crystallization and/or consolidation of the compound AB. It is rather contrasting to general patterning methods where thermal driving force of firing is mostly used for the consolidation of the particles.3) We have developed the Direct Patterning of CdS, PbS and CaWO4 on papers by Ink-Jet Reaction method and LiCoO2 by electrochemically activated interfacial reactions.3) Furthermore, we have succeeded to fabricate BaTiO3 patterns on Ti by a laser beam scanning and carbon patterns on Si by a needle electrode scanning directly in solutions.4) Recent success in TiO2 and CeO2 patterns by Ink-Jet Deposition, where nano-particles are nucleated and grown successively on the surface of substrate thus become dense even below 300 C3) will be presented. References 1)MRS Bulletin,25[9],Sept. issue 2000, special issue for Soft Processing of Advanced Inorganic Materials ,Guest Editor:M. Yoshimura and J. Livage. 2)Yoshimura, M., J. Mater. Sci.,41 [5],1299-1306 (2006), 43[7]2085-2103(2008). 3)Yoshimura, M. and Gallage R., Solid State Electrochem., 12[7/8]775-782(2008). 4) Watanabe,T., Yoshimura, M. ,Thin Solid Film, 515, 2696-2699 (2006), Carbon, 44, 799-802 (2006). 5)Wu,J-J.,Liao,W-P.,Yoshimura,M. Nano Energy,On-line July 11,2013 .

add to my program (close full abstract)

17:00 **A general strategy for the synthesis of micelle-templated mesoporous metal carbonates and metal oxides**

Authors : Bjoern Eckhardt1; Erik Ortel1; Denis Bernsmeier1; Peter Strasser1; Ulla Vainio2; Joerg Polte1; Franziska Emmerling3; Ralph Kraehnert1
Affiliations : 1Technical University of Berlin, Berlin, Germany, 2 Deutsches Elektronen-Synchrotron DESY, Germany, 3 BAM Federal Institute of Materials Research and Testing, Germany

Resume : Catalysis, energy storage and light harvesting require functional materials with tailored porosity and nanostructure. We developed a new synthesis approach for metal carbonates and metal oxides with micelle-templated pore structure. The synthesis relies on triblock-copolymers and a new type of precursor. The obtained materials were analysed by SAXS, SEM, TEM, FTIR and XRD. Cross-section SEM images of templated mesoporous ZnCO3 obtained after the first calcination reveals a homogeneous film with a thickness of about 1100 nm. A second calcination at higher temperatures preserves the mesopore structure. The carbonate film transforms into nanocrystalline ZnO evidenced by SAED and XRD while retaining the templated mesopore structure. The developed synthesis is the only soft-templating methode reported so far that yields mesoporous metal carbonates, as well as mesoporous ZnO, Co3O4 and MgO. Our contribution presents the different materials prepared by the new synthesis approach.

I.8. 2

add to my program (close full abstract)

17:15 **Building mesoporous and nanocomposite thin films from metal oxide nanocrystals**

Authors : Delia J. Milliron(a,b), Natacha Krins(a), Raffaella Buonsanti(a), Brett A. Helms (a), Anna Llordes(a)
Affiliations : (a) Lawrence Berkeley National Laboratory, 1 Cyclotron Road, Berkeley, California 94720 (USA) (b) Department of Chemical Engineering, The University of Texas at Austin, 200 E. Dean Keeton Street, Austin, Texas 78712 (USA)

I.8. 3

Resume : The integration of inorganic nanocrystals as building units into mesoscale architectures yields materials whose structure is controllable on atomic, nano, and meso length scales providing a foundation for understanding how system-level functional properties emerge. We assembly nanocrystals into

thin film electrodes by chemically displacing the insulating organic ligands coating their surfaces to leave exposed coordination sites at which block copolymer templating agents dynamically adsorb [1]. Through selection of the nanocrystal and polymer building blocks, the crystallite size and shape, the mesopore dimensions, and the inorganic wall thickness are all tunable. As a result, electrochemical properties can be correlated with structure on multiple length scales to determine design rules for high performance electrodes. In one example, the shape and size of anatase titania nanocrystals are correlated with performance characteristics of lithium ion battery electrodes. Titanium oxide nanorod-based mesoporous films are found to exhibit minimal loss in charge capacity out to at least 1000 cycles. In nanocomposites, both the nanoscale components and their interfaces are essential in defining structure and function. Our approach has been to form chemical bonds linking inorganic clusters (e.g. polyoxometalates or POMs) to colloidal metal oxide nanocrystals. When films of these assemblies are thermally annealed, the clusters undergo condensation. They cross-link to form a continuous amorphous matrix surrounding, and covalently linked to, the embedded nanocrystals. The resulting composite materials combine intrinsic characteristics of each component and exhibit unique functionality that we ascribe to reconstruction at the nanocrystal-glass interface. For example, we designed ITO-in-niobium oxide composites that can independently control the transmittance of visible and near infrared light as a function of voltage. More over, the optical contrast is enhanced by 5 times compared to the pure niobium oxide glass. As revealed by Raman spectroscopy, linking with the nanocrystals profoundly reorganizes the glass structure [2]. These results highlight the tremendous opportunity to manipulate amorphous structure through covalent linking to nanocrystals and thereby realize new functionality. 1) R. Buonsati et al., Nano Lett., 2012, 12, 3872. 2) A. Llordes et al., Nature, 2013, 500, 323.

add to my program (close full abstract)

17:45 **Nanostructured transparent electrodes - advanced material design for controlled enzyme immobilization**

Authors : Nina Heidary1, Anabel Molero1, Amandine Guiet1, Stefano Frasca2, Khoa Ly1, Tillmann Utesch1, Maria Mroginski1, Ingo Zebger1, Inez Weidinger1, Ulla Wollenberger2, Anna Fischer1*

Affiliations : 1) Technical University Berlin, Strasse des 17. Juni 135, 10623 Berlin, Germany 2) University Potsdam, Karl-Liebknecht-Str. 24-25,14476 Golm, Germany

Resume : Nanostructured transparent conductive thin film electrodes are promising platforms for the further design of enzymatic bio-electronic devices, such as enzymatic fuel cells or biosensors. High surface area materials by design, nanostructured transparent thin film electrodes allow the quantitative immobilization of high amounts of enzyme. In addition, by taking advantage of their transparency for spectroscopyic investigations, fundamental insights into enzyme surface immobilization processes involving the material-enzyme interface can be gained, allowing deduction of guidelines for further material and interface design. In here, by combining tailored nanostructured thin film synthesis, enzyme film-voltammetry and various spectroscopic techniques (UV-Vis, IR and RR), we could gain insights into the crucial parameters controlling the binding, the orientation (i.e. electrochemistry) and the stability of selected enzymes on model as well as high-surface area transparent conductive surfaces, as demonstrated amongst others for hydrogenase-based systems.

I.8. 4

add to my program (close full abstract)

Poster session 2 : An Hardy

18:00 **Indium Tin Oxide Grown by Aerosol Assisted CVD and Incorporation of Ligand Stabilised Silicon Nanocrystals**

Authors : Shane O'Brien* a, Keith Linehan b, Hugh Doyle b, Andrew Kingsley c, Chris Ashfield c, Bettina Frank c, Ling Xie d, Klaus Liefer d, Philippe Thony e, Simon Perraud f , Martyn E. Pemble a and Ian M. Povey a

Affiliations : a Advanced Materials and Surfaces Group, Tyndall National Institute-University College Cork, Lee Maltings, Cork, Ireland; b Nanotechnology Group, Tyndall National Institute-University College Cork, Lee Maltings, Cork, Ireland; c SAFC Hitech, Power Road, Bromborough, Wirral CH62 3QF, UK; d Department of Engineering Sciences, Uppsala University, Box 534, 75121, Uppsala, Sweden; e INES R.D.I , Laboratoire des Composants Photovoltaïques (CEA) Savoie TechnoLac- bât. Alouette 3, F-73370 Le Bourget du Lac , France; f CEA, LITEN, 17 Rue des Martyrs, 38054 Grenoble Cedex 9, France.

I.P2. 1

Resume : Nanocomposite films were successfully grown by aerosol-assisted CVD in a single deposition step using a mixture of Indium Tin neodecanoate and ligand stabilised silicon nanocrystals. Samples were analysed by HRTEM and silicon nanocrystals with a density of 1.2 × 10 12 cm-2 were observed. From the reconstructed 3D tomogram, the averaged distance between the nearest nanoparticles is 8.3 nm and the 3D density of nanoparticles is 1.6 × 10 18 cm-3. These data show the versatility of aerosol assisted CVD, as achieving such a density of silicon nanocrystals of carefully controlled size and shape within a polycrystalline host matrix by currently used methods would be significantly more complex and less controlled than the nanocomposite produced by the approach taken here. Therefore, these nanocomposite films meet requirements for further development in PV test structures, in terms of having a narrow size distribution of silicon nanocrystals within a 2-5nm particle diameter range with a surface concentration of 101 2 cm-2 contained within a transparent conductive oxide matrix.

add to my program (close full abstract)

18:00 **Effect of Pt doping on the microstructural and optoelectronic properties of SnO2**

Authors : A. Hajjaji1,a, W. Dimassi1, M. Ben Rabha1, M.Amlouk3, My Ali El Khakani2, B. Bessais1 and M. Gaidi1

Affiliations : 1Laboratoire de Photovoltaïque, Centre de Recherches et des Technologies de l'Energie, Technopole de Borj-Cédria, BP 95, 2050 Hammam-Lif, Tunisia 2Institut National de la Recherche Scientifique, INRS-Énergie, Matériaux et Télécommunications, 1650, Blvd. Lionel-Boulet, Varennes, QC, Canada J3X-1S2 3Unité de Physique des Dispositifs à Semi-conducteurs, Faculté des Sciences de Tunis, Campus Universitaire 2092 Tunis, Tunisia

Resume : In this paper, we report on the effect of noble metal doping (namely by Pt) on the opto-electronic properties of SnO2 thin films prepared by pyrosol method. The microstructural and surface morphology of SnO2 films were characterized by X-ray diffraction (XRD) and atomic force microscopy (AFM) as a function doping concentration. By means of Light beam Induced current (LBIC) investigation and spectral response we demonstrated that the sensitivity of photo response of SnO2 films can be enhanced by metallic particles incorporation. The best result, in term of diffusion length, has been obtained for an optimum concentration of 3 at. % of metallic incorporation. The induced change has been correlated to the associated morphological and structural characteristics of SnO2 films. Keywords: Tin dioxide, XRD; Surface morphology, LBIC, Pt.

I.P2.2

add to my program (close full abstract)

18:00 **Electrical properties of graphene oxide on flexible substrate**

Authors : Te-Hua Fang*, Shao-Hui Kang,Tao-Hsing Chen

Affiliations : Department of Mechanical Engineering, National Kaohsiung University of Applied Sciences, Kaohsiung 807, Taiwan

Resume : Graphene is a one-atom-thick layer of bonded-sp2 carbon atoms packed into a two-dimensional honeycomb lattice [1]. It has a high-electron mobility of up to 15,000 cm2/V•s at room temperature and 60,000 cm2/V•s at 4 K [2, 3]. Moreover, It has high optical transparency and can absorb πα ≈ 2.3% of white light, where α is the fine-structure constant. [4]. In this research, graphene oxide (GO) was deposited through the electrophoretic deposition (EPD) system to obtain lower the oxygen concentration. Moreover, the direct fabricating patterns of large-scale GO films using stamping transfer processes on a polydimethylsiloxane (PDMS) substrate. The thickness of the GO films was controlled to adjust the optical, electrical, and mechanical properties by EPD. GO was deposited by EPD system. The EPD system processed cathode (ITO), anode (highly oriented pyrolytic graphite (HOPG)), and put graphite powder (1 g) as the electrolyte (in 100 ml of water). Through the anodizing process to a direct-current (DC) voltage of 10 V was applied for 1, 3, 5, and 10 min (samples 1, 2, 3, and 4, respectively) to an electrolyte in contact with the ITO surface to generate a GO film. In addition, PDMS (evenly mixed with a hardening agent at a ratio of 10:1) was poured onto a GO/ITO substrate. The GO/ITO substrate was transferred to a furnace and heated (338K for 4 h) to solidify the PDMS. Through GO films lift-off an ITO glass substrate, leaving just the GO films on the PDMS substrate. The finished flexible substrates were samples 1~4. The GO film was characterized by Raman spectroscopy and X-ray photoelectron spectroscopy (XPS). A micro-Raman system (Renishaw, Vendor) with a wavelength is 514 nm. XPS (JEOL JAMP-9500F) system using a monochromatic Al-Kα X-ray source with photon energy is 1486.6 eV. The microstructures of the deposited materials were measured by scanning electron microscopy (SEM, Zeiss Auriga FIB-SEM system), scanning confocal microscopy (SCM, Keyence VK-X200), and

I.P2.3

transmission electron microscopy (TEM, Philips Technai G2f20). Atomic force microscopy (AFM, NT-MDT SFC050L) was used to determine the surface morphology. A nanoindentation device (Hysitron Triboscope, TI 700 Ubi) equipped with a Berkovich diamond probe with a radius of approximately 100 nm was used to measure the nanomechanical properties in the experiment. The current-voltage (I-V) characteristics of the GO films were measured using a digital sourcemeter (Keithley 2400). The absorptivity and reflectivity of the GO films were examined under various wavelengths using an ultraviolet-visible (UV-Vis) spectrophotometer (Jasco V-670). The EPD parameters for producing uniform films of GO and the average surface roughness increased as a result of oxidation [5]. AFM measurements and scanned range (area is 5×5 μm) to analyze the surface roughness of the GO films. The surface roughness values were 3.2±0.2, 3.8±0.1, 4.5±0.6, and 6.3±1.5 nm at layer thicknesses of around 150, 200, 280, and 300 nm, respectively, for samples 1~4. The SCM images, which were measured the thickness of the GO films. Resistance increased with the thickness of the deposited films because at a given voltage, the electric current decreases as the film get thicker. Raman spectra of strong peaks appear in the G band (sp3, 1336 cm-1), D band (sp2, 1590 cm-1), and 2D band (2720 cm-1). The peak frequency of the G band of single-layer graphene sheets (1585 cm-1) shifted about 5 cm-1 into higher frequencies after being stacked. The results show that high-performance GO films were fabricated. XPS spectra shows samples that the peaks for C1s are at 284.5, 285.5, 286.5, and 288.9 eV, corresponding to C–C, C–N, C–O, and O–C=O groups, respectively. The binding energy peaks at 286.5 eV (C-O) and 288.9 eV (O–C=O) indicate large numbers of oxygenated carbon structures. The sheet resistance of the GO films measured by the four-point-probe method was approximately 320~430 Ω/sq, which is comparable to previously reported values for graphene films [6, 7]. The GO films obtained using EPD had a lower sheet resistance than that of GO/r-GO films. The results show that the GO film thickness greatly affects sheet resistance. The GO films showed conductivity, with a sheet resistance of 320~430 Ω/sq with 60~72% transparency. Experiments showed that transfer processes for flexible substrates can easily produce cost-effective transparent conductive films. Keywords: Graphene oxide; electrophoretic deposition; polydimethylsiloxane (PDMS); transparent conductive films (TCFs) References 1. Geim A K and Novoselov K S 2007 Nat. Mater. 6 183. 2. Novoselov K S, Geim A K, Morozov S V, Jiang D, Zhang Y, Dubonos S V, et al. 2004 Science 306 666. 3. Zhang Y B, Tan Y W, Stormer H L and Kim P 2005 Nat. 438 201. 4. Kuzmenko A B, van Heumen E, Carbone F and van der Marel D 2008 Phys. Rev. Lett. 100 117401. 5. Zhao S, Surwade SP, Li Z, Liu H. 2012 Nanotechnology 23 355703. 6. Kim K S, Zhao Y, Jang H, Lee S Y, Kim J M, Kim K S, et al. 2009 Nature 457 706. 7. Li X, Zhu Y, Cai W, Borysiak M, Han B, Chen D, et al. 2009 Nano Lett. 9 4359.

18:00 **Numerical Investigation of nanoscale SiGe DG MOSFET performance against the interfacial defects**

Authors : T. Bentrcia1, F. Djeffal2, M. Meguellati2 and D. Arar2
Affiliations : 1) Department of Physics, University of Batna,Batna 05000, Algeria. 2)LEA, Department of Electronics, University of Batna, Batna 05000, Algeria. E-mail: faycal.djeffal@univ-batna.dz, faycaldzdz@hotmail.com, Tel/Fax: 0021333805494

Resume : The SiGe-based alloy is considered as one of the most promising materials for reliable and high performance microelectronic devices. The use of a lower band-gap material in the channel region of the MOSFET, such as SiGe, is a potential candidate given their compatibility with the process developed for pure Si-based devices. Moreover, the important increasing in the drain current due to the increased electrons mobility in SiGe material is expected. However, the growth of this material is not totally controlled, and the presence of defects is more than expected after a growth run of this material. Therefore, in order to obtain a global view of SiGe-based nanoscale Double Gate (DG) MOSFET performance under critical conditions, numerical modeling of nanoscale SiGe DG MOSFET including Interfacial defect effects (SiGe/SiO2) is indispensable for the comprehension of the fundamentals of such device characteristics. Based on numerical investigation of a nanoscale SiGe DG MOSFET including the defects in the interface region, in the present paper a numerical model for I-V and small signal characteristics by including the interfacial defects, after considering the uniform function approximation for the interface defects distribution at the drain said, is developed to explain the immunity behavior of the nanoscale SiGe-based transistor against the defect densities, as function of dimensional parameters and germanium mole fraction. In this context, DC and RF characteristics of the

I.P2.4

proposed design are analyzed by 2-D numerical simulation and compared with conventional Si DG MOSFET characteristics.

add to my program (close full abstract)

18:00 **The formation titanium dioxide thin films on transparent substrates and the study of physicochemical properties.**

Authors : Stepanov A.Yu, Sotnikova L.V., Vladimirov A.A., Larichev T.A., Titov F.V., Dyagilev D.V.
Affiliations : Kemerovo State University

Resume : Now the thin oxide films are widely used in different fields of industry, science and technology. An action of semiconductor and optoelectronic devices, media for recording and storage of information is often based on the use of thin-film technologies. Creating transparent electronic devices such as touch and flexible displays, organic light-emitting diodes, electro luminescent sources of light, photovoltaic and optically active coverage is the most attractive area of research. Titanium dioxide is a promising material for creating of transparent oxide semiconductor films. However, the creating of such films has to use complex and energy-consuming methods. The development of technologies of simple, cheap and large-scale manufacture of transparent conducting and insulating films are stimulated by the leading manufacturers of electronic devices. In our work transparent titanium dioxide films were obtained by the methods of beam activation decomposition (UV and □-ray) of organometallic precursor. The titanium chloride alcoholic solution was used as a precursor. The centrifuge technique was used to cover the precursor on the transparent substrate. The film thickness was varied by changing of the solution concentration and conditions of application of the precursor. The optical properties, phase composition and structure of the obtained films were investigated by the methods of spectrometric, x-ray phase analysis (XRF), atomic force microscopy (AFM).

I.P2.5

add to my program (close full abstract)

18:00 **AC conductivity and Electric modulus studies in Sm-doped Pb free Glasses**

Authors : Jong-Ho Park
Affiliations : Department of Science Ecuation Chiju National University of Education

Resume : With remarkable growth of display industry, there have been increasing demands for the development and improvement of glass parts for display devices. Fundamental and systematic study for the Pb-free glasses and dielectrics in particular is required as the demands rise for environmentally benign materials Thus, frequency and temperature dependence of dielectric properties and electrical conductivity of (13-x)BaCO3-80B2O3-7Li2O · xSm2O3 (BBLS) Pb free glass were studied in the ranges of 10-1 ~106 Hz and 298 ~ 900K, respectively. The experimental dielectric data have been analyzed in the light electric modulus formalism. The electric modulus representation shows well -defined relaxation peaks. The frequency-dependent conductivity behavior at different temperatures provides a qualitative description of the conduction mechanism. The relaxation, occurs as a result of the hopping of charge carries between localized states and the correlated barrier hopping model, describes the dominant mechanism

I.P2.6

add to my program (close full abstract)

18:00 **Bias stress under illumination in solution processed zinc tin oxide (ZTO) thin-film transistors**

Authors : Li-Chih Liu1, Jen-Sue Chen*1, and Jiann-Shing Jeng2
Affiliations : 1National Cheng Kung University, Tainan 701, Taiwan; 2Department of Materials Science, National Tainan University, Tainan 700, Taiwan

Resume : In our previous study, solution-processed zinc tin oxide (ZTO) thin-film transistors were fabricated from zinc nitrate and tin (II) chloride precursors using a spin coating method accompanied with annealing at 500 oC. The ZTO TFTs exhibited a good field-effect mobility of 14 cm^2/Vs, small subthreshold slope of 0.32 V/decade and high on/off ratio of 10^8. Subsequently, in this study, we investigate the variation of Id-Vg characteristics under bias stresses without and with light illumination (of wavelength 405 nm), including positive gate bias stress (PBS), negative gate bias stress (NBS), positive bias illumination stress (PBIS), and negative bias illumination stress (NBIS). The ΔVth (Vth^after stress - berfore stress) window is narrower after PBIS as compared to PBS while the ΔVth window become much wider after NBIS as compared to NBS. The result is attributed to presence of oxygen vacancies in ZTO and the photo-ionization of oxygen vacancies during light illumination. The ionized oxygen vacancies and accompanying electrons will interact with the applied bias and lead to the change of Id-Vg characteristics. A detailed

I.P2.7

mechanism will be discussed to understand the bias stress stability of solution processed ZTO thin-film transistors.

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18:00 **Opto- electronic properties of Orthorhombic NdMnO3 perovskite via modified Becke- Johnson potential.**

Authors : B. Bouadjemi *, 1, S. Bentata1, T. Lantri1, A. Abbad2, S. Benotmane3 and B.Bouhafs3.
Affiliations : 1Laboratory of Technology and Solid Properties, 2Signals and Systems laboratory, LSS, Faculty of Sciences and Technology, BP227 Abdelhamid Ibn Badis University, Mostaganem (27000) Algeria, 3 Laboratoire de Modélisation et de Simulation des Matériaux Univesity of sidi Belabbes, (22000) Algeria *E-mail:bbouadjemi@yahoo.fr

Resume : In this work, we present an ab initio calculation for the structural, electronic, magnetic and optical properties of the orthorhombic NdMnO3 through density-functional-theory (DFT) calculations using both generalized gradient approximation GGA and GGA+U approaches, the exchange and correlation effects are taken into account by an orbital independent modified Becke Johnson (MBJ). The predicted band gaps using the MBJ exchange approximation show a significant improvement over previous theoretical work with the common GGA and GGA+U very closer to the experimental results. Band gap dependent optical parameters like dielectric constant, index of refraction, absorption coefficient, reflectivity and conductivity are calculated and analyzed. We find that when using MBJ we have obtained better results for band gap of NdMnO3 than in the case of GGA and GGA+U. The values of band gap founded in this work by MBJ are in a very good agreement with corresponding experimental values compared to other calculations and this comprehensive theoretical study of the optoelectronic properties predicts that this material can be effectively used in optical devices. Keywords: optical properties, half-metallic ferromagnet, strong correlation, MBJ potential, Orthorhombic NdMnO3. References [1] D. Koller, F. Tram, and P. Blaha, Phys. Rev.B 85, 155109(2012). [2] B. Amin, P. Iftikhar Ahmad, M. Maqbool, S. Goumri-Said, R. Ahmad, J. Appl. Phys. 109 (2011). 023109–023105.

I.P2.8

add to my program (close full abstract)

18:00 **The electronic, structure properties of the TiO2: a first principles investigation within the modified Becke–Johnson exchange potential plus LDA and GGA**

Authors : S.Benatmane*1, B.Bouhafs1, B. Bouadjemi 2 and S. Bentata 2
Affiliations : 1Department of physics Faculty of sciences Djillali Liabes University of Sidi Bel-Abbes, 22000, Algeria 2Laboratory of Technology and Solid Properties,Faculty of Sciences and Technology, BP227 Abdelhamid Ibn Badis University, Mostaganem (27000) Algeria Email*1: b.saadia@live.fr

Resume : The TiO2 has been recently used to realize high-temperature ferromagnetic semiconductors. In fact, it has been widely used for a long time as white pigment and sunscreen because of its whiteness, high refractive index, and excellent optical properties. However, its electronic structures and the related properties have not been satisfactorily understood. Here, we use Tran and Blaha's modified Becke-Johnson (TB-mBJ) exchange potential (plus a local density approximation correlation potential) within the density functional theory to investigate electronic structures and optical properties of rutile and anatase TiO2. Our comparative calculations show that the energy gaps obtained from mBJ method agree better with the experimental results than that obtained from local density approximation (LDA) and generalized gradient approximation (GGA), in contrast with substantially overestimated values from many-body perturbation (GW) calculations. As for optical dielectric functions (both real and imaginary parts), refractive index, and extinction coefficients as functions of photon energy, our mBJ calculated results are in excellent agreement with the experimental curves. Key words: DFT / FP-LAPW / GGA / LDA / the TiO2 /the mBJ and optical properties References [1] H. K. Jang, S. W. Whangbo, H. B. Kim, Y. S. Lee, I. W. Lyo and C. N. Whang, J. Vac. Sci. Technol. A 18, 917 (2000). [2] J. D. Park and T. S. Oh, J. Korean Phys. Soc. 37, 1072 (2000).

I.P2.9

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18:00 **Ferromagnetism, magnetotransport and magnetocaloric properties of iron substituted manganese Pr0.67Sr0.33FexMn1-xO3 manganites oxide elaborated by ball milling method.**

Authors : W. CHERIF, M. ELLOUZE, F. HALOUANI, M. Ben AMAR.
Affiliations : professor

Resume : Abstract: Perovskite-type complex manganites Ln1-xAxMnO3 were Ln is a rare earth (Ln = La, Pr, Sm ?) and A is a divalent element (A = Ca, Sr, Ba ?) have attracted considerable attention because of their interesting electrical, magnetic and catalytic properties. Manganites are of vital interest to a

I.P2.10

wide community of materials scientists not only because of the fascinating phenomena and properties exhibited, but also due to their potential technological applications in magnetic ordering and sensors. In this work, we present the Structural, magnetic and magnetotransport properties of Pr0.67Sr0.33FexMn1-xO3 with 0 ≤ x ≤ 1 samples have been investigated. Powder samples have been elaborated by ball milling method. This powder samples have been elaborated using the mecanosynthesis reaction by mixing precursors Pr6O11, Mn2O3, Fe2O3 and SrCO3 up to 99.9 % purity in the desired proportion according to the following reaction: 0.67 Pr6O11 0.33 SrCO3 3 x Fe2O3 3(1-x)Mn2O3 → 6 Pr0.67Sr0.33FexMn1-xO3 δ CO2 The phase purity, homogeneity, and crystal properties were determined by powder X-ray diffraction. Magnetization measurements versus temperature and applied magnetic field were recorded by vibrating sample and SQUID magnetometers. Electrical measurements as a function of temperature and magnetic applied field were performed on dense ceramic pellets by the conventional four-probe technique in the temperature range 70 ? 300 K on a SQUID magnetometer. Rietveld analysis of the X-ray diffraction show that the samples crystallise in the orthorhombic perovskite system with Pnma space group. The investigated samples exhibit a ferromagnetic to paramagnetic transition with increasing temperature. The magnetic transition temperature Tc is found to decrease with the presence of iron in the structure. It decrease from 380 K for x = 0 to 180 K for x = 0.2. The maximum of the magneto resistance obtained for Pr0.67Sr0.33Fe0.02Mn0.98O3 sample is about 76 % at 240 K, however is about 91 % at 210 K, for the Pr0.67Sr0.33Fe0.08Mn0.92O3 sample. The magneto resistance in the studied samples is about 25 % at room temperature. The presence of manganese in the structure leads to an increase of the Curie temperature as well as to spontaneous magnetization.

add to my program (close full abstract)

18:00 **Chemical Solution Deposition of LiMn2O4 as cathode material for Li-ion Batteries**

Authors : G. Maino1, N. Peys1,2, H. Damm1, Jan D'Haen3, A. Hardy1,2 and M. K. Van Bael1,2
Affiliations : 1Hasselt University, Institute for Materials Research, Inorganic and Physical Chemistry, Diepenbeek, Belgium / 2IMEC vzw, Division IMOMEC, Diepenbeek, Belgium / 3Hasselt University,, Institute for Materials Research, Electrical and Physical Characterisation, Diepenbeek, Belgium

Resume : LiMn2O4 is an excellent candidate in thin-film Li-ion battery due to its high voltage plateau, non-toxicity and good rechargeability. In this study, chemical solution deposition routes are being explored for the synthesis of LiMn2O4 thin films. Major assets are its low cost, the excellent stoichiometry control and the high deposition rate. Aqueous and non-aqueous precursor solutions are synthesised and successfully used for the deposition of LiMn2O4 films via spin- and spray-coating on TiN and Pt. Through an elaborated study of the deposition and processing parameters, specific conditions are derived for the formation of crystalline LiMn2O4. The stoichiometry, crystallinity and morphology are studied via Raman spectroscopy, X-Ray Diffraction and (cross-sectional) Scanning Electron Microscopy, respectively. Additional information about the precursor residues is obtained by Grazing angle Attenuated Total Reflectance-Fourier Transform Infrared Spectroscopy. The film's features depend mainly on the coating technique. Additionally, the key parameters of each coating technique and in the film processing are varied and related to the properties of the obtained LiMn2O4 film such as surface roughness, density, porosity, thickness and crystallinity. Crystalline and high porous LiMn2O4 films has been deposited at 450°C in air via spincoating. The same procedure can be applied for spray-coating with the same film morphology, leading to the perspective of new conformal depositions.

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18:00 **Performance of solution processed Si-Zn-Sn-O Thin Film Transistors depending on Annealing Conditions.**

Authors : Sang Min Han, Jun Young Choi, Sang Yeol Lee
Affiliations : Department of Semiconductor Engineering, Cheongju University, Cheongju, Chungbuk 360-764, Republic of Korea; Department of Electrical Engineering, Korea University, Seoul 136-701, Republic of Korea; Department of Semiconductor Engineering, Cheongju University, Cheongju, Chungbuk 360-764, Republic of Korea

I.P2. 12

Resume : Oxide semiconductor which has been studied extensively as a semiconductor material has a wide band gap and high mobility, capable of replacing the amorphous silicon. Recently, there have been many reports on different amorphous oxide semiconducting materials and among them, the

materials that are the most extensively used currently is indium-gallium-zinc-oxide (IGZO). However, indium is not an abundant material. It is necessary to reduce indium usage for the future. Therefore, indium free materials, such as zinc-tin-oxide (ZTO) based oxide semiconductors, have been significantly studied for active channel layer of thin film transistors (TFTs). We have investigated silicon zinc tin oxide (SZTO) thin films under various silicon ratios. SZTO TFTs were fabricated by solution processing with the bottom gate structure. Furthermore, annealing process was performed in at different temperatures in various annealing conditions, such as air ambient, N2, vacuum and wet ambient. Completed fabrication of SZTO TFT, and the performance of TFT has been compared depending on the annealing conditions by measuring the bias temperature stress (BTS) and the transfer curve. In addition, chemical components in SZTO thin films has been investigated by X-ray photoemission spectroscopy (XPS). It is confirmed that the electrical performance and stability of SZTO TFTs are improved by adopting optimized annealing conditions. Optimized annealing condition has been found for obtaining high mobility and hig

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18:00 **Interplay between nanostructure and functional electro-optical properties of multifunctional oxides**

Authors : Maria M. Giangregorio, Graziella Malandrino, Sergio O. Battiato, Maria R. Catalano, Giovanni Bruno and Maria Losurdo
Affiliations : Institute of Inorganic Methodologies and of Plasmas, IMIP-CNR, via Orabona 4, 70126 Bari, Italy; Dipartimento Scienze Chimiche, Università di Catania, INSTM, UdR Catania, Viale Andrea Doria 6, I-95125 Catania, Italy

Resume : Transition metal oxide nanostructures have been gaining increased attention due to their distinctive properties that significantly differ from their bulk counterpart. This behavior of transition metal oxide nanomaterials, mostly depending on their small size effect, surface effect and quantum effect, makes them interesting materials for various technological applications. Among those, we focus on NiO, Co3O4, Fe2O3, and also MgO nanostructured oxides, which have drawn much attention for their large scale applications as catalysts, battery electrodes, gas sensors, antiferromagnetic layer, electrochemical devices, and magnetic material. In this contribution, we focus on the interplay between the nanostructure and the optical and functional properties. The unique properties of transition metal oxide nanostructures, depending strongly on their structure, i.e. size, shape, defects and oxygen deficiency, therefore demands non-destructive techniques that offer opportunities for investigating their structure dependent optical, electrical and magnetic properties. Structural, compositional and optical properties of the oxides are investigated by spectroscopic ellipsometry (SE) corroborated by Raman spectroscopy, atomic force microscopy, Kelvin probe and magnetic force microscopy. The emphasis is on surface defects by oxygen vacancies and on the nanostructure driven by the substrate interfacial energy.

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18:00 **Upconversion luminescence from ZrO2:Er,Yb nanoparticles produced by pulsed laser ablation in water**

Authors : M.R.N. Soares, T. Holz, M.J. Soares, T. Monteiro, F.M. Costa
Affiliations : Departamento de Física e I3N, Universidade de Aveiro, 3810-193 Aveiro, Portugal

Resume : Inorganic nanoparticles (NPs) doped with lanthanides ions (Ln3+) arises as a new class of luminescent materials of interest for photonics and biological applications. ZrO2 is an effective host for the optical activation of the Ln3+ ions leading to efficient room temperature solid state lighting. In wide band gap materials, Er3+ is a widely studied activator emitting at telecom wavelengths (~1.54 μm), due to the transition between the two lowest 2S+1LJ multiplets, 4I13/2->4I15/2. The codoping with Yb3+ (which has a 2F7/2 and 2F5/2 fundamental and excited manifold) provides a sensitizer to the Er3+ upconverted photons from the infrared to the visible spectral region which is of interest for biological labeling. By pumping the ZrO2:Er,Yb samples with 980 nm wavelength photons (resonantly with the 2F7/2->2F5/2 absorption of the Yb3+ and with the 4I15/2->4I11/2 absorption of the Er3+), the green 2H11/2, 4S3/2 ->4I15/2 and red 4F9/2->4I15/2 transitions from the Er3+ are favored. The green and red luminescence is strongly dependent on the ions concentration. We report for the first time, the preparation of ZrO2 NPs doped with Er3+ and codoped with Er3+ and Yb3+ produced by pulsed laser ablation in liquids (PLAL). The possibility to produce colloidal solution in biocompatible solvents is one of main advantages of PLAL relatively to other methods used to prepare NPs

I.P2. 14

for biological labeling. The role of the synthesis parameters and ions concentration on the up converted luminescence will be explored and the models for the recombination processes will be proposed.

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18:00 **Topotactic Fluorination of SrFeO2.5 and SrCoO2.5 Thin Films by Using Polyvinylidene Fluoride**

Authors : Tsukasa Katayama, Akira Chikamatsu, Yasushi Hirose, Tomoteru Fukumura, Tetsuya Hasegawa

Affiliations : Department of Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan; Department of Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan CREST, Japan Science and Technology Agency (JST), Bunkyo-ku, Tokyo 113 -0033, Japan; Department of Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan CREST, Japan Science and Technology Agency (JST), Bunkyo-ku, Tokyo 113 -0033, Japan Kanagawa Academy of Science and Technology (KAST), Kawasaki, Kanagawa 213-0012, Japan; Department of Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan CREST, Japan Science and Technology Agency (JST), Bunkyo -ku, Tokyo 113-0033, Japan; Department of Chemistry, The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan CREST, Japan Science and Technology Agency (JST), Bunkyo -ku, Tokyo 113-0033, Japan Kanagawa Academy of Science and Technology (KAST), Kawasaki, Kanagawa 213-0012, Japan

I.P2. 15

Resume : Since the discoveries of superconductivity in non-ordinary oxyfluorides Sr2CuO2F2+x, replacements of O2- by F- in transition-metal oxides have attracted considerable attention. One of promising methods to obtain oxyfluorides is topotactic reaction using polyvinylidine fluoride (PVDF). For instance, bulk SrFeOx changed into SrFeO2F by simply annealing with PVDF [1]. It is expected that the reactivity of thin film with PVDF is much higher than that of bulk due to larger surface area and smaller volume. So far, however, topotactic fluorination using PVDF has been only applied to bulk samples. In this study, we performed topotactic fluorination by using PVDF into SrFeO2.5 and SrCoO2.5 epitaxial thin films grown on SrTiO3(001) substrates. As a result, we successfully synthesized perovskite SrFeO3-xFx epitaxial thin films, in which the fluorine content x was controllable in a wide range of 0.8–2 by fluorination temperature. The fluorination reaction was conducted at 150–270 °C which is much lower than that reported for bulk, 400 °C. Moreover, the optical bandgap of the SrFeO3-xFx films was wider than that of SrFeO2.5 and LaFeO3. We also successfully synthesized SrCoOxFy epitaxial thin films by the same reaction at 150 °C. [1] J. Phys.: Condens. Matter 2008, 20, 215207.

add to my program (close full abstract)

18:00 **Formation of a dipole nitride film on InP: toward new MISFET.**

Authors : C.Njel, D.Aureau, A-M Gonçalves*, A.Etcheberry

Affiliations : Institut Lavoisier de Versailles ILV - UMR- CNRS 8180 (http://www.ilv.uvsq.fr) UVSQ, 45, Avenue des Etats-Unis 78000 Versailles Cedex-France. *Fax/Tel: + 33 (0) 1 39 25 44 19/18 - E-mail: anne-marie.goncalves@uvsq.fr

I.P2. 16

Resume : The nitridation of InP surface is an attractive way of passivation. The modified surface can be used for insulator manufacturing as well as for Metal-Insulator-Semiconductor devices or field effect transistors (FET) [1]. Unlike silicon dioxide (SiO2) which behaves as a protective material on silicon surface, InP oxides involve significant degradation of InP electrical properties. The native oxides removal and the passivation of InP surface are therefore significant steps for the realization of InP-based high-performance compounds. Several methods are described in the literature for the nitridation of the InP surface as ion bombardment nitrogen (N2+) procedure or plasma N2 technique [2]. This paper presents an original way of InP nitridation, involving an ultra thin film which structures the interface at a nanometer scale. The passivation of III-V semicondutors has been already evidenced in liquid ammonia (-55 °C) during an anodic treatment [3]. An extraction from the solvent of InP sample has been successfully made. Thanks to XPS analysis, a reproducible polyphosphazene like film has been evidenced on InP (-[P(NH2)=N]n-) [4]. In this work, the coupling approach of electrochemistry and XPS analysis provides the step-by-step process of the passivating film. A flat band potential shift has been observed by in-situ of capacitance measurements during the film formation. The polyphosphazene like film behaves like a dipole which provides a new way of MISFET manufacturing.

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18:00 **Influence of annealing condition on electrical property of copper electrode: Closes to improve conductivity**

I.P2. 17

Authors : Dal Sung Kong 1, Gill Sang Han 2, Min Jeong Kim 3, Hyunjung Shin 1 and Hyun Suk Jung 2

Affiliations : 1 Department of Energy Science, Sungkyunkwan University, 2066 Seobu-ro, Janan-gu, Suwon-si, Gyeongi-do 440-746, Korea;2 School of Advanced Materials Science and Engineering, Sungkyunkwan University, 2066 Seobu-ro, Janan-gu, Suwon-si, Gyeongi-do 440-746, Korea;3 Department of Materials Science and Engineering, Seoul National University, Gwanak-ro, Gwanak-gu, Seoul 151-742, Korea

Resume : As an alternative technique for the complicated photolithography, the printing process has received great attention for the fabrication of conductive metallic patterns. Copper paste or ink which implied in conductive metallic patterns has been studied to replace the expensive conductive materials such as gold and silver paste or ink. However, a problem of copper is to form a copper oxide in ambient atmosphere consequently deteriorating the electrical conductivity. Therefore, the printed copper electrodes have been sintered under reduction atmosphere such as gaseous mixture and nitrogen to avoid oxidation during heat treatment. In this work, we observed that N2 atmosphere more effectively decompose the organic binders than gaseous mixture of 5% H2 and 95% N2. At 400 ℃, the resistivity of the sintered film in nitrogen atmosphere (3 x 10^2 uΩcm) was 2 orders of magnitude lower than that of sintered in reducing atmosphere (10^4 uΩcm). The film sintered at 600 ℃ in nitrogen atmosphere has exhibited Cu2O. Despite of formation of copper oxides the grain growth of copper nanoparticles led to a dramatic decrease in the electrical resistivity (9 uΩcm). From this study, the grain growth of copper nanoparticles during decomposition of the organic is more important factor than retardation of copper oxide formation to fabricate of highly electrical conductive copper films.

add to my program (close full abstract)

18:00 **Fabrication and electrochemical properties of carbon-coated LiMnPO4 nanoparticles for lithium-ion battery**

Authors : Shengnan Huang1, Zhaolong Li1, Shanshan Jiang1, Shan Lu1, Yue Yu1, Quanyao Zhu1,*, Galina S. Zakharova2

Affiliations : 1 State Key Laboratory of Advanced Technology for Materials Synthesis and Processing, School of Materials Science and Engineering, Wuhan University of Technology, Luoshi Road 122, Wuhan 430070, P. R. China; 2 Institute of Solid State Chemistry of the Ural Branch, Russian Academy of Science, Pervomaiskaya ul. 91, Yekaterinburg, 620219, Russia

I.P2. 18

Resume : The carbon-coated LiMnPO4 nanoparticles were synthesized by a freeze-drying method. Carbon was coated on LiMnPO4 nanoparticles by a thermal decomposition process. The analysis of X-ray diffraction (XRD) revealed that the crystal structure of the LiMnPO4 was orthorhombic. The field emission scanning electron microscopy (FESEM) images indicated that the carbon-coated LiMnPO4 nanoparticles were dozens of nanometers in diameter. The electrochemical properties were carried out by the cyclic voltammetry (CV) and galvanostatic discharge/charge cycling analysis. This carbon-coated LiMnPO4 nanoparticle displayed superior battery performance with enhanced specific capacity and excellence cycle performance.

add to my program (close full abstract)

18:00 **Effect of Nd substitution on the physical properties of multiferroic BiFeO3**

Authors : T. Slimani Tlemçani1, M. Taibi2, T. El Bahraoui1, A. Belayachi1 and M. Abd-Lefdil1

Affiliations : 1University of Mohammed V-Agdal, Materials Physics Laboratory, P. B. 1014, Rabat, Morocco; 2Laboratoire de Physico-Chimie des Matériaux Inorganiques et Organiques, Ecole Normale Supérieure Rabat-Morocco.

I.P2. 19

Resume : Multiferroic materials have attracted great attention due to their potential applications in multifunctional devices. In this work, powders of Bi1-xNdxFeO3 (x= 0; 0.3) were successfully synthesized by a sol-gel method. X-ray diffraction patterns revealed the formation of pure BiFeO3 (BFO) and BNFO. No secondary phases were observed within the detection limit of the XRD technique. We observed that the neodymium substitution leads to the change of the BiFeO3 symmetry. The obtained samples were also characterized by Raman spectroscopy, differential scanning calorimetry (DSC) and dielectric measurements.

add to my program (close full abstract)

18:00 **Preparation Technique of Thorium Films by Electrochemical Deposition for Nuclear Optical Frequency Standard Based on Thorium-229**

Authors : P.V. Borisyuk 2, Y.Y. Lebedinskii 1,2, V.I. Troyan 2

Affiliations : 1-Moscow Institute of Physics and Technology (MIPT); 2-National Research Nuclear University (MEPhI)

I.P2. 20

Resume : The increase of the accuracy of optical frequency standards by means of the development of "nuclear clocks" – a novel frequency standard based on the nuclear transition to the long-living isomer nuclear state of Th-229 with

energy ~7.6 eV is of great interest. The main problem is the fact that there are no experimental data on the direct measurement of the energy of the isomeric transition in Th-229, and the above result was obtained only by indirect measurements, and has great uncertainty. Ion scattering spectroscopy (ISS) might be used for more precision investigations of the isomeric transition in Th-229. It caused by the fact that ISS spectra exhibit the fine structure determined by the target surface electronic structure. In the case of low energy nuclear transition it can give the information about the isomer nuclear state of Th-229. To proof this supposition it is necessary to prepare high quality samples with a high thorium surface coverage. An original preparation technique of the thorium films by electrochemical deposition from thorium nitrate solution on different substrate is reported. It was found that electrochemical deposition of Th on the metal surface provide formation of continuous films, while the deposition on the semiconductor substrates leads to the formation of thorium island films. The origin of the observed thorium films formation and the results on the investigation of Th films on Si(111) and polycrystalline Cu surfaces by XPS and ISS are discussed.

add to my program (close full abstract)

18:00 **An insight into the epitaxial nanostructures of NiO and CeO2 thin film dielectrics for AlGaN/GaN heterostructures**

Authors : Emanuela Schilirò1,2, Sergio Battiato2, Graziella Malandrino2, Patrick Fiorenza1, Fabrizio Roccaforte1, Raffaella Lo Nigro1

Affiliations : 1Istituto per la Microelettronica e Microsistemi Consiglio Nazionale delle Ricerche - (CNR-IMM), Strada VIII 5, 95121 Catania, Italy 2Dipartimento di Scienze Chimiche, Università degli Studi di Catania, and INSTM udr Catania, viale Andrea Doria 6, 95125, Catania, Italy

Resume : Wide band gap semiconductors are considered suitable candidates for high frequency and high power electron devices. In particular, GaN-based semiconductor field effect transistor (MESFET) and high electron mobility transistor (HEMT) devices have shown excellent progress. However, one of the more challenging aspects of GaN devices technology is related to the achievement of functional oxides, able to improve the device performance in terms of crucial parameters including: channel mobility, parasitic capacitance and gate leakage current. In this context, epitaxial oxides thin films, such as NiO and CeO2, have been grown by metal-organic chemical vapor deposition (MOCVD) on AlGaN/GaN heterostructures. Very thin (less than 20nm thick) epitaxial layers have been obtained at already at low temperature (500°C). Despite both possess low lattice mismatches with respect to AlGaN/GaN, different orientation have been observed. In particular, NiO films were grown along the <111> direction while CeO2 thin films showed mixed <111> and <100> orientations. In both cases, the <111> structural relationship has been justified by the hexagonal symmetry of the {111} planes, which may match the (0001) hexagonal plane of AlGaN substrate. On the other hand, the CeO2<100> preferential orientation can be explained on the basis of kinetic factors. Finally, electrical characterization demonstrated that the epitaxial films can be very promising as gate dielectrics for AlGaN/GaN transistors technology. In fact, both films showed really interesting electric properties such as dielectric constants (NiO= 11,7 and CeO2 =26) close to the ideal values.

I.P2.21

add to my program (close full abstract)

18:00 **Growth of A2WO6 on SrTiO3 and LaAlO3 Substrates by Pulsed Laser Deposition: XRD, TEM, Raman and AFM Investigations**

Authors : Thomas Carlier, Marie-Helene Chambrier, Sonia Estrade, Anthony Ferri, Jean-François Blach, Belkacem Meziane, Francesca Peiro, Desfeux Rachel

Affiliations : Universite Lille Nord de France, F-59000 Lille, France; CNRS, UMR 8181, F-59650 Villeneuve d'Ascq, France; Universite d'Artois, UCCS, F-62300 Lens, France; LENS,MIND-In2UB, Electronics Department, Universitat de Barcelona (UB),Marti i Franques 1, Barcelona 08028, Spain

Resume : Since 60's, oxides based on A2O3-MO3 (A = Bi3+, La3+ or Ln3+; M = Mo and W) system are of significant technological interest for their laser applications, ionic conduction, catalytic, photoluminescence and ferroelectric properties. In this work, we focus on the growth in thin films of A2WO6 compounds (A = Bi3+, La3+ or Ln3+), where only two monoclinic and orthorhombic crystalline systems are possible. Moreover, in the case of La2WO6 and Bi2WO6, a phase transition is observed. For other compositions, the structure is depending on the synthesis route. Besides, the specific structure leads to particular properties. From A2WO6 target, thin films were grown by Pulsed Laser Deposition on (100)-SrTiO3 and (110)-LaAlO3 substrates, and growth parameters were studied. Microstructural investigations performed by

I.P2.22

High Resolution X-Ray Diffraction revealed the stabilization of orthorhombic polymorph phase with each substrate. The films were shown to be (00l) oriented. Microstructural properties were also finely characterized by Transmission Electronic Microscopy (TEM). Nanoscale piezo-/ferroelectricity were explored by Piezoresponse Force Microscopy and in-situ Scanning-TEM. Finally, photoluminescence was highlighted by Raman experiments at λ = 514.5 nm for some compounds.

add to my program (close full abstract)

18:00 **Surface Passivation Techniques of ZnO Nanorods for Enhanced Performance of Piezoelectric Energy Harvesters**

Authors : Nimra Jalali, Joe Briscoe, Yan Zhi Tan, Peter Woolliams, Mark Stewart, Paul M. Weaver, Markys Cain and Steve Dunn.
Affiliations : Nimra Jalali; Joe Briscoe; Steve Dunn from Queen Mary University of London, United Kingdom. Yan Zhi Tan from Nanyang Polytechnic, Singapore. Peter Woolliams; Mark Stewart; Paul M. Weaver; Markys Cain from National Physical Laboratory, United Kingdom.

Resume : The use of nanostructured ZnO in piezoelectric energy harvesters has many advantages such as ease of synthesis on a range of substrates and greater mechanical stability than bulk ceramics. However, the high surface area also leads to a large number of defect states that increase carrier density and screen the polarisation leading to reduced output. We report methods to passivate ZnO nanorods using either semiconducting CuSCN or layer-by-layer deposited polyelectrolytes for ZnO/PEDOT:PSS piezoelectric energy harvesters. We focus on the impact of ZnO nanorod passivation in p-n junction devices and relate performance to impedance and time constant changes. The polyelectrolyte and CuSCN passivation resulted in 897 mV and 470 mV output: 4 and 7 times higher than non-passivated device. The peak power density also increased from 44 μW/cm2 to 120 μW/cm2 with the polyelectrolytes and 318 μW/cm2 with CuSCN. The higher output when passivating with CuSCN was attributed to the strong bonding with ZnO and its lower impedance than the polyelectrolyte. Impedance measurements show that the time constant increases from 0.0045 ms for non-passivated to 1.14 ms for passivated ZnO, which indicates improved charge storage in ZnO and a decrease in the internal screening rate. Thus the passivation-induced reduced screening rate can be linked to the improved nanogenerator performance. However, it is also shown that the choice of passivating material is also important to optimise the efficiency.

I.P2. 23

add to my program (close full abstract)

18:00 **Inkjet printing of Ta2O5-based dielectric patterns from solution**

Authors : Aleksander Matavž, Raluca C. Frunză, Barbara Malič
Affiliations : Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia; Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia; Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia;

Resume : Transparent electronics is a new and fast growing research and development field, aiming at the realization of fully transparent and lightweight devices. It requires low cost deposition, low temperature processing and has to meet the demand of continuous device downscaling. The implementation of high -K materials as gate dielectrics is one of several strategies developed to allow further miniaturization of microelectronic components, and Ta2O5 is a promising candidate. Moreover, inkjet printing is a versatile direct patterning technique enabling printing of fine features. The aim of our study was to pattern 2D-structures of Ta2O5-based dielectrics for capacitors or gate insulators in thin-film transistors. Alkoxide-based organic solutions originally designed for chemical solution deposition of thin films were modified in terms of surface tension and viscosity to be suitable for piezoelectric inkjet printing. More viscous solvents as 1,3-propanediol and glycerol were admixed and comparative tests were done. All inks were stable and jetting even after long periods of time. The printing parameters including the temperatures of the cartridge, waveform, drop spacing, and the substrate temperature were adjusted to allow patterning of 2D structures on selected substrates.

I.P2. 24

add to my program (close full abstract)

18:00 **Elaboration by sol-gel and characterizations of ferroelectric Ba0.85Sr0.15TiO3 thin films for sensor realization**

Authors : Aymen SELMI1, Manuel MASCOT2, Fathi JOMNI1, Jean-Claude CARRU 2, Béchir YANGUI 1
Affiliations : 1 Laboratory for Materials, Organization and Properties (LMOP), University

I.P2. 25

of Tunis El Manar 2092 TUNIS, TUNISIA 2 Unité de Dynamique et Structure des Matériaux Moléculaires (UDSMM), Centre de la Mi-Voix, Université du Littoral-Côte d'Opale – 62228 - Calais, FRANCE.

Resume : The European directive RoHS (Restriction of Hazardous substances) prohibits, since july 2006, various polluting materials like lead in electronic components. In this view, we have studied BaTiO3 ferroelectric thin films doped by Strontium (BST). The deposition of the BST films was done by a soft chemical process [1], the sol-gel route, on silicon substrates covered by platinum with (111) orientation. All our films, characterized by X-Ray diffraction, are well crystallized and the perovskite phase is identified. The microstructural properties were studied by SEM : that permits to determine the mean size of the grains which were between 30 and 90 nm. The chemical composition was evaluated to be Ba0.85Sr0.15TiO3. The thickness of the films measured in cross-section by SEM was between 50 and 400 nm. Dielectrical measurements were made in radiofrequencies from 100Hz to 1MHz : at room temperature and 1 kHz a permittivity value as high as 1000 is obtained for the 400 nm thin film. The corresponding loss tangent is about 0.03. Ferroelectric characterizations and tunability were made by the measurement of the capacitance of the films under a DC bias varying from -40 volts to +40 volts. We have also determined the pyroelectric coefficient γ with a home-made measuring device in order to realize a low cost infrared sensor. [1] M. MASCOT et al. "Electrical properties of Ba0.8Sr0.2TiO3 films deposited by sol-gel on platinized silicon substrate", Ferroelectrics, 362 (2008) 79-86.

add to my program **(close full abstract)**

18:00 **Synthesis and characterization of Na0.5Bi(0.5-x) CexTiO3powders: a lead-free piezoelectric material**

Authors : S. Supriya, Antonio J. Dos santos-García, F. Fernández-Martinez and C. Colon
Affiliations : Industrial Chemistry and PolymersDepartment, ETSIDI, Polytechnic University of Madrid (UPM), Madrid-28012, Spain.

Resume : Cerium-doped sodium bismuth titanate compounds,Na0.5Bi(0.5-x) CexTiO3 (x = 0.05 to 0.15) (NBCT),crystallize with the pyrochlore-type structure when theyare obtained at moderate temperatures (750ºC). However, astructural phase transition from pyrochlore- toperovskite-type structure takes place by increasing the temperature up to 1200ºC. The structural characterization of these polymorphs was performed by means of the Rietveld refinement of the XRD data and the structural transformation was monitored by in-situ XRD thermo-diffractograms. The thermal stability of the samples wasevaluated bythermogravimetry/differential thermal analysis (TG/DTA) and crystal lattice distortions were checked by Raman and FT-IR Spectroscopy. The presence of a metallic component within a ferroelectric matrix results in an improvement of the dielectric and ferroelectric properties.Therefore, Ce-doping on Na0.5Bi0.5TiO3(NBT) can induce metal-insulator transition, and enhance its properties. In this work we present our recent results on the synthesis of Ce-doped NBTcompounds and the effect that Ce-doping has on the dielectric and ferroelectric properties.

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add to my program **(close full abstract)**

18:00 **SILICOPHOSPHATE FILMS DOPED WITH ORGANIC COMPOUNDS FOR NONLINEAR OPTICAL APPLICATIONS**

Authors : I.C. Vasiliu1, I. Ionita2, A. Matei3 , M.Elisa1, R. Iordanescu1, I. Feraru1, A. Emandi1
Affiliations : 1INOE 2000 - National Institute for Optoelectronics, 409 Atomistilor Str., Magurele RO-077125, Bucharest, Romania, icvasiliu@inoe.inoe.ro 2UB - University of Bucharest, 405 Atomistilor Str., Magurele RO-077125, Bucharest, Romania 3INFLPR - National Institute for Laser, Plasma and Radiation Physics, 409 Atomistilor Street, Magurele, RO-077125 Bucharest, Romania

Resume : Doped organic compounds are of great interest for optical communications and high-density optical data storage due to their large second-order nonlinearity and high-speed response. A promising approach in the fabrication of new materials for second-order nonlinear optics is sol-gel technique. The present paper reports on the sol-gel synthesis of some pyrazolone derivative doped SiO2-P2O5 films. The precursors used for sol gel synthesis were tetraethylorthosilicate (TEOS) and phosphoric acid (H3PO4). The organic compound was added under continuous stirring in the precursors' mixture. The structure of the deposited azo-derivatives doped thin films was examined by Fourier transform infrared spectroscopy, and atomic force microscopy and their optical properties by UV-VIS spectroscopy. The nonlinear optical efficiencies due to the interaction of the NLO-active chromophores with the inorganic matrix has a significant influence on the second harmonic

I.P2. 27

generation capabilities that was measured using a femtosecond Ti:sapphire laser. The properties of the films were investigated and correlated with the concentration of the organic dopant and the thermal treatment temperature.

add to my program (close full abstract)

18:00 **Spontaneous Electrochemical Deposition of Core-Shell Cu-Ni(OH)2 Nanobelts as High-Performance Electrodes for Pseudocapacitors**

Authors : I-Chun Chang1,Ting-Ting Chen1, Yin-Jie Pan1, Yu-Shu Lin1, Hsin-Tien Chiu2 and Chi-Young Lee1*

Affiliations : 1 Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan, R. O. C. 2 Department of Applied Chemistry, National Chiao Tung University, Hsinchu 30010, Taiwan, R.O.C.

Resume : The core-shell Cu-Ni(OH)2 nanobelts (NBs) are constructed as pseudocapacitor materials for potential energy storage devices. These core-shell NBs were prepared by two spontaneous electrochemical deposition steps, which is a simple, cost effective and green. The densely interlacing copper NBs network serve as excellent nanoscale current collectors providing high surface area, good conductivity,1 and the uniform coated Ni(OH)2 nanosheet shortens ion diffusion paths and facilitates migration of electrolyte ions. Besides, the polymeric binder free electrode avoids the active material surface being blocked. The core-shell Cu-Ni(OH)2 NBs electrode delivers a high specific capacitance of 2426 F g–1 at 10 A g–1 and a remarkable rate performance (81% maintained) even at 100 A g–1 in 1 M KOH electrolyte. The rate performance and the long-term cycle stability were further promoted by partial substitute of Ni with Co. The improved rate performance (86% maintained) and the long-tern stability (91%) at galvanostatic charge-discharge rate of 30 A g-1, strongly suggesting core-shell Cu-CoxNi1-x(OH)2 NBs being promising candidates for next generation high-performance supercapacitor. Reference: (1) Huang, T.-K.; Cheng, T.-H.; Yen, M.-Y.; Hsiao, W.-H.; Wang, L.-S.; Chen, F.-R.; Kai, J.-J.; Lee, C.-Y.; Chiu, H.-T. Langmuir 2007, 23, 5722– 5726.

I.P2.28

add to my program (close full abstract)

18:00 **Solution-derived Ta2O5-based dielectric thin films for transparent electronic devices**

Authors : Raluca C. Frunză, Pedro Barquinha, Elena Tchernychova, Luís Pereira, Elvira Fortunato, Rodrigo Martins, Barbara Malič

Affiliations : Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia; CENIMAT-I3N, Departamento de Ciência dos Materials and CEMOP/UNINOVA, Faculdade de Ciências e Technologia, FCT, Universidade Novade Lisboa, Campus da Caparica, 2829-516 Caparica, Portugal; Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia; CENIMAT-I3N, Departamento de Ciência dos Materials and CEMOP/UNINOVA, Faculdade de Ciências e Technologia, FCT, Universidade Novade Lisboa, Campus da Caparica, 2829-516 Caparica, Portugal; CENIMAT-I3N, Departamento de Ciência dos Materials and CEMOP/UNINOVA, Faculdade de Ciências e Technologia, FCT, Universidade Novade Lisboa, Campus da Caparica, 2829-516 Caparica, Portugal; CENIMAT-I3N, Departamento de Ciência dos Materials and CEMOP/UNINOVA, Faculdade de Ciências e Technologia, FCT, Universidade Novade Lisboa, Campus da Caparica, 2829-516 Caparica, Portugal; Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia;

Resume : Ta2O5 is a promising high-κ dielectric, due to its high refractive index, high dielectric constant (in the range 22-28 for the amorphous state) and good thermal and chemical stability, although its small band offset with oxide semiconductors leads to high leakage currents. The present study aims at the preparation of solution-derived Ta2O5-based thin films suitable for transparent electronic devices, using a multicomponent approach to enhance the electrical properties. Thin films of the ternary composition Ta2O5-Al2O3-SiO2 with the Ta:Al:Si = 8:1:1 atomic ratio were deposited from alkoxide-based organic solutions and processed at temperatures not exceeding 400 °C. As reference, pure Ta2O5 thin films were also prepared. All samples were amorphous, showed uniform and flat surfaces, and exhibited high optical transparency in the visible range. The Ta2O5-based thin films exhibited promising properties for transparent capacitors and thin-film transistors (TFTs). The Ta2O5 sample processed at 400 °C exhibited the highest permittivity (εr ≈27). The εr decreased with lowering of the processing temperature, and showed lower values for the mixed composition samples. Metal-insulator-semiconductor structures of the high-κ dielectric layers were characterized by analyzing capacitance-voltage curves recorded at different frequencies. TFTs with the solution-derived gate insulators and sputtered GIZO channel layer rendered good operating properties, such as on-off ratio above 10^8, turn-on voltage between -1 and 0 V and field-effect mobility above 10 cm^2/Vs.

I.P2.29

add to my program (close full abstract)

18:00 **Structural characterization and ferroelectric properties in metastable Ln2Ti2O7 (Ln=Sm, Eu, Gd) thin films**

Authors : A. Bayart,1,2 S. Saitzek,1,2 A. Ferri,1,2 M. Huvé,1,3 P. Roussel,1,3 R. Desfeux,1,2

Affiliations : 1 Univ Lille Nord de France, F-59000 Lille, France 2 UArtois, UCCS, F-62300 Lens, France CNRS, UMR 8181, F-59650 Villeneuve d'Ascq, France 3 ENSCL, UCCS, F-59652 Villeneuve d'Ascq, France CNRS, UMR 8181, F-59650 Villeneuve d'Ascq, France

Resume : Lanthanide dititanate family, Ln2Ti2O7, adopts two type of structure and the stability depends of the ratio between the cations radii Ln3+ and Ti4+. For r(Ln3+)/r(Ti4+) included in the range {1.46-1.78}, the formed compound will privilege a pyrochlore-like structure for Ln = Sm to Lu. For ratio higher than 1.78, the layered perovskite type is preferred for Ln = La to Nd. Layered perovskite structure compounds are known for their ferroelectric and piezoelectric properties mainly used for the elaboration of high temperature devices. In this work, we sought to show it was possible to extend to the ranks of stability of the layered perovskite structure for smaller Ln3+ ionic radii (i.e. Sm, Eu, Gd, ...) including through epitaxial constraints. The growth of thin films has been achieved by Sol-gel method or Pulsed Laser Deposition on SrTiO3 and LaAlO3 substrates. We also present the structural characterization performed by High Resolution X-ray Diffraction on each substrate with (100) or (110) orientations. Indeed, studies performed on (110)-oriented SrTiO3 or LaAlO3 substrates, shows a growth following (00l) plans. While for the (100)-oriented SrTiO3 or LaAlO3 substrates, the growth is carried out according to the planes (012) tilted compared to the substrate plane. Finally, the ferroelectricity, in these metastable thin films, will demonstrated through measurements performed at the nanoscale level by Piezoresponse Force Microscopy (PFM).

I.P2.30

add to my program (close full abstract)

18:00 **Transparent conducting oxides (TCOs) based on Nb-doped and V-doped TiO2 thin films**

Authors : M. Stoica, M. Nicolescu, L. Predoana, S. Preda, M. Anastasescu, M. Duta, M. Gartner, M. Zaharescu

Affiliations : "Ilie Murgulescu" Institute of Physical Chemistry, Romanian Academy

Resume : With a suitable dopant, the TiO2 films may exhibit an enhanced TCO behavior. In this respect, single and multilayer Nb/V doped TiO2 transparent films with a molar ratio TiO2:Nb2O5 and TiO2:V2O5 of 98:2 were obtained by sol-gel dip coating on microscope glass substrate, using a withdraw rate of 5 cm/min. The reagents used were tetraethyl orthotitanate, Nb/V ethoxide and ethanol as solvent. Before deposition the solutions were aged for 24 h. Following deposition the films were thermally treated at 450 °C for 1 hour, using a heating rate of 5 °C/min. Thus, films with 1, 2, 5 and 10 layers resulted and then structurally (X-Ray Diffraction), morphologically (Atomic Force Microscopy) and optically (Ellipsometry) characterized. The XRD analysis revealed the amorphous nature of single layered films, while the multilayered films crystallized in the anatase phase of TiO2 for both type of dopants. Surface morphology depends on the number of film layers as determined from AFM investigations, surface roughness being proportional with the number of deposited layers. Modeling the ellipsometric data acquired on the 200–1700 nm spectral range, at three angles of incidence, the film thickness, surface roughness, optical constants and charge carrier numbers were inferred and correlated with the microstructure and morphology of the films. Ellipsometric transmission data showed a red-shift with the increase of layer number for both type of the doped films, as well as high transmission values.

I.P2.31

add to my program (close full abstract)

18:00 **Investigations of the structural, electronic and magnetic properties of Fe2-xTixO3/Fe2O3 thin films grown on Al2O3 (0001)**

Authors : Teresa Dennenwaldt1, Maike Lübbe2, Michael Winklhofer2, Alexander Müller1, Markus Döblinger1, Hasan Sadat Nabi2, Maria Gandman3, Tzipi Cohen-Hyams4, Wayne D. Kaplan4, Wolfgang Moritz2, Rossitza Pentcheva2 and Christina Scheu1

Affiliations : 1Department of Chemistry and Center for NanoScience, Ludwig-Maximilians-Universität München, Butenandtstr. 5-13, 81377 Munich, Germany; 2Department of Earth and Environmental Sciences and Center for Nanoscience, Ludwig-Maximilians-Universität München, Theresienstr. 41, 80333 Munich, Germany; 3Department of Materials Science and Engineering, 210 Hearst Memorial Mining Building, University of California, Berkeley, USA; 4Department of Materials Science and Engineering, Technion – Israel Institute of Technology, Haifa 32000, Israel

I.P2.32

Resume : Heterointerfaces between hematite (α-FeIII2O3, weak ferrimagnetic) and ilmenite (FeIITiO3, antiferromagnetic) are supposed to exhibit a strongly ferrimagnetic contact layer due to the formation of a mixed valence layer of Fe2+/Fe3+ (1:1 ratio) caused by compensation of charge mismatch at the chemically abrupt boundary.1 So far, it is not studied what happens when ilmenite is replaced by Ti-doped hematite Fe2-xTixO3 (x < 0.5) where Fe2+/Fe3+ < 1. We investigated thin films of α-Fe2O3/Fe2-xTixO3 (x = 0.44) on α-Al2O3 (0001) substrates which were grown by molecular beam epitaxy concerning their structural (in-situ surface X-ray diffraction, transmission electron microscopy), electronic (electron energy loss spectroscopy) and magnetic properties (superconducting quantum interference device measurements).2 We observed an increased magnetic moment and a formation of a chemically distinct interface layer, which might also be magnetically distinct as indicated by the observed magnetic enhancement in the Fe2-xTixO3/Fe2O3/Al2O3 system compared to the pure Fe2O3/Al2O3 system. The interface between this layer and the hematite layer shows an enrichment of Fe2+ which forms an uncompensated spin lattice, and might therefore be responsible for the interface magnetism. 1 P. Robinson et al., Nature 418, 517 (2002). 2 T. Dennenwaldt, M. Lübbe, M. Winklhofer, A. Müller, M. Döblinger, H. Sadat Nabi, M. Gandman, T. Cohen-Hyams, W. D. Kaplan, W. Moritz, R. Pentcheva and C. Scheu, submitted.

add to my program (close full abstract)

18:00 **Enhanced holes mobility in AlO and pentacene-based OTFTs due to the passivation of the oxide surface using PVP**

Authors : A. Sleiman, M. Kreyenborg-Nichols, T. Alshahrani*, D. Ashall, P. W. Sayers and M. F. Mabrook
Affiliations : Bangor University

Resume : We report on the enhanced holes mobility in organic thin film transistors (OTFTs) based on aluminium oxide (AlO) as a dielectric and penatcene as the semiconductor. The enhancement was through the passivation of the AlO surface using self-assembled molecular monolayers. The OTFTs benefit from aluminium (Al) as a gate, AlO, pentacene and gold (Au) ohmic contacts as source and drain to pattern the OTFTs channel. A control device without passivation was fabricated for comparison reasons in the Al/AlO/pentacene/Au structure. In the passivated OTFTs an organic thin film passivation layer (PL) was introduced between the AlO and pentacene to form the Al/AlO/PL/pentacene/Au structure. The materials used as a PL were octadecylphosphonic acid (ODPA), polymethyl methacrylate (PMMA) and poly-4-vinylphenol (PVP). All devices with different PLs had better transistor performance than the control device. The calculated mobilities of the devices with PLs were all higher than that of the control device (4.0×10-4 cm2/Vs). An atomic force microscopy (AFM) scans of the evaporated pentacene on AlO and different PLs were carried out to study the pentacene morphology grown on different layers. The control device showed that amorphous pentacene was grown on the AlO, while polycrystalline pentacene was grown on the PLs. For the passivated OTFTs, different mobilities were recorded for different materials used as PLs. OTFTs with ODPA showed the lowest mobility of 0.016 cm2/Vs, while OTFTs using PVP showed the highest mobility of 0.11 cm2/Vs. This was correlated to the grain size of the polycrystalline pentacene grown on the PL, where the mobility of the devices increased as the grain size increased.

I.P2.33

add to my program (close full abstract)

18:00 **Temperature-dependent transfer characteristics of solution-processed indium gallium and indium yttrium mixed oxide thin-film transistors**

Authors : Felix Jaehnike, Duy Vu Pham, Alexey Merkulov, Corinna Weber, Claudia Bock, Ulrich Kunze
Affiliations : Evonik Industries AG Electronic Solutions, D-45772 Marl; Ruhr-Universität Bochum, Werkstoffe und Nanoelektronik, D-44780 Bochum

Resume : Temperature-dependent field-effect measurements were performed on solution-processed indium oxide thin-film transistors (TFTs). We demonstrate the effect of gallium and yttrium doping on the performance and stability. These elements were used due to their higher oxygen binding energy compared to indium. It is believed that the formation of oxygen vacancies can be reduced. First, the transfer characteristics of TFTs with various compositions of In/Ga and In/Y were analyzed without temperature stress under nitrogen atmosphere to avoid any influence by moisture and oxygen from the ambient. The electrical properties of the resulting devices were significantly affected by the composition of the mixed oxides. The highest field effect mobility in the linear regime was determined to be 18 cm2/Vs for a pure In2O3-based TFT. For concentrations of

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gallium and yttrium higher than 10 mol % a strong deterioration of the TFT performance was observable. In order to investigate the effect of gallium and yttrium on the threshold voltage alteration, the samples were stressed for t = 30 min at different temperatures ranging from T = 20 °C to T = 90 °C. A clear shift of the threshold voltage in the negative direction of VG was observable. The shift increases with increasing temperature; however it was significantly reduced with higher doping concentrations. The results showed that the doping with gallium and yttrium suppressed the negative threshold voltage shift during the temperature stress.

add to my program (close full abstract)

18:00 **Hydrothermal synthesis of GIZO nanoparticles for solution-processed electrolyte-gated transistors**

Authors : L. Santos, P. Barquinha, R. Branquinho, D. Salgueiro, L. Pereira, R. Martins, E. Fortunato

Affiliations : CENIMAT/I3N, Departamento de Ciência de Materiais, Faculdade de Ciências e Tecnologia, Universidade Nova de Lisboa and CEMOP/UNINOVA, Campus da Caparica, 2829-516 Caparica - Portugal

Resume : Solution-processed field-effect transistors are important building blocks in flexible electronics. Nevertheless, many challenges have still to be overcome in order to achieve high-performance transistors. Low temperature, reproducibility, large areas and cost effectiveness are at the present the main concerns. In this work we developed a electrolyte-gated transistor based on hydrothermal synthesized GIZO nanoparticles (Ga:In:Zn - 3:6:2) dispersed in ethanol with variable amount of ethylene glycol and annealed at 350 and 250 ºC for one hour. Solid composite polymer electrolyte was based on aqueous dispersions of vinyl acetate stabilized with cellulose derivatives, acrylic acid ester in styrene and lithium perchlorate. Both layers were deposited by spin coating. The best performance resulted in ION/IOFF of 105 with mobility of 9 cm2/V.s. Electrolyte-gated transistors (EGTs) are particularly interesting for nanoparticle based semiconductors as the electrolyte promotes a more efficient coverage of the channel layer besides reducing the working voltage when compared with conventional dielectrics gating. The operation mechanism of the produced EGTs changed from electric double layer to electrochemical doping by increasing the applied gate voltage range.

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add to my program (close full abstract)

18:00 **Post-growth annealing of GaAs/Ge layers studied by photoreflectance spectroscopy**

Authors : S. Soltani, I. Zaied, Z. Chine, A. Rebey, B. El Jani

Affiliations : Unité de Recherche sur les Hétéroépitaxies et Applications, Faculté des Sciences de Monastir, 5019 Monastir, Tunisie

Resume : We have investigated the effects of post-growth annealing on optical and structural proprieties of GaAs thin films grown on Ge substrates by Metal Organic Vapor Phase Epitaxy (MOVPE). The GaAs/Ge samples were annealed at 650 °C for 20 min in N2 ambient. Photoreflectance (PR) and photoluminescence (PL) techniques were used in addition to high resolution x-ray diffraction (HRXRD) measurements to characterize GaAs epitaxial layers before and after annealing. PR spectra of as grown GaAs films did not show any Franz-Keldysh Oscillation (FKO) generated by the electric field inside these films. We believe that this is due to the highly non uniform electric field and the extremely narrow surface depletion region which are the results of high density of defects and traps in GaAs films. Unlike the as grown layers, PR spectra of the annealed ones exhibit FKO features. This appearance of FKO's after thermal treatment at 650 ° C may be related to an improvement in surface quality of GaAs films.

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add to my program (close full abstract)

18:00 **Characterization of Conmensurated Grown of Au on single phase Fe3O4 thin layers**

Authors : A. Munoz-Noval, J. Rubio-Zuazo, E. Salas, G.R. Castro

Affiliations : Instituto de Ciencia de Materiales de Madrid, Consejo Superior de Investigaciones Cientificas (ICMM-CSIC), Madrid, Spain and Spanish CRG (SpLine), European Synchrotron Radiation Facility, Grenoble, France

Resume : Metal-ferrimagnetic hybrid system have been fabricated by growing Au thin films epitaxially over single phase Fe3O4 thin layers. These single phase Fe3O4 thin films have been grown over SrTiO3 substrates by Pulsed Laser Deposition (PLD). This process is well controlled and highly reproducible allowing the control of the thickness in the magnetite thin films. The chemical composition is monitored and pre-characterized by in situ XPS and REED. The evaporation of Au over the Fe3O4 surfaces is performed maintaining the vacuum environment. By this, the oxidation of the magnetite surface before the capping

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with the Au layer is avoided. The Au evaporation has been studied in situ by XRD and High Energy X ray Photoelectron Spectroscopy and it has been determined that the Au grows commensurate over the Fe3O4 substrate. These Au-Fe3O4 hybrid systems have been characterized ex situ by temperature dependent X ray Absorption Spectroscopy and the electronic transport has been studied. Several anomalies in the electronic properties have been observed.

add to my program (close full abstract)

18:00 **Fabrication and characterization of Spinel Li4Ti5O12 Thin-Films for Lithium-ion Micro-batteries**

Authors : Nouha Labyedh(a,b), Brecht Put(a,c), Sven Gielis(d,e), Abdel-Aziz El Mel(a,f), Marlies Van Bael(d,e), An Hardy(d,e), Mekki Ksouri(b), Philippe M.Vereecken(a,f)
Affiliations : (a)imec, Kapeldreef 75, B-3001 Heverlee, Belgium; (b)Electrical Engineering department, ENIT, Tunis EL Manar University; (c)Department of Physics, KULeuven, B-3001 Leuven, Belgium; (d)Hasselt University, Institute for Materials Research, Inorganic and Physical Chemistry, Diepenbeek, Belgium; (e)IMEC vzw, Division IMOMEC, Diepenbeek, Belgium; (f)Center for Surface Chemistry and Catalysis, Katholieke Universiteit Leuven, Kasteelpark Arenberg 23, bus 2461, Leuven, B-3001, Belgium

Resume : Lithium titanate (Li4Ti5O12 or LTO) is despite its higher working potential (1.55V vs. Li+/Li) used as negative electrode in lithium ion batteries for its high rate capabilities and long life cycle stability. The material is of particular interest for all solid-state batteries as the LTO spinel has negligible volume expansion or compression during Li+ insertion and extraction. In this work, we report on a novel and low-cost fabrication method for LTO thin film electrodes for solid state micro-batteries. This process is based on a simple solid state reaction between TiO2 and LiO2 stacked-layers upon thermal annealing under ambient atmosphere. The TiO2 layer is prepared by thermal oxidation of a Ti thin film grown by magnetron sputtering using pure argon plasma, whereas the Li2O layer is deposited by solution processing. The chemical state of the films is evaluated by X-ray photoelectron spectroscopy (XPS) and elastic recoil detection analysis (ERDA). The morphology and the structure of the LTO films are investigated by scanning electron microscopy (SEM) and X-ray diffraction (XRD), respectively. The prepared films exhibit a columnar morphology and the characteristic spinel crystal structure of LTO. Furthermore, the cyclic voltammetry performed on the LTO films reveals a cathodic peak around 1.65 V (vs. Li+/Li) which refers to the insertion of the Li in the spinel LTO, and an anodic peak located at 1.5 V (vs. Li/Li+) attributed to the extraction of Li from the LTO. Charge and discharge measurements were performed at different C-rates over a voltage range between 1 V and 2 V. At rates between 1C and 5C, the potential-charge curves show flat operational plateaus at 1.55 V (vs Li+/Li) for both charging and discharging. The prepared LTO films exhibited good cycling performance, indicated by a 96% of capacity retention after 100 cycles at 1C.

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add to my program (close full abstract)

18:00 **Nanostructured films of metal oxides for fast lithium insertion**

Authors : Peter Zehetmaier, Ksenia Fominykh, Johann M. Feckl, Kristina Peters, Dina Fattakhova-Rohlfing
Affiliations : Department of Chemistry and Center for NanoScience (CeNS), Ludwig-Maximilians-University (LMU), Butenandtstr. 5-13 (E), 81377 Munich, Germany (*email: dina.fattakhova@cup.uni-muenchen.de)

Resume : Development of electrode materials for lithium batteries providing high energy density and high power is a major challenge in the field of electrochemical energy storage. Nanostructuring has a profound effect on the material's properties and is considered as one of the key routes towards the improvement of their efficiency. The performance of already known materials can be strongly enhanced by decreasing the crystal size to only a few nanometers and by judiciously designing their nanomorphology. Using a novel solvothermal tert butanol synthesis route we develop new pathways for the fabrication of different binary and ternary metal oxide nanoparticles for the application in lithium-ion batteries as well as the ways to their controlled assembly into continuous networks. The combination of extremely small crystalline nanoparticles in crystalline frameworks with extremely high surface areas is greatly beneficial in electrochemical lithium insertion reactions and leads to a drastic acceleration of the Li insertion process and a high accessible maximum capacity. We were able to obtain fully crystalline interconnected porous frameworks composed of ultrasmall titania (TiO2) and lithium titanate spinel nanocrystals, which was shown to be the fastest ever-reported titanate morphology as anode material for lithium ion insertion. Currently we work on

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extending our synthesis strategy to development of other nanostructured metal oxide morphologies for the use as cathode materials.

add to my program (close full abstract)

18:00 **Structural and magnetic properties of MFe2O4 (M=Ni, Co) polycrystalline thin films grown via sol-gel processing**

Authors : E.Venkata Ramana, M.P.F.Graça, M.A.Valente
Affiliations : I3N-Aveiro, Department of Physics, University of Aveiro, Aveiro 3810 193, Portugal

Resume : Spinel ferrites have been employed in a variety of applications viz. magnetic materials, magnetic biomedicine, catalysis and spintronics, in view of their excellent magnetic behavior, catalysis and chemical stability. The spinel ferrites provide a non-zero magnetic moment along with spin-dependent band gaps that can be utilized in the field of spintronics as spin-filters and spin-transfer torque devices. In some recent work, NiFe2O4 (NFO) and CFO thin films were reported to possess direct bandgap 3.7 eV and 2.7 eV respectively at room temperature. Out of them, CFO is robust up to its magnetic transition temperature of 795 K. In view of the interesting physical properties we here present structural, optical and magnetic properties of sol-gel derived ferrite thin films. NFO and CFO Thin films having a thickness in the range 120-300 nm were grown by spin coating the 0.1 M solutions on (100) oriented Si and (111) oriented Pt/TiO2/SiO2/Si substrates. X-ray diffraction and pole figure analysis indicated the formation of (111) oriented polycrystalline thin films. Magnetization measured on both NFO and CFO thin films exhibited easy in-plane axis. Raman spectroscopic measurements were performed to see the effect of annealing temperature on phonon vibrations. The UV/Vis spectra were measured in reflectance mode to estimate the direct bandgap of film grown in different conditions. The results are presented as a function of growth parameters.

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add to my program (close full abstract)

18:00 **Low cost synthesis of a single phase YAG:Dy phosphor for white emission**

Authors : P. Forte, J. F. C. Carreira, M. R. N. Soares, F. M. Costa, T. Monteiro, L. Rino
Affiliations : Departamento de F?sica e i3N, Universidade de Aveiro, Aveiro, Portugal

Resume : Garnet structures are widely used to produce white-lighting phosphors in the LED industry since bright-blue (Ga,In)N sources became available, Yttrium aluminium garnet doped with cerium ions (YAG:Ce) being the most prominent due to the Ce3+ yellow emission combination with the blue emission of the (Ga,In)N chip. When excited in the near UV, Dy3+ ions can also emit strong blue and yellow bands and if incorporated in a suitable host, they are good candidates for white-lighting phosphors. Here, we present a variation of the solution synthesis combustion technique with two fuels combination that can be used to directly synthesize YAG:Dy nanopowders with crystallite sizes of about 40 nm. This process allow the production of the single phase YAG:Dy at low temperature and time load with minimum energy consumption, without the usual need of any post synthesis heat treatments, as confirmed by X-ray diffraction and Raman spectroscopy measurements. Photoluminescence measurements confirmed the incorporation, during the synthesis process, of the dysprosium ions in a trivalent charge state. A study of different Dy concentrations, on the structural and optical properties of the YAG:Dy nanophosphor, suggests an optimum value of 2 mol % of dopant as well as the possibility of using small variations in this ratio to fine tune the colour temperature of the emission.

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add to my program (close full abstract)

18:00 **Passivation of defects related to the Atomic Layer Deposition of Al2O3 on III-V (110) surfaces**

Authors : Tyler Kent, Mary Edmonds, Evgueni Chagarov, Ravi Droopad, Andrew C. Kummel
Affiliations : University of California San Diego; University of California San Diego; University of California San Diego; Texas State University; University of California San Diego

Resume : Introduction III-V semiconductor based metal oxide semiconductor field effect transistors (MOSFETs) are an appealing alternative to traditional Si based MOSFETs, due to their extremely high electron mobilities. The limiting factor in utilizing III-V based MOSFETs is the semiconductor/oxide interface. This interface is plagued by a large density of interfacial traps (Dit) which arise during the atomic layer deposition (ALD) of the oxide and are attributed to undercoordinated atoms, metal-metal bonds, and strained bonds at the interface.1 These trap states result in decreased MOSFET efficiency. To increase device performance it is critical to understand the III-V/oxide interface and to find ways of passivating or preventing the formation of trap states. This can be

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done by studying the deposition of the first oxide monolayer since most trap states exist at the semiconductor/oxide interface. To continue improving device performance not only does the semiconductor/oxide interface need to be optimized, but also the transistor architecture can be manipulated. Recently Intel announced commercially available logic chips which utilize a tri-gate, i.e. finFET, structure.2 Some benefits of utilizing this architecture include better electrostatic confinement, a lower subthreshold swing, and minimization of short channel effects.3 Vertically aligned (001) InGaAs finFETs would have (110) sidewalls.4 The formation of an ideal semiconductor/oxide interface is crucial, regardless of device architecture. In this study the deposition of Al2O3 was investigated by studying each half cycle ALD reaction. The deposition of the first half cycle precursor, trimethylaluminum (TMA), was studied on the GaAs (110) surface. Subsequently, the second half-cycle reaction was studied in which an oxidant was dosed on top of the TMA/GaAs surface. Scanning tunneling microscopy (STM) was used to probe the atomic bonding configuration of the TMA/oxidant to the surface and scanning tunneling spectroscopy (STS) was used to determine the electronic properties of the surface. X-ray photoelectron spectroscopy (XPS) was employed to confirm the presence Al2O3 on the surface. Models the chemisorption of TMA and H2O to the GaAs (110) surface were created using density functional theory (DFT). Experimental N-type GaAs (100) samples were doped with 4x1018 cm-3 Si. The samples were loaded into an Omicron variable temperature UHV chamber and cleaved in-situ to expose the (110) crystallographic face. Samples were then transferred to the STM/STS chamber where STM was used to ensure a defect free clean (110) surface while STS was used to determine the position of the Fermi level. Various amounts of TMA were then dosed at a variety of temperatures and annealed for various times and temperatures. STM was used to determine the atomic configurations of the partial and full coverage surfaces. STS was employed to determine the electrical characteristics of these surfaces. Subsequent to TMA dosing, a varying amount of O¬2 or H2O were dosed at 25 °C followed by a series of anneals at 250 °C. Again STM and STS were used to determine the atomic structure of the chemisorbates and the electrical properties of the surface. DFT modeling was used to determine the most energetically favorable bonding configurations and density of states of all chemisorbed structures. Using a home built ALD pulsed valve system, 10 cycles of Al2O3 were deposited and XPS was used to confirm an ideal oxide stoichiometry. Results STM was used to ensure a clean, defect free GaAs (110) surface. The clean surface has a zigzag chain of Ga and As atoms oriented in the $(1\bar{1}0)$ direction. Each surface As is elevated relative to each surface Ga which results in the group V atoms in a tetrahedral sp3 bonding configuration with a filled dangling bond while each group III atom is in a planar sp2 bonding configuration with an empty dangling bond. This buckled configuration results in an unpinned Fermi level which was determined by STS. Initially 5 Langmuir (L) of TMA was dosed on the clean surface at 25 °C and annealed to 135 °C for 30 min. This resulted in partial coverage of TMA and chemisorption sites are clearly observed via STM. In order to increase oxide nucleation density a larger dose of TMA is necessary. 10 L of TMA was dosed onto the clean GaAs (110) surface at 25 °C and annealed to 135 °C for 30 min. This resulted in formation of an ordered 1/3 monolayer (ML) of adsorbates. The ordered rows of chemisorbates are rotated 40° clockwise relative to the clean surface rows. The spacing between rows is 17 Å, 3x the spacing of the clean surface rows, indicating maximum nucleation density has not been achieved. A qualitative model of the atomic bonding configuration is proposed to explain the observed row spacing and rotation. Exposure of the surface to 50 L of TMA at 200 °C followed by an anneal at 230 °C for 30 min resulted in formation of a complete ordered monolayer of TMA with some distinct defect sites. STM showed the ordered rows of adsorbates are oriented in the same direction as the clean surface rows; additionally the spacing between rows is 5.6 Å which is identical to the clean surface spacing. This indicated maximum nucleation density had been achieved for the first half cycle reaction for Al2O3 deposition. STM also revealed two types of defects on the surface. One defect site contained a row rotated 40° relative to the clean surface rows, similar to the low coverage case. The other defect site, a bright sphere in the STM image, is believed to be caused by background water in the chamber reacting with the initial TMA monolayer. This resulted in an oxygen atom bridge bonded between adjacent TMA molecules. A subsequent reaction between the bridge bonded oxygen atoms and a TMA molecule resulted in a TMA molecule protruding from the surface about 2.5 Å, which corresponds to the defect observed in the STM image. DFT was used to model these defect sites. STS was used to determine the electrical quality of the TMA monolayer. A large conduction band (CB) edge

state was observed which pins the Fermi level midgap. DFT calculations show the CB edge state is due to the formation of metallic Al-Ga bonds. These edge states are a contributing factor to the density of interfacial trap states and without passivation will decrease device performance and degrade the quality of the oxide. To study the second half cycle reaction for ALD of Al2O3, 1000 L of O2 was dosed on top of the full coverage TMA surface at 25 °C followed with an anneal at 250 °C for 30 min. STM showed that the surface maintained ordered rows in the (1¯10)direction and the spacing between rows remained 5.6 Å. Additionally STM showed that the number of bright sites dramatically decreased, which can be attributed to oxygen reacting with the initial TMA monolayer. STS showed that after dosing 1000 L of O2 the CB edge state is dramatically reduced, but the Fermi level remains pinned. A subsequent dose of 59,000 L of O2 still does not completely passivate the CB edge state. In a separate experiment 2000 L of H2O was dosed at 25 °C and annealed at 250 °C for 30 min. STS shows the CB edge state is completely passivated after dosing with H2O. DFT was used to model this system and it was found that the –OH groups selectively insert into the metallic Al-Ga bonds. By breaking the metal-metal bond the calculated density of states shows the CB edge state can be completely passivated, which was experimentally verified. Using a home built ALD pulsed valve system, 10 cycles of TMA/H2O were deposited on MBE grown InGaAs (110). Using XPS it was confirmed that a stoichiometric oxide had formed. Using STS we confirmed that the bandgap across the whole sample had increased from 0.8 eV to 2.9 eV which indicated a high nucleation density with minimal defects for the first monolayer of oxide deposition. Conclusion We are the first group to use STM/STS to study ALD of Al2O3 on any III-V (110) surface. We demonstrated that it is possible to form an ordered monolayer of TMA with an extremely high nucleation density on GaAs (110), but some defects were present which resulted in a large conduction band edge state. These edge states are passivated using the second half cycle reaction in which H2O is dosed onto the TMA/GaAs surface. The passivation was successful due to –OH groups selectively inserting into the metallic Al-Ga bonds and this completely passivated the CB edge state. This passivation scheme ensures nucleation of the ALD of Al¬2O3 in every unit cell while maintaining a high degree of order which should lead to an ideal semiconductor/oxide interface and improved MOSFET performance. 1 J. Robertson, Applied Physics Letters 94, 152104 (2009). 2 C. Auth, et al., in VLSI Technology (VLSIT), 2012 Symposium on (IEEE, 2012), p. 131. 3 D. Hisamoto, T. Kaga, Y. Kawamoto, and E. Takeda, in Electron Devices Meeting, 1989. IEDM'89. Technical Digest., International (IEEE, 1989), p. 833. 4 M. Jurczak, N. Collaert, A. Veloso, T. Hoffmann, and S. Biesemans, in SOI Conference, 2009 IEEE International (IEEE, 2009), p. 1.

add to my program **(close full abstract)**

18:00 **Low sheet resistivity, high transparency SnOx-based transparent conductive oxides for their applications in OLEDs**

Authors : D. Afouxenidis, M. Esro, G. Vourlias, W. P. Gillin and G. Adamopoulos*
Affiliations : M. Esro; D. Afouxenidis Lancaster University, Engineering Department, Lancaster LA1 4YR, United Kingdom. G. Vourlias; Physics Department, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece W.P. Gillin; Physics Department, Queen Mary, University of London, Mile End Road, E1 4NS London, United Kingdom G. Adamopoulos; Lancaster University, Engineering Department, Lancaster LA1 4YR, United Kingdom.

Resume : Indium-Tin-Oxide (ITO) is currently used in OLED panels for the transparent cathode and constitutes the dominant material of choice. However, indium is becoming increasingly scarce and hence an expensive resource. Also ITO itself exhibits serious technical drawbacks related to the costly deposition techniques. ITO alternatives have been investigated aiming to produce indium-reduced or indium-free oxides, conducting polymers, carbon nanotubes, graphene, nanowires and nanoparticles however they all suffer from either low optical transparency, low sheet resistivity, lower work functions than ITO, i.e. poor energetic alignment with hole transporting layer HOMO. In this work, we report the application of ambient spray pyrolysis for the deposition of highly transparent, high work function Antimony-doped Tin Oxide (ATO) thin film as OLED anodes. ATO films were studied by means of X-rays Diffraction, AFM, UV-visible absorption spectroscopy, 4-point probe, Hall Effect, Kelvin Probe and implemented in RGB OLED structures. For optimum antimony doping, the as-deposited ATO films exhibit excellent characteristics i.e. high work function (5.05 eV) wide direct band gap (4.65 eV), high transparency (90 %) in the visible spectrum, low sheet resistivity (25 Ohm/sq) and carrier mobility of 32 cm2 V-1 s-1. The antimony-doped tin oxide R,G,B, OLEDs show similar I-V and

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L-V characteristics to those of ITO and high external quantum efficiencies of about 12%, 0.3 % and 13% respectively.

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18:00 **Half-metal magnetic nanopatricles coated with semiconductive materials**

Authors : O. Pana, M. L. Soran, S. Gutoiu, M. Stefan, C. Leostean, S. Macavei
Affiliations : National Institute for Research and Development of Isotopic and Molecular Technologies, 65-103 Donath, St. PO Box 700, 400293 Cluj-Napoca, Romania

Resume : Different types of magnetic nanoparticles composites can be designed as multifunctional platforms with controllable magnetic properties, thus being able to facilitate their use in different applications. Moreover, the interface interactions between different components can greatly improve the performance of the multi-components system and even generate new synergetic properties. In this work new properties of nanocomposite systems based on magnetic nanoparticles of half-metallic type coated with semiconducting materials are presented. In case of half metallic ferromagnets, the spin–up (majority) and spin-down (minority) conduction bands are split such that the Fermi level is situated in the upper unfilled minority band. This splitting is generally due to intense low symmetry crystalline fields, intense spin-orbit couplings. Two types of half-metal magnetic nanoparticles like Fe3O4 and FePt (L10) alloy were coated with semiconductors like ZnS, TiO2 and poly(3 hexylthiophene (P3HT). It was found that the saturation magnetization of Fe3O4 nanoparticles was significantly increased and adjusted while in case of hard FePt (L10) alloy nanoparticles the coercivity was drastically modified. The process is due to the interface charge/spin-down polarized transfer from the semiconductor to the surface layers of half-metal nanoparticles. It produces an increase of the magnetic order inside these near interface magnetic layers and, over a certain distance, due to the depletion in spin–down states, a magnetic polarization of the semiconductor valence band results. Additionally, in case of FePt (L10) alloy nanoparticles the magnetically polarized semiconductor becomes exchange coupled to the hard magnetic phase.

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18:00 **Aqueous chemical solution deposition of (LixMg1-2xAlx)Al2O4 films as possible spinel electrolyte in solid-state Li-ion batteries**

Authors : Sven Gielis 1, 2, Brecht Put 3, 4, Nick Peys 1, 2, Thomas Vranken 1, 2, Fabio Rosciano 5, Philippe M. Vereecken 3, 6, An Hardy 1, 2, Marlies K. Van Bael 1, 2
Affiliations : 1 Hasselt University, Institute for Materials Research, Inorganic and Physical Chemistry, Diepenbeek, Belgium 2 imec, division imomec, Diepenbeek, Belgium 3 imec, Leuven, Belgium 4 Department of Physics, KU Leuven, Leuven, Belgium 5 Toyota Motor Europe, Advanced Technology 1, Zaventem, Belgium 6 KU Leuven, Centre for Surface Chemistry and Catalysis, Leuven, Belgium

Resume : The development of all-solid state Li-ion batteries would significantly improve battery safety and could bring higher energy density at system level. Recently, (LixMg1-2xAlx)Al2O4 (LMAO) has been suggested as Li-ion electrolyte with spinel structure and thus structurally compatible with the Li4Ti5O12 and LiMn2O4 spinel electrodes [1]. To lower the internal resistance, the electrolyte thickness should be minimized. In a thin-film battery architecture, the electrolyte thickness can be scaled until nm thickness provided the films are pin-hole free, uniform and electronically blocking [2]. The synthesis of LMAO films via an aqueous chemical solution deposition route was investigated. Stable Li/Mg/Al multimetal ion precursors were developed by mixing citrato-based Li, Mg and Al ion solutions in different ratios so that the theoretical x-value in (LixMg1-2xAlx)Al2O4 was varied (0≤x≤0.5). Prior to film deposition, HT-XRD of Li/Mg/Al powders, obtained by precursor gelation, showed that for x ≤0.3 phase -pure spinel LMAO could be formed at 600°C in air. From the precursor (X = 0.05), films were spin coated on Si3N4, followed by a thermal treatment in air. Smooth (SEM/AFM) and phase-pure spinel films (XRD) were obtained. For electrical characterization, films were made on Pt/TiN/Si substrates. The ionic conductivity was determined by electrochemical impedance spectroscopy. [1] F. Rosciano, et al., PCCP 15: 6107 (2013) [2] P. M. Vereecken & C. Huyghebaert, ECS Trans. 58(10): 111 (2013)

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add to my program (close full abstract)

18:00 **Optical properties of TiO2 Thin films prepared by Sol Gel method**

Authors : Z.ESSALHI 1, B.HARTITI 1, A. LFAKIR 1, M. SIADAT 2 and P. THEVENIN 3
Affiliations : 1 MAC& PM Laboratory, ANEPMAER Group, Department of Physics, FSTM, University Hassan II Mohammedia Casablanca ,Mohammedia, Morocco; 2 LCOMS Laboratory, Universit? of Lorraine; 3 LMOPS Laboratory, Universit? of Lorraine, Metz, France

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Resume : Titanium dioxide is a nontoxic material good market and has high mechanical and chemical stability. Furthermore, titanium dioxide has excellent semiconducting properties; the areas of application TiO2 are diverse, including the photovoltaic, gas sensors, antireflection coatings. We are interested in the synthesis by the sol-gel process of thin layers. sol-gel process is a relatively new method for producing oxide materials (glass, ceramics ...). And this is the easiest and most efficient in terms of quality layers. The basic principle of the sol-gel process (corresponding to the abbreviation of "solution- gelification") is: a solution-based precursor in the liquid phase turns into a solid by a set of chemical reactions such polymerization at room temperature. In this work, TiO2 thin films were deposited by sol gel method on glass substrates (3-TiO2/glass). The optical properties of the samples were analyzed at various rotational speeds. The samples were characterized by mean of: Raman spectroscopy and UV-Visible spectroscopy. The transmission specter of thin films of titanium oxide indicate that they are transparent in the visible and opaque in the UV, as well as the transmission and the calculated optical band gap increased with increasing in rotational speed, The band gap values for our thin layers are between 3.12 and 3.41 eV. They are in perfect agreement with the values found by other authors and are very close to those of the anatase phase 3.2 eV. The Raman specter show the Anatase phase. Keywords: TiO2 , thin films, sol gel, anatase , band gap.

add to my program (close full abstract)

18:00 **Solution processed aluminium titanate dielectrics for their applications in high mobility ZnO based thin film transistors**

Authors : D. Afouxenidis, M. Esro, G. Vourlias and G. Adamopoulos*
Affiliations : D. Afouxenidis; M. Esro; Lancaster University, Engineering Department, Lancaster LA1 4YR, United Kingdom. G. Vourlias; Physics Department, Aristotle University of Thessaloniki, 54124 Thessaloniki, Greece G. Adamopoulos; Lancaster University, Engineering Department, Lancaster LA1 4YR, United Kingdom

Resume : Metal oxide semiconductors are very attractive candidates for implementation into TFTs mainly because of their high charge carrier mobility, high optical transparency and excellent chemical stability. Recent work has also been focusing on the development of variable-voltage oxide transistors using mainly high-k dielectrics i.e. ZrO2, HfO2, Y2O3 and Al2O3. Oxide transistors based on high-k dielectrics have received the most attention and variable-voltage devices have been demonstrated. Here, we report solution-processed, variable-voltage ZnO transistors based on aluminium and titanium oxide composite films as the gate dielectrics. The films were deposited on ITO-coated glass substrates from Ti and Al soluble precursors using the spray pyrolysis technique at 400 oC. The dielectric films were characterised by AFM, UV-Vis absorption spectroscopy, admittance spectroscopy, X-ray diffraction and spectroscopic ellipsometry. Data analysis showed amorphous Al2O3 and stoichiometric (in the solution) Al2O3.TiO2 films with dielectric constants in the range between 9 and 14 and optical band gaps between 6.1 eV and 4.4 eV respectively. Similarly, stoichiometric Al2O3.TiO2 showed improved leakage currents by 2 orders of magnitude (compared to Al2O3) in the order of 1 nA/cm2. BG-TC ZnO-based TFTs that also manufactured by spray pyrolysis on Al2O3.TiO2 gate dielectrics showed enhanced electron mobilities from 9 cm2 V−1 s−1 to 23 cm2 V−1 s−1 and current on/off ratios from 10^4 to 10^6.

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add to my program (close full abstract)

18:00 **Information support of the multiscale computational scheme of multilayer semiconductor nanostructures**

Authors : Abgarian K. K.,Marasanov A.M., Sechenykh P. A.
Affiliations : Institution of Russian Academy of Sciences Dorodnicyn Computing Centre of RAS

Resume : The article examines the object - relational approach to the creation of a database, designed to provide informational support to the multiscale computational scheme of multilayer semiconductor nanostructures. The MSNS computational scheme developed earlier by our group uses hierarchic representation of computational data obtained by various computational modules. Each layer of MSNS is treated separately. In contrast to well-known materials databases, which serve for storing and retrieving of information on existing structures and its properties, the database described in this paper is the central unit of MSNS computational scheme. The database provides data interchange between various computational units. In this paper we describe the modern approach to material database design. More specifically, data storaging relational model which applies to solving resource-intensive and different-scale problems is proposed. Object-relational scheduler architecture is used in our

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work. It allows high-speed data exchange between various computational units of MSNS computational scheme. We introduce simple and user-friendly interface allowing criteria-based data retrieving as well as creation of input files for computational modules. These approaches can be applied in various branches of science, including the aviation and space industry, in particular in control systems of engineering (materials science) data.

add to my program (close full abstract)

18:00 **Physical properties of undoped and Li-doped NiO thin films prepared by sol–gel spin coating method**

Authors : M. Jlassi 1,I. Sta 1, M. Hajji 12, M.F.Boujmil 1 , M. Kompitsas 3, H. Ezzaouia 1.
Affiliations : Laboratoire de Photovoltaïque, Centre de Recherche et des Technologies de l'Energie, Technopole de Borj-Cédria, BP 95, 2050 Hammam-Lif, Tunisie. 2 Institut Supérieur d'Electronique et de Communication de Sfax, Université de Sfax, BP 868, 3018 Sfax, Tunisie. 3 National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, 48, Vasileos, Konstantinou Ave., 11635 Athens, Greece.

Resume : Transparent semiconductor thin films of nickel oxide (NiO) and NiO doped lithum were deposited onto glass substrates by the sol–gel method and spin-coating technique. The effect of the [Li] / [Li + Ni] ratio on the morphological, photoluminescence (PL) and optical properties of NiO films of these films have been investigated. The morphological properties of NiO: Li films were studied by atomic force microscopy (AFM) technique. The surface morphology of the nanostructure films is found to depend on the concentration of Li. The optical study showed that all films were highly transparent. The transmittance in the visible region varies between 70% and 85%, depending on the dopant concentration. The dependence of both the refractive index (n) and extinction coefficient (k) on the wavelength, has been reported for the films. A shift in the optical band gap from 3.21 to 3.68 eV has been observed. The PL spectrum reveals a significant improvement in the UV luminescence of NiO films doped with different Li concentrations. Keywords: Photoluminescence, Optical constants, spin-coating, nickel oxide, lithum doping.

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add to my program (close full abstract)

18:00 **Development and investigation of thin film protective coatings for the beryllium windows and lenses used in X-Ray sources.**

Authors : O.Yurkevich, K. Maksimova, A. Goikhman
Affiliations : Immanuel Kant Baltic Federal University, Kaliningrad, Russia

Resume : Beryllium windows and lenses to control of X-Ray radiation parameters in different conditions are used in modern sources of synchrotron radiation. The disadvantage of this material is the oxidation of beryllium elements under high energy X-Ray beam. To prevent the oxidation and destruction processes of Be optical elements the nitrogen blowing is obligatory to use at the most synchrotrons at the moment. At this work we report on the passivation coatings protecting the Be windows. As beryllium lenses have typical thickness 2 μm[1], there should be an appropriate method for covering such objects with a complicated shape. Atomic layer deposition (ALD) is the most suitable method for such tasks. Al2O3 is chosen as a passivation material – that is perfect diffusion barrier for oxygen. The possibility of various sample shape using and appropriate x-ray speckle pattern image of coverage opens up the opportunities of extreme conditions experimental techniques applying. The structural properties, chemical state, interaction between thin film and substrate are investigated in both laboratory and synchrotron facilities. The set of our experimental results allow evaluating the perspectives of using protective Al2O3 coatings by ALD for additional reduction of safety requirements and the simplifying of optical experimental schemes at synchrotrons.. 1. Ali Khounsary, Eric M. Dufresne, Kristina Young, Cameron M. Kewish, conference "Advances in X-ray/EUV optics, Components and Applications", vol. 6317, USA, 2006.

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add to my program (close full abstract)

18:00 **Hybrid organic-inorganic nanocomposites for terahertz applications**

Authors : D. Hourlier1, S. Venkatachalam1, J.C. Boyaval1, G. Ducournau1, Y. Blum2, J. F. Lampin1
Affiliations : 1- Institut d'Electronique, de Micro et Nanotechnologies, CNRS-UMR8520, Avenue Henri Poincaré BP 60069, F-59652 Villeneuve d'Ascq Cedex, France 2- Chemical Science and Technology Laboratory, SRI International, Menlo Park, CA 94025, USA

Resume : The TeraHertz (THz) portion corresponds to the part of the electromagnetic spectrum having frequencies ranging from 0.3 to 10 THz. Unlike UV or X-rays, THz photons are not energetic enough to break chemical bonds or to ionize atoms or molecules. These radiations have found widespread applications in diverse disciplines for example in chemical sensing, identification

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of explosives, in security screening, and imaging of cancer. In spite of the tremendous progress in the development of THz sources, other components such as detectors, absorbers and modulators are required for effective control and manipulation of THz radiation. In the present study, we have examined the reflection and absorbance over a wide range of THz of hybrid organic-inorganic nanocomposites. By using free-space S-parameters THz measurements, such materials demonstrate a very low reflection and a high absorbance up to 99% in the range 0.2 to 0.5 THz. These properties are mainly due to the ability to associate mixed compositions at nanoscale and also the existence of a porous, sponge-like microstructure. Moreover, the absorbance level can be significantly varied by adjusting synthesis and processing parameters.

add to my program (close full abstract)

18:00 **Investigations of the structural, electronic and magnetic properties of Fe2-xTixO3/Fe2O3 thin films grown on Al2O3 (0001)**

Authors : Teresa Dennenwaldt(1), Maike Lübbe(2), Michael Winklhofer(2), Alexander Müller(1), Markus Döblinger(1), Hasan Sadat Nabi(2), Maria Gandman(3), Tzipi Cohen-Hyams(4), Wayne D. Kaplan(4), Wolfgang Moritz(2), Rossitza Pentcheva(2) and Christina Scheu(1)

Affiliations : (1) Department of Chemistry and Center for NanoScience, Ludwig-Maximilians-Universität München, Butenandtstr. 5-13, 81377 Munich, Germany (2) Department of Earth and Environmental Sciences and Center for Nanoscience, Ludwig-Maximilians-Universität München, Theresienstr. 41, 80333 Munich, Germany (3) Department of Materials Science and Engineering, 210 Hearst Memorial Mining Building, University of California, Berkeley, USA (4) Department of Materials Science and Engineering, Technion – Israel Institute of Technology, Haifa 32000, Israel

Resume : Heterointerfaces between hematite (α-FeIII2O3, weak ferrimagnetic) and ilmenite (FeIITiO3, antiferromagnetic) are supposed to exhibit a strongly ferrimagnetic contact layer due to the formation of a mixed valence layer of Fe2+/Fe3+ (1:1 ratio) caused by compensation of charge mismatch at the chemically abrupt boundary.1 So far, it is not studied what happens when ilmenite is replaced by Ti-doped hematite Fe2 xTixO3 (x < 0.5) where Fe2+/Fe3+ < 1. We investigated thin films of α-Fe2O3/Fe2-xTixO3 (x = 0.44) on α-Al2O3 (0001) substrates which were grown by molecular beam epitaxy concerning their structural (in-situ surface X-ray diffraction, transmission electron microscopy), electronic (electron energy loss spectroscopy) and magnetic properties (superconducting quantum interference device measurements).2 We observed an increased magnetic moment and a formation of a chemically distinct interface layer, which might also be magnetically distinct as indicated by the observed magnetic enhancement in the Fe2-xTixO3/Fe2O3/Al2O3 system compared to the pure Fe2O3/Al2O3 system. The interface between this layer and the hematite layer shows an enrichment of Fe2+ which forms an uncompensated spin lattice, and might therefore be responsible for the interface magnetism. 1 P. Robinson et al., Nature 418, 517 (2002). 2 T. Dennenwaldt, M. Lübbe, M. Winklhofer, A. Müller, M. Döblinger, H. Sadat Nabi, M. Gandman, T. Cohen-Hyams, W. D. Kaplan, W. Moritz, R. Pentcheva and C. Scheu, submitted.

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Solution processing and properties of functional oxide thin films and nanostructures

26 May 2014 | 27 May 2014 | **28 May 2014** | 29 May 2014 | 30 May 2014

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start at	Subject	Num.
	Thin films : Johan ten Elshof	
08:30	**Composition and nanostructure engineering of solution derived oxide thin films for electrochemical devices** **Authors :** Theodor Schneller **Affiliations :** RWTH Aachen University, Institut für Werkstoffe der Elektrotechnik II **Resume :** Tailor-made materials are the key to solve issues concerning miniaturization of electronic devices, development of renewable energy sources, and enabling new functionalities. Metal oxide films are a very promising class of materials due to their vast variety of interesting physical properties such as ferroelectricity, electronic and ionic conductivity etc. The latter are of particular interest for their use in energy devices such as solid oxide fuel cells (SOFC) and other electrochemical cells. Among the thin film fabrication methods chemical solution deposition represents an economical and highly flexible way to prepare these oxide films in high quality without complex and size limiting vacuum apparatuses [1]. After a brief survey of the established principles of morphology control for typical complex electronic oxide thin films the attention is directed to modern deposition methods such as ink-jet printing and the use of "hybrid solutions" consisting of dedicated mixtures of microemulsion derived nanoparticle dispersions and traditional precursor solutions. The latter enables interesting possibilities of morphology engineering ranging from dense columnar microstructures to nanocomposites with tailored heterogeneity. By means of solid electrolyte and cathode films for proton conducting SOFCs the gained morphology engineering knowledge will be demonstrated. [1] T. Schneller, R. Waser, M. Kosec, D. Payne (Eds.) Chemical Solution Deposition of Functional OxidesThin Films (2013)	I.9. 1
	add to my program (close full abstract)	
09:00	**Biotemplated porous titania scaffolds with incorporated pre-synthesized titania nanocrystals** **Authors :** Alesja Ivanova (1), Liana Movsesyan (2), Pirmin Ganter (1), Maria Fravventura (3), Jiri Rathousky (4), Dina Fattakhova-Rohlfing (1) and Thomas Bein (1)* **Affiliations :** (1) Department of Chemistry and Center for NanoScience (CeNS), University of Munich (LMU); (2) Darmstadt University of Technology; (3) Delft University of Technology, (4) J. Heyrovsky Institute of Physical Chemistry, Academy of Sciences of the Czech Republic; *email: bein@lmu.de **Resume :** Combination of materials with different functional properties is an effective approach to extend the material's functionality. Sol-gel derived porous titania films incorporating highly crystalline pre-formed titania nanoparticles, so called 'Brick and Mortar' films, are efficient materials for photocatalysis and photovoltaics. In our study we demonstrate that nanocrystalline cellulose (NCC) can act as an efficient biogenic shape-persistent template in the 'Brick and Mortar' synthesis. Highly porous NCC templated titania networks containing uniformly incorporated pre-synthesized titania nanoparticles of ca 13 nm are investigated by means of microwave conductivity measurements and tested in the photocatalytic conversion of NO and 4-chlorophenol. The results show a drastic increase of photocatalytic activity for the mesoporous films containing 75% crystalline titania particles compared to the pure sol-gel films with similar morphology. Moreover, NCC templated 'Brick and Mortar' scaffolds reveal higher conductivity than NCC templated sol-gel titania. We demonstrate that structuring with rigid cellulose crystals overcomes some of the limitations typical	I.9. 2

for the soft templating approaches. Owing to its mechanical stability, straightforward formation and well-defined porosity, NCC templated 'mortar' is a perfect scaffold for the incorporation of 'bricks' with target functionality. Self-assembly of various inorganic oxides can be realized by NCC assisted 'Brick and Mortar' route.

add to my program (close full abstract)

09:15 **Atomic Layer Deposition in comparison with solution processing – from differences to similarities and combinations**

Authors : Mikko Ritala
Affiliations : Department of Chemistry, University of Helsinki, Finland

Resume : Atomic layer deposition (ALD) is a gas phase technique for the deposition of thins films in highly controlled and conformal manner. The key feature of ALD is the saturative surface reactions of the alternately supplied precursor vapors that make the film growth self-limiting. ALD processes are run typically above 200 °C but low temperature ALD processes are increasingly explored too. At first sight ALD may look like almost opposite to solution techniques like sol-gel, but there are similarities as well. For example, for oxide film deposition similar chemistries are used, like hydrolysis of metal precursors and reactions between metal chlorides and alkoxides. The principle of ALD can also be applied in solutions by dipping the substrate alternately to cation and anion solutions in a technique known as SILAR (successive ionic layer adsorption and reaction), and there also exist hybrid techniques with one precursor being gaseous and the other one coming from a solution. ALD can also be combined with solution techniques, like for converting the readily ALD made CaCO3 into the compositionally more challenging hydroxyapatite films, crystallizing the ALD made metal-organic-framework (MOF) precursor films into the proper structure, and activating the noble metal ALD processes for selective area growth with printed solution-derived activation layers. I.9. 3

add to my program (close full abstract)

09:45 **Relationship between Nanocrystallite Size and IR Reflectivity**

Authors : Tim Kemmitt, John Kennedy, Fang Fang, Campbell McNicoll
Affiliations : Callaghan Innovation, PO Box 31-310, Lower Hutt, New Zealand MacDiarmid Institute for Advanced Materials and Nanotechnology, PO Box 600, Wellington NZ GNS Science, PO Box 31-312, Lower Hutt, New Zealand University of Canterbury, Private Bag 4800, Christchurch 8140, New Zealand.

Resume : White or bright coloured surfaces efficiently reflect light across the visible spectrum. However the visible wavelengths make up only 46% of the solar radiation at the terrestrial surface. The largest portion, the near-infra-red (NIR) (750 ? 2500 nm) represents 49% of the energy intensity, with the remaining 5% being in the ultraviolet. Surfaces that can efficiently ensure broad band reflectivity are useful as they can remain cooler even under direct irradiation. Examples of NIR reflecting materials have been demonstrated to reduce the temperatures of building interiors1, spacecraft2 etc. Heat reflecting paint also has the added benefit of longer lifetime due to reduced thermal exposure. Crystallite sizes as well as aggregate sizes affect reflectivity3. A recent study has compared nanocrystalline with microcrystalline oxides as well as comparing reflectivities of different sieved fractions of nanocrystalline oxide aggregates5. Our objective was to isolate the relative influences of the crystallite sizes and the aggregate sizes. In particular to focus on a smaller and constant aggregate size that could typically be used in a glossy surface coating and to systematically vary the nanocrystallite sizes. Thus we have synthesized spherial titania particles with low polydispersity of around 350 nm diameter, as controlled size aggregates. The crystallite sizes within these primary particles was then varied by thermal or hydrothermal treatment and the NIR reflectivity data examined. References 1. Haines JA, US Patent 2,005,215,685, 2005; Shia ML, Kalkanoglu HM, and Kong KC, US Patent 2,005,072,114, 2005. 2. Johnson JA, et al, Progr. Org. Coatings, 47 (2003) 432-442. 3. Jeevanandam P, et al, J. Phys Chem C, 111, 1912-18, 2007. I.9. 4

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10:00 **Coffee & tea**

Energy materials : Mikko Ritala & Theodor Schneller

10:30 **From Molecules to Functional Nanostructures for Energy and Health Applications**

Authors : Sanjay Mathur*, Thomas Fischer, Ralf Mueller, Raquel Fiz and Laura Wortmann
Affiliations : Institute of Inorganic Chemistry, Chair, Inorganic and Materials Chemistry, University of Cologne, Greinstrasse 6, D-50939 Cologne, Germany E-mail: sanjay.mathur@uni-koeln.de

Resume : Chemical nanotechnologies have played, in the past few decades a major role in the convergence of life, physical and engineering sciences leading not only to simple collaboration among the disciplines but to a paradigm shift based on true disciplinary integration. The successful synthesis, modification and assembly of nanobuilding units such as nanocrystals and wires of different materials have demonstrated the importance of chemical influence in materials synthesis, and have generated great expectations for the future. Implications of chemistry as an innovation motor are now visible for knowledge leap forward in various sectors such as materials engineering for energy, health and security. Inorganic nanostructures inherit promises for substantial improvements in materials engineering mainly due to improved physical and mechanical properties resulting from the reduction of microstructural features by two to three orders of magnitude, when compared to current engineering materials. This talk will present how chemically grown nanoparticles, nanowires and nanocomposites of different metal oxides open up new vistas of material properties, which can be transformed into advanced material technologies. The examples will include application of superparamagnetic iron oxide nanoparticles for magnetic resonance imaging (MRI) and drug delivery applications, vapour phase synthesis and electrospinning of nanowires for application as electrode materials and in water splitting reactions (for solar hydrogen production). Finally, the current challenges of integration of nanomaterials in existing device concepts will be discussed.

I.10.1

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11:00 **Hydrothermal - Electrochemical synthesis of metal oxides for energy applications**

Authors : Ugur Unal
Affiliations : Koc University, Chemistry Department, Surface Science and Technology Center Rumelifeneri yolu Sariyer 34450 Istanbul Turkey

Resume : In our group, we focus on the electrochemical synthesis of metal oxides under hydrothermal conditions and utilization of these films in water splitting, solar cell and supercapacitance applications. Oxides of transition metals are very popular for such applications and research conducted in this field is directed towards improving the properties to get the highest possible performance. The electrochemical synthesis of metal oxide films, particularly Zinc, Iron and Manganese oxides under hydrothermal conditions was presented and their properties were discussed in this study. ZnO and Fe2O3 were utilized in solar energy applications. Different morphologies for doped or undoped films can be obtained by changing the synthesis conditions. Manganese oxide films are presented for their supercapacitative behavior. Manganese oxide films deposited under hydrothermal conditions demonstrated superior supercapacitative behavior to the films deposited at conventional methods.

I.10.2

add to my program (close full abstract)

11:15 **Oxide ion and hole conductivity in Pr2NiO4 dispersed with Au nano particle**

Authors : Tatsumi Ishihara, Junji Hyodo, and Shintaro Ida
Affiliations : International Instituet for Carbon Neutral Energy Research (WPI-I2CNER), Kyushu University, Fukuoka, Japan; Department of Applied Chemistry, Faculty of Engineering, Kyushu University, Fukuoka, Japan

Resume : Pr2NiO4 shows large anisotropy in oxide ion and hole conductivity. In this study, change in oxide ion and hole conductivity in Pr2NiO4 doped with Cu and Ga by dispersion of Au was studied by using ion blocking techniques and Hall effects measurement. Dispersion of Au nano particles was performed by impregnation of Au source in liquid followed by sintering. Because of difference in thermal expansion of Au and Pr2NiO4, tensile strain was formed after sintering and cooled to low temperature. Tensile strain was estimated with line broadening method by XRD measurement and it was found that oxide ion conductivity was increased by formation of Au dispersion. Increase in oxide ion conductivity became more significant with decreasing temperature, however, hole conductivity was also increased by dispersion of Au nano particle because of increased amount of hole which is charge compensate of interstitial oxygen. In contrast, mobility of hole was decreased because of distorted lattice by tensile strain. Oxygen diffusivity was further studied with 18O diffusion. In reply to the increased oxide ion conductivity, diffusion constant of oxygen was

I.10.3

confirmed. Increase in surface exchange coefficient of oxygen was also observed by dispersion of Au nano particles in bulk of Pr2NiO4. Surface composition was analyzed with low energy ion scattering spectroscopy and oxygen vacancy was concentrated at surface by Au dispersion resulting in the increased surface exchange coefficient of oxygen.

add to my program (close full abstract)

11:30 **Thin film synthesis of Li3xLa(2/3)-xTiO3 (LLT) solid electrolyte for all-solid-state lithium-ion batteries** I.10.4

Authors : E.J. van den Ham, N. Peys, C. De Dobbelaere, H. Damm, J. D'Haen*, F. Mattelaer**, C. Detavernier**, A. Hardy and M.K. Van Bael
Affiliations : Hasselt University, Institute for Materials Research, Inorganic and Physical Chemistry and imec, division imomec, Agoralaan building D, 3590 Diepenbeek, Belgium; **Hasselt University, Institute for Materials Research, Material Physics and imec, division imomec, Agoralaan building D, 3590 Diepenbeek, Belgium. **Ghent University, Department of Solid State Sciences, Krijgslaan 281, 9000 Ghent, Belgium.
Resume : Lithium-ion (Li-ion) batteries are promising candidates to tackle the challenging energy storage problem due to their high power and energy density. However, contemporary Li-ion batteries suffer from limited lifetime and safety hazards because of the liquid electrolyte used. Introduction of a solid electrolyte such as LLT, which is known for its high Li+ conductivity [1], could circumvent these issues. Although solid electrolyte thin films are crucial to form an all-solid-state Li-ion battery, little is known about synthesis of LLT thin films. In this study thin films of LLT have been deposited on TiO2 as an anode material; via spin-, spray- and dip coating an aqueous citrate and non-aqueous ethanol based precursor solution. Thermal analysis of the solution gels showed that the organic matrix of both precursors is decomposed at 600°C in air. The crystallization of the obtained LLT thin films was investigated by in-situ XRD. A prolonged heating at 700 °C in air was required to obtain tetragonal perovskite LLT on TiO2. SEM and GATR-FTIR showed that dense thin films with a thickness between 50 and 400 nm have formed without significant precursor residues. The results, presented in the current study, significantly contribute to the detailed understanding of the solution deposition process and phase formation in towards dense, crystalline thin films of LLT as a possible candidate material for all-solid-state Li-ion batteries. [1] Inaguma et al.; Solid State Comm. 86, 1993, 689

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11:45 **Mesoporous thin films by soft templating: direct synthesis of LiV2O5 vs. electrochemical lithium intercalation in V2O5** I.10.5

Authors : Sebastien Caes, Jose Carlos Arrebola, Natacha Krins, Benedicte Vertruyen
Affiliations : LCIS-Greenmat, Department of Chemistry B6, 3 Allée de la Chimie, University of Liège, B-4000 Liège, Belgium
Resume : In Li-ion batteries, high rate electrochemical performance is enhanced by using nanostructured electrodes with shorter diffusion paths and higher surface area in contact with the electrolyte. In particular, mesoporous thin films (MTFs) offer 3D interconnection of the inorganic network at the nanoscale and favor good electrical contact and efficient charge transport inside the pore walls. In the present work, V2O5 and LiV2O5 MTFs were prepared by soft-templating methods combining sol-gel chemistry and block copolymer structuring agents. Wormlike vanadium oxide and lithium vanadium oxide MTFs were obtained on silicon by Evaporation Induced Micelles Packing using a polystyrene-block-poly(ethylene oxide) structuring agent. Optimized heat treatments lead to the crystallization of gamma-LiV2O5 or alpha-V2O5. These calcination conditions ensure the degradation of the structuring agent while preventing the collapse of the mesostructure, yielding MTFs with 30-35 nm pore size diameter. Using the same sets of synthesis conditions, films were coated on conductive glass to compare the electrochemical performance of chemically lithiated films (LiV2O5 films) with post-synthesis electrochemical lithium intercalation in V2O5 films: V2O5 films have better specific capacities; cyclability is good for both compositions, even at relatively high current density (30 C).

add to my program (close full abstract)

12:00 **Electrodeposited Manganese dioxide for 3D Lithium-ion Battery Applications** I.10.6

Authors : Yafa Zargouni, Stella Deheryan, Aleksandar Radisic, A. Etman, D. J. Cott, Khaled Alouani, Cedric Huyghebaert, Philippe M. Vereecken
Affiliations : CENA, Riyadh, Saudi Arabia; imec, Kapeldreef 75, Leuven, Belgium; Chemistry Department, Tunis El-Manar University, Tunis, Tunisia; Centre for Surface Chemistry and Catalysis, Leuven University, Leuven, Belgium; Chemistry Department, Alexandria University, Alexandria, Egypt
Resume : Lithium manganese oxides (LiMnOx) have been actively pursued for use as cathode for 3D batteries due to low cost, non-toxicity and easy

proceeding of MnO2. In this work we studied the electrochemical deposition of MnO2 thin films on high aspect ratio silicon pillar arrays coated with carbon as a technologically-relevant current collector. Silicon pillars were coated with 20nm TiN, acting as diffusion barrier for Li into Si. Thin carbon coatings were evaluated as technological relevant alternative for Pt. For this, about 30nm of carbon was grown on ALD TiN/Si pillars by CVD. The electrolytic MnO2 (EMD) films were anodically deposited from aqueous solution of 0.3M MnSO4•xH2O+0.55M H2SO4. EMD film thickness on TiN is strongly limited due to oxidation of TiN. Carbon replaces Pt protecting TiN from oxidation. Crystal structure of EMD films was characterized by XRD and its porosity determined by comparing RBS to SEM. Electrochemical lithiation and delithiation experiments showed an improved cycle performance for carbon coated TiN substrates compared to Pt coated TiN substrates. The difference is attributed to decreased porosity for EMD to carbon surface compared to platinum surface. The average lithium storage capacity for planar EMD films is about 50□Ah/cm2 per □m (at 10mV/s comparable with charging rate of 20C). Based on a surface area gain of 28 for 3D pillar structures, a capacity of 0.2mAh/cm2 is expected for conformal coated 200 nm film at these high rates.

add to my program (close full abstract)

12:15 **Solution-derived porous GeOx as high performance anodes for Li-ion batteries**

Authors : Wei-Qiang Han*, Xiaoliang Wang, Huajun Tian, Feng-Xia Xin
Affiliations : Ningbo Institute of Materials Technology & Engineering (NIMTE), Chinese Academy of Sciences, Ningbo, 315201, P. R. China, e-mail: hanweiqiang@nimte.ac.cn

Resume : There is great interest in developing novel anode materials for high-performance Li-ion batteries, which are the key parts of electric vehicles and grid energy storage. Many researchers have focused in recent years on resolving the crucial problem of capacity fading in Li-ion batteries when carbon anodes are replaced by other IV?elements (Si, Ge, or Sn) with much higher capacities. Some progress was achieved by using different nanostructures (mainly carbon coatings), so that cycle numbers reached 100-200 times. However, obtaining longer stability via a simple process remains challenging. Here we demonstrated that a nanostructure of amorphous hierarchical porous GeOx made by chemical solution route has a very stable capacity of ~1,250 mAh g-1 for 600 cycles .
Acknowledgements: This work is supported by the "Strategic Priority Research Program" of the Chinese Project Academy of Science, GrantNo.XDA01020304, the National Natural Science Foundation of China (Grant No. 51371186), Ningbo 3315 International Team of Advanced Energy Storage Materials.

I.10.7

add to my program (close full abstract)

12:30 **Lunch break**

Printing & patterning I : Sanjay Mathur

14:00 **Complex Oxide Nanoparticles and Thin Films by Chemical Solution Processing and Ink Jet Deposition**

Authors : Isabel Van Driessche
Affiliations : Ghent University, Dep. Of Inorganic and Physical Chemistry, SCRiPTS, Krijgslaan 281, 9000 Gent, Belgium, Isabel.vandriessche@UGent.be

Resume : The enormous potential of oxide ceramics is based on their manifold functionalities. Especially in the form of nanostructures, these material properties can be tailored for use in innovative applications in communication, electronics, energy technology and catalysis. This research proposes alternative processing methods for ceramic nanoparticles based on microwave heating from aqueous solutions or on hot injection methods. Afterwards, deposition of nanoparticles containing inks using ink-jet printing at ambient pressure is performed. With that, we aim at developing smart and environmentally friendly processes that require lower energy input. Where ink-jet printing has been used for many years in depositing text or patterns on textile or paper,it is only recently that there has been a growing interest in using the deposition technique for functional ceramic coatings and patterns. The biggest advantage of ink-jet printing as a one-step process is its low investment cost, scalability, the more efficient use of materials and the high control of the thickness of the coating. Moreover, ink-jet printing has the potential to switch quite easily from continuous coatings to direct printing of a multi-filamentary pattern in a one-step process. Hereby, lithography, wet chemical etching, ion beam etching, laser ablation, having a variety of disadvantages such as high cost, local degradation

I.11.1

of the film or tape fragmentation, are avoided. The fluid properties of the ink, often expressed with dimensionless constants, like the Reynolds and Weber numbers, for printable liquids are discussed. The technique was employed to deposit superconducting layers in coated conductors, containing pinning centers of multi-oxide nanoparticles, YSZ as electrolyte in solid oxide fuel cells and in thermal barrier coatings and TiO2 as photocatalytic coatings.

add to my program (close full abstract)

14:30 **Inkjet printing IGZO Thin-Film Transistors: toward annealing temperature decrease**

Authors : Clément Talagrand1, Maxime Veilly1, Xavier Boddaert1 and Philippe Collot2
Affiliations : 1 Ecole Mines de Saint-Etienne CMP-GC, Dept PS2 .Gardanne, 880 route de Mimet, France; 2 Ecole Nationale Supérieure d'Arts et Métiers ParisTech, Aix-En-Provence, 2 cours des Arts et Métiers, France

Resume : Inkjet printing is an additive deposition process that can be achieved under STP conditions. This technology enables the use of flexible substrates for new low-cost electronic devices manufacturing, such as flexible displays composed of printed transistors. For TFT fabrication, a-InGaZnO is among the best candidates for channel material. However, in order to achieve high mobility printed transistors, high annealing temperatures (not compatible with flexible substrates) are necessary. This issue can be overcome by a two-steps strategy. The first step has been to analyze phenomena occurring during classic thermal annealing. A cross-analysis between spectroscopic ellipsometry and energy-dispersive X-ray spectroscopy demonstrated that a-InGaZnO undergoes homogenization and chemical oxidation from 200°C to 400°C, and then a densification until 500°C. Above this temperature, the material crystallizes. To complete the study, transistors were printed and mobility up to 0.4 cm²/ V.s and an Ion/Ioff of 107 are demonstrated. The second step has been to replace classic thermal annealing methods by low temperature sintering processes. In order to mimic the phenomena observed previously, two different technics were used successively: low temperature annealing in oxidizing atmosphere and then selective flash sintering or UV-annealing. A similar methodology was used to investigate these thin films properties. Results will be exposed, discussed and compared for all annealing methods.

I.11.2

add to my program (close full abstract)

14:45 **Nano-Rheology Printing (nRP): A Direct Printing Technique for Well-Defined Metal Oxide Patterns and Devices**

Authors : Tatsuya Shimoda [1,2,3,*], Toshihiko Kaneda [1], Daisuke Hirose [3], Takaaki Miyasako [1], Phan Trong Tue [1,2], Yoshitaka Murakami [2], Shinji Kohara [3,4], Jinwang Li [1,2], Tadaoki Mitani [1,2], Eisuke Tokumitsu [1,2,3] & Shogo Nobukawa [3]
Affiliations : [1] Japan Science and Technology Agency (JST), ERATO, Shimoda Nano-Liquid Process Project, 2-5-3 Asahidai, Nomi, Ishikawa 923-1211, Japan; [2] Green Devices Research Center, Japan Advanced Institute of Science and Technology (JAIST), 2 -13 Asahidai, Nomi, Ishikawa 923-1211, Japan; [3] School of Materials Science, Japan Advanced Institute of Science and Technology, 1-1 Asahidai, Nomi, Ishikawa 923-1292, Japan; [4] SPring-8/Japan Synchrotron Radiation Research Institute (JASRI), 1-1-1 Kouto, Sayo-cho, Sayo-gun, Hyogo 679-5198, Japan. * Email: tshimoda@jaist.ac.jp

Resume : None of the existing direct printing techniques can produce well-defined patterns with sharp edge and sub-micron or smaller dimensions that are required by fine electronic devices. Here, we report our newly developed printing method that allows well-shaped sub-micron metal oxide patterns to be directly printed. Excellent and all-oxide, all-solution-processed thin-film transistors with channel lengths around 500 nm were completely printed by this method in an air atmosphere. This method, named nano-rheology printing (nRP), utilizes a viscoelastic softening transformation of the precursor gel at a certain temperature, where the gel can be thermally imprinted. During imprinting, the organic components are decomposed and gasified so that the gel undergoes metal-oxide densification. That renders very small shrinkage during post-annealing, thereby achieving a high shape fidelity to the mould. These two prominent features, i.e. viscoelastic softening transformation and densification constitute the basis for this printing method. Analyses revealed that gels showing such nRP abilities consist of a large group of special inorganic core-organic shell cluster structures, which are originally cultivated in solution. This method has worked for patterns down to several tens of nanometers. Using this technique together with our materials techniques, we are fabricating all-oxide, all-solution-processed and all-printed circuits.

I.11.3

add to my program (close full abstract)

15:15 **Structural and Electrical Properties of Flexible Ink-jet Printed HfO2-Based MIM Capacitors after Plasma Treatment**

Authors : G. Vescio, J. López-Vidrier, O. Casals, S. Hernández, J. D. Prades, B. Garrido, A. Cirera

Affiliations : MIND/IN2UB Electronics Department, Universitat de Barcelona, c/ Martí i Franquès 1, Planta 2, E–08028 Barcelona, Spain

Resume : The ink-jet printing process has been proved to be a viable technique for fabrication of metal-insulator-metal (MIM) capacitors using high-k hafnium oxide (HfO2) nanoparticles (NPs) on different flexible substrates (Kapton, PET, LTCC), with a low temperature annealing (~225 °C). In this work, an ink-jet printed thin film containing HfO2 NPs has been characterized, in order to confirm the integrity of these layers within a MIM capacitor. In addition, the dielectric properties of these films were also investigated by measuring the relative permittivity and loss tangent of the capacitor structure. We observed that the conventional post-annealing treatment was not effective in removing the carbon impurities, which were incorporated in the HfO2 films during the ink-jet process. Moreover, both Ag silver electrodes were printed by inkjet technique, so that the effect of the Ag bottom electrode oxidation on the electrical performance of the MIM (Ag/HfO2/Ag) structure was evaluated. As well, the samples were exposed to different plasma treatments (in particular N2, O2 and Ar ambient were employed) to simultaneously remove both carbon contamination and interfacial AgxO during the production process. The investigation of these layers was carried out by means of Raman and X-ray photoelectron spectroscopies. This way, the effect of the different treatment conditions on the chemical composition and structural variation of the samples was examined. Besides, the MIM capacitors electrical characterization revealed an overall high performance of the device containing the HfO2 film with lower carbon contamination. Particularly, a higher capacitance density (from >0.1 fF/um2 to ~1-2 fF/um2) was obtained, as well as a lower leakage current (~1.5×10-7 A/cm2 at 2V) and small voltage coefficients of capacitance (VCCs) of α ~18ppm/V2 and β ~146ppm/V.

I.11.4

add to my program **(close full abstract)**

15:30 **Coffee & tea**

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PROGRAM VIEW : 2014 Spring
MY PROGRAM : 2014 Spring

Symposium : I

Solution processing and properties of functional oxide thin films and nanostructures

26 May 2014 | 27 May 2014 | 28 May 2014 | **29 May 2014** | 30 May 2014

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start at	Subject	Num.
	Nanoparticles : Johan ten Elshof	
08:30	**Synthesis and applications of multifunctional nanomaterials** **Authors :** Stanislaus S. Wong (1,2) **Affiliations :** 1. Department of Chemistry, State University of New York at Stony Brook, Stony Brook, NY 11794-3400; and 2. Condensed Matter Physics and Materials Sciences Department, Brookhaven National Laboratory, Building 480, Upton, NY 11973 **Resume :** Our group is fundamentally interested in the design of a series of nanoscale composite structures, combining two different nanomaterials using diverse strategies. Such a multifunctional composite material possesses unique optoelectronic and catalytic properties that are distinctive from and at times, superior to those of its individual constituent components. In essence, our hope and expectation is that chemical synthesis can be used to control structure – property correlations. In this presentation, we focus on the applications of fundamental chemical principles with respect to the synthesis of metal-containing and metal-oxide-containing nanostructures. In particular, we describe advances in the use of complementary, sustainable, and cost-effective solution-based methodologies that allow us to generate functional nanomaterials without the need to sacrifice on sample quality, purity, and crystallinity, in addition to control over size and shape. We have subsequently created a number of different architectures for gaining valuable insights into solar and fuel cell applications, photocatalysis, and nanomedicine. add to my program (close full abstract)	I.12.1
09:00	**Shape-tailored metal nano-oxides for novel multifunctional photoelectrochemical devices** **Authors :** Riccardo Scarfiello (a), Luisa De Marco (a), Michele Manca (a)*, Roberto Giannuzzi (a), Maria Belviso (b), Giuseppe Gigli (b) and Davide P. Cozzoli (b) **Affiliations :** (a) Center for Biomolecular Nanotechnologies, Fondazione Istituto Italiano di Tecnologia - Energy Platform Via Barsanti, 73010 Arnesano (Lecce), Italy (b) National Nanotechnology Laboratory, CNR Istituto Nanoscienze, c/o Distretto Tecnologico, Via Arnesano km 5, 73100 Lecce, Italy **Resume :** Ability to develop controllable electrode architectures in which the structural and morphological features of the constituent building units provide tailored nanotextures with specific functionalities still represents a crucial challenge towards boosting the performances of a large spectrum of energy conversion and storage devices. Among others, surfactant-assisted liquid-phase synthetic approaches have been especially distinguished for their versatility in providing precision-tailored metal-oxide nanocrystals. We recently designed and set-up different solvothermal routes based on the reaction Ti and W precursors in the presence of suitable organic surfactants. They made possible to synthesize shape-tailored nanocrystals which could be readily processed into nanporous films suitable for disparate energy conversion and storage purposes. We here report the exploitation of several classes of TiO2 (either in the anatase or TiO2-B phase) and WOx 1D nanocrystals, obtained by properly optimized surfactant-assisted nonaqueous sol-gel routes to fabricate high-quality nanostructured electrodes which exhibit excellent storage capacitance and fast electron transfer kinetics. An exhaustive electrochemical characterization has been carried out to elucidate the correlation holding between their electrochemical prerogatives and the intimate structure of the electrodes. add to my program (close full abstract)	I.12.2

09:15 **Controlled Iron oxide nanoparticles size trough a non aqueous sol gel route and microwave energy towards highly sensitive T1 and T2 MRI contrast agent**

Authors : J. Bolley, M. Boucher; S. Meriaux;N. Pinna, L. Motte, Y. Lalatonne
Affiliations : a. CSPBAT (UMR7244), Universit? Paris 13 b. Neurospin, CEA c. Humboldt-Universit?, Berlin Institut de Chimie d. H?pital Avicenne, Service de M?decine Nucl?aire

Resume : Magnetic Resonance Imaging (MRI) is a very powerful technique for diagnostic in clinical medicine and biomedical research. One important challenge for this scope is the development of targeted magnetic probes capable of achieving a high specificity and sensitivity by in vivo. To achieve these goals, USPIO (Ultra Small Particle Iron Oxide) have been produced from 2 to 12 nm and the particle surface has been functionalized with PEG and c-RGD peptides in order to demonstrate the specificity to αvβ3 integrins associated with a wide range of cancers. For controlling the nanoparticles size, we adapted the Pinna and Niederberger et al. method under microwave treatment. The synthesis is carried out using benzyl alcohol, which acts as a reagent and growth controlling agent particles. This compound occurs naturally in many plants and appears as a compound of choice in the context of the synthesis of nanoparticles for biological applications. We show that we can easily modulate the particle size depending on the microwave parameters and allowing to control their magnetic behavior. We observe that the MRI contrast is very dependent on the nanoparticles size. Herein the extremely small nanoparticles (< 4nm) are positive T1 MRI contrast agent whereas larger particles exhibit a very strong T2 contrast. The in-vivo experiments have been performed on brain mice demonstrating a very good contrasting efficiency and allows a strong enhancement of the brain vasculature.

I.12.3

09:30 **Monitoring the insertion of Co(II) ions into maghemite nanoparticles by XAFS and magnetization measurements**

Authors : C. Vichery, I. Maurin, O. Proux, I. Kieffer, J.-L. Hazemann, R. Cortes, J.-P. Boilot, T. Gacoin
Affiliations : C. Vichery : EMPA, Swiss Federal Laboratories for Materials Science and Technology, Laboratory for Mechanics of Materials and Nanostructures, Feuerwerkerstrasse 39, CH-3602, Thun, Switzerland ; C. Vichery, I. Maurin, R. Cortes, J.-P. Boilot and T. Gacoin : Physique de la Matiere Condensee, UMR7643, CNRS-Ecole Polytechnique, 91128 Palaiseau, France ; O. Proux, I. Kieffer and J.-L. Hazemann : BM30B/FAME beamline, European Radiation Synchrotron Facility, 38043 Grenoble cedex 9, France ; O. Proux and I. Kieffer : Observatoire des Sciences de l'Univers de Grenoble, UMS 832, CNRS-Universite Joseph Fourier, 38041 Grenoble cedex 9, France ; J.-L. Hazemann : Institut Neel, UPR 2940, CNRS-Universite Joseph Fourier, 25 avenue des Martyrs, BP 166, 38042 Grenoble cedex 9, France

Resume : Iron oxide nanoparticles have been extensively studied for biomedical applications. In order to reach optimum efficiency, each application requires particles with tailored saturation magnetization and magnetic anisotropy, parameters which are strongly influenced by the chemical composition, size and shape distributions but also by the crystallinity of the particles. In this study, we focused on tuning the chemical composition, through doping, while keeping the other parameters constant. The influence of cobalt doping on the magnetic anisotropy of gamma-Fe2O3 nanoparticles was investigated by adsorption of Co (II) ions onto the surface of preformed particles followed by diffusion in the solid phase upon heat treatment. The incorporation of small amounts of Co dopants, less than 1 at%, was monitored by magnetization measurements combined with X-ray absorption spectroscopy experiments. Analyses of the X-ray absorption fine structures allowed for unraveling the differences in local atomic structure and valence state of Co upon annealing. A thermally activated diffusion in the spinel lattice was observed in the 250-300°C range, leading to a substantial increase in magnetocrystalline anisotropy. This study thus provided a direct correlation between magnetic anisotropy and dopant localization in Co doped maghemite.

I.12.4

09:45 **Self-Assembly of Organic-Inorganic Hybrid Nanocrystals in Highly Ordered Nanocrystalline Monolayer**

Authors : Daisuke Hojo, Takanari Togashi, Tadafumi Adschiri
Affiliations : Advanced Institute for Materials Research, Tohoku University; Department of Material and Biological Chemistry, Yamagata University; Advanced Institute for Materials Research, Tohoku University

I.12.5

Resume : Realizing the printed electronics where metal oxide nanocrystals (NCs) are incorporated has attracted considerable attention recently. Generally, high crystalline metal oxide is only obtained through high temperature

treatments. If metal oxide NCs are formed elsewhere at high temperature in advance and those are aligned densely on the surface at room temperature from solution processing, high crystalline film layer can be fabricated even on a heat-sensitive substrate. In order to apply metal oxide NCs to the surfaces, three things have to be considered at least. 1) Disperse the NCs in a solvent. 2) Self-assemble the NCs on the substrate with drying the solvent. 3) Fix the NCs on the substrate. Among these processes, necessary interaction between the metal oxide cores, modifiers, solvent, and the substrate is totally different. This could then lead to a difficulty to apply NCs to the surface. A sufficiently highly ordered monolayer of hybrid NCs was self-assembled in the concentrated solvent and thus printed to a surface from a face-down configuration. The surface was also pre-modified so that the chemical bonds were established between hybrid NCs and the substrate to fix the NCs. To arrange hybrid NCs on such a "sticky" surface, pre-aligned nanocrystalline monolayer should be placed on the surface before random deposition of NCs taking place by using the face-down configuration. That resulted in the uniform and ordered nanocrystalline monolayer of macroscopic size.

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10:00 **Coffee & tea**

Hybrids & nanosheets : Lynette Keeney & Lourdes Calzada

10:30 **Synthesis and Assembly of inorganic-nanocellulose hybrids**

Authors : Lennart Bergstrom
Affiliations : Department of materials and environmental chemistry Stockholm University, Sweden

Resume : The ability to control structure and functionality at all length scale has developed tremendously in the last decades. It is clear that optimal design of nanostructured materials require integration of various approaches to synthesize, functionalize, characterize and process the nanosized species for various applications. Here, we will give an overview of recent research on the bio-inspired fabrication of multifunctional materials based on nanocellulose and inorganic nanoparticles. We will demonstrate how the microstructure and magnetic, mechanical, and optical properties of various inorganic-nanocellulose hybrids can be tailored by controlling the foaming and helical assembly of nanocellulose and how the properties can be tailored by nucleation and growth of inorganic nanoparticles onto the nanocellulose surfaces. Examples include hybrids based on nanocellulose crystals and amorphous calcium carbonate results in transparent and hard hybrid coatings and hybrids of cellulose nanofibrils and titania nanoparticles that result in transparent and flexible free-standing films with a hardness comparable to concrete. We will also describe recent work on the preparation of thermally insulating and flame retardant nanocellulose hybrid foams. References: 1. D. Gebauer, V. Olinyk, M. Salajkova, J. Sort, Q. Zhou, L. Bergström, and G. Salazar-Alvarez, Nanoscale, 3, 3563-3566, 2011 2. C. Schütz et al., PLoS ONE 2012, 01/2012 7(10):e45828 3. N. T. Cervin, L. Andersson, J. Ng Boon Sing, P. Olin, L. Bergström and L. Wågberg, Biomacromolecules, 14, 503-511 2013. 4. J. P. F. Lagerwall, C. Schütz, M. Salajkova, J. Noh, J. Hyun Park, G. Scalia, and L. Bergström, NPG Asia materials 2014.

I.13.1

add to my program (close full abstract)

11:00 **Poly(N-vinyl pyrrolidone)/BaMgAl10O17:Eu2+: Development of a blue luminescent nanocomposite suitable for eco-energetic lighting devices (LEDs)**

Authors : Nathalie Pradal (a,b), Geneviève Chadeyron (a,b), Sandrine Therias (b,c), Rachid Mahiou (b,c)
Affiliations : (a) Clermont Université, ENSCCF, Institut de Chimie de Clermont-Ferrand, BP 10448, F-63000 CLERMONT-FERRAND; (b) Clermont Université, Université Blaise Pascal, Institut de Chimie de Clermont-Ferrand, BP 10448, F-63000 CLERMONT-FERRAND; (c) CNRS, UMR 6296, ICCF, BP 80026, F-63171 AUBIERE

I.13.2

Resume : Recently, phosphor films have attracted much attention due to their potential applications as phosphors for WLEDs. Conventionally, phosphors used in these devices are obtained via a solid state reaction leading to large size and irregular shapes. These features can affect optical properties and do not allow the shaping of the materials as homogeneous films. To avoid these drawbacks, works are focused on the improvement of usual phosphors by developing new synthesis methods. We report here an original and fast process leading to

nanosized Eu2+-doped BaMgAl10O17 blue phosphors. Particles were then incorporated into an alcoholic polymer solution and from the mixture, flexible, handy and free-standing luminescent films have been elaborated by casting. Structural, morphological and optical features of both powders and films were studied. All the characterizations evidenced that inorganic nanoparticles are well incorporated into the polymer film. Furthermore, photostability of the polymer/phosphor nanocomposite film, which is nowadays a key point for LEDs marketing in order to develop a complete product sheet characterizing devices durability, has been studied after exposure to an accelerated artificial photoageing at wavelengths higher than 300 nm and a comparison with pristine PVP film has been realized. The nanocomposite film we have achieved can be combined with an excitation source, such as UV LED, to produce colored or white light (after combination with other phosphors).

add to my program (close full abstract)

11:15 **Functional nanostructures and nanofilms based on layered transition metal hydroxides**

Authors : Renzhi Ma, Takayoshi Sasaki
Affiliations : International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS) 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan

Resume : Layered hydroxides possess a lamellar structure with positively charged host slabs intercalating exchangeable anions. Different combinations of metal cations impart a wide variety of interesting properties for anion exchange, adsorption, catalytic, as well as electrochemical and magnetic applications. Over the last decade, there has been widespread interest in the attempt to exfoliate layered hydroxides into single-layer host units, i.e., positively charged nanosheets with ultimate two-dimensional features. We describe the synthesis, phase transformation and chemical exfoliation of layered hydroxides in uniform hexagonal platelet shape with various combinations of di- and tri-valent transition metal elements (Fe, Co, Ni), realizing a vital concept of rationally designing and controlling the oxidation states of transition metal cations in a hydroxide layer, i.e., redox reaction and valence engineering. We also report the synthesis of monometallic (Co, Ni) and bimetallic (Co-Ni, Co-Zn, Co-Cu) hydroxide nanotubes (nanocones) based on the modification of coordination geometry of transition metal cations and incorporation of anionic surfactants. Transition metal hydroxide platelets and nanocones could be exfoliated into unilamellar nanosheets in formamide. Exfoliated hydroxide nanosheets, bearing a positive charge at a two-dimensional molecular scale, can be used as a model system for electrostatic layer-by-layer assembly in combination with polyanionic counterparts for various functional nanoarchitectures, such as lamellar aggregates and nanofilms. The investigations indicate their potential uses in electronic devices as well as electrochemical energy storage systems.

I.13.3

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11:45 **New positively-charged oxide nanosheets from exfoliation of 14-H Ba7Co6BrO17 and 18R-Ba6Co5BrO14 oxybromides in various solvents.**

Authors : Blázquez Alcover I., Huvé M., Mentré O., Daviero-Minaud S.
Affiliations : Univ. Lille Nord de France F–59000 Lille, CNRS UMR 8181–Unité de Catalyse et de Chimie du Solide – UCCS

Resume : In recent years, 2D-inorganic nanosheets obtained via exfoliation of layered compounds have attracted intensive research. Various layered compounds (clays, metal oxides or hydroxides…) have been delaminated into their elemental layers in aqueous or organic solvent via soft-chemical procedures. Most exfoliations of transition-metal oxides lead to colloidal suspensions of negatively charged nanosheets. They can be re-combined with a wide range of positive-charged counter-ions or positive nanosheets. Positive nanosheets are rare. They mainly belong to layered double hydroxides (LDH) or rare earth hydroxides. To develop new positive 2D-units with intrinsic magnetic properties, we have focus on the 14H-Ba7Co6BrO17 and 18R-Ba6Co5BrO14 oxybromides, developed in our laboratory and formed of ferromagnetic hexagonal-perovskite blocks, with removable Br-. Here, we demonstrate the possible exfoliation of these compounds into positive nanosheets in several solvent like DMF, DMSO or butanol. In all cases, colloidal suspensions with characteristic Tyndall effect are obtained. The exfoliation process is followed by X-Rays diffraction and SEM. Nanosheets characterizations are done by TEM, Raman and IR spectroscopies. TEM pictures show crystalline particles of about 50nm wide, without bromide as shows EDS analysis. zeta potential measurements confirm their positive charge. Magnetic characterizations and are under process.

I.13.4

add to my program (close full abstract)

12:00 **Patterning the Orientation of Perovskite Thin Films by Epitaxy on Nanosheets**

Authors : M. Nijland, S. Thomas*, N. Banerjee, D.H.A. Blank, G. Rijnders, J. Xia*, G. Koster, and J.E. ten Elshof
Affiliations : MESA+ Institute for Nanotechnology, P.O. Box 217, 7500 AE, Enschede, the Netherlands; * University of California, 4129 Frederick Reines Hall, Irvine, CA 92697-4575

Resume : We show that inorganic nanosheets can be used to locally control the nucleation of films deposited by pulsed laser deposition. Nanosheets of Ti0.87O2 and Ca2Nb3O10 were synthesized and placed on Si substrates from wet-colloidal dispersions by Langmuir-Blodgett deposition. Films of SrRuO3 were subsequently formed on the substrates containing the nanosheets. The presence of nanosheets had a clear impact on both the morphology of the films and the orientations of the crystallites. The nanosheets also had a clear effect on the magnetic properties of the films, which showed anisotropic behavior when a seed layer of nanosheets was used but not when SrRuO3 was directly deposited on Si. Besides nucleation, growth on the nanosheets could be controlled in two distinct ways. Layers of SrRuO3 on Ca2Nb3O10 nanosheets with atomic scale roughness could be obtained by introduction of a SrTiO3 buffer layer. For the case of Ti0.87O2 nanosheets, a double layer significantly improved the crystallographic orientation of SrRuO3 compared to just a monolayer. We finally show that patterning of the nanosheets is possible by photolithography and lift-off. Alternating lines of Ti0.87O2 and Ca2Nb3O10 were used to locally control the orientation of SrRuO3 deposited on top of these patterns. Clear contrast in magnetization was visualized with optical magnetometry with µm resolution.

I.13.5

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12:15 **Size dependent emission of ZnO nanosheets**

Authors : T. V. Torchynska1* and B. El Filali2,
Affiliations : 1ESFM-National Polytechnic Institute, Mexico D.F. 07738, Mexico. 2UPIITA-National Polytechnic Institute, Mexico D.F.07738, Mexico.

Resume : Photoluminescence (PL), X ray diffraction (XRD) and Raman scattering have been studied in crystalline ZnO nanosheets (NSs) of different sizes, estimated by scanning electronic microscopy (SEM). ZnO NSs with the size from the range of 60-600 nm were created by the electrochemical (anodization) method and followed thermal annealing at 400 °C for 2 hours in ambient air. XRD study confirms the wurtzite structure of ZnO NSs and has revealed that the lattice parameters increase monotonically with decreasing NS sizes. Simultaneously the intensity of a set of Raman peaks increases and Raman peaks shift into the low energy range. The surface phonon has been detected in smallest size ZnO NSs. Two types of PL bands deal with a set of phonon replicas of free excitons and the defect related emission have been detected in ZnO NSs. The intensity enhancement of exciton- and defect-related PL bands with decreasing ZnO NS sizes has been revealed. The intensity stimulation of exciton-related PL bands is attributed to the realization of the week confinement and the exciton-light coupling with the formation of polariton in small size ZnO NSs of 67-170 nm. The intensity rising of defect- related PL bands is attributed to the concentration enlargement of surface defects when the surface to volume ration increases at decreasing ZnO NS sizes. Numerical simulations of radiative lifetimes and exciton radiative recombination rates in ZnO NSs for different emission wavelengths have been done using the exciton – light coupling model.

I.13.6

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12:30 Lunch break

Japan in motion : Stanislaus Wong & Narcis Mestres

14:00 **Low temperature reactions of functional solids**

Authors : Hiroshi Kageyama
Affiliations : iCeMS and Graduate School of Engineering, Kyoto University

Resume : The synthesis of transition metal oxide nanosheets usually requires multistep processing, involving a high temperature solid state reaction, protonation of interlayer alkali metal ions, and an acid–base reaction with quaternary ammonium cations. This process, however, tends to yield a large amount of unexfoliated materials. We recently demonstrated a rapid single step synthesis of MnO2 nanosheets by oxidizing Mn(II) ions in a TMA-OH solution at room temperature [1, 2]. This method allows formation of single-layered MnO2

I.14.1

monosheets without any purification (e.g. centrifugation), because the reaction procedure does not include any exfoliation step. The extremely high fraction of single layer sheets from the one-pot procedure provides a big room for further reactions toward new/improved properties. For instance, MnO2/AB(acetylene black) composite exhibits an excellent specific capacity and capacitance [3]. Several functional organic-inorganic hybrid materials can be prepared [4-6], including viscoelastic nanocomposite composed of titania nanosheets with multiple conductometric sensitivities and shape deformable nanocomposite composed of manganese oxide nanosheets. If time allows, we would like to show low-temperature, solvent-less processing of thin film oxides [7].
References [1] K. Kai et al., J. Am. Chem. Soc. 130, 15938-15943 (2008). [2] K. Kai et al., Mater. Res. Bull. 47, 3855-3859 (2012). [3] K. Kai et al., J. Mater. Chem. 22, 14691-14695 (2012). [4] K. Kai et al., Dalton Trans. 41, 825-830 (2011). [5] Y. Yoshida et al., Dalton Trans. 40, 7291-7294 (2011). [6] Y. Yoshida et al., J. Mater. Chem. 21, 5863-5866 (2011). [7] T. Yajima et al., J. Am. Chem. Soc. 134, 8782-8785 (2012).

14:30 **Solution-based 2D Nanoarchitectonics with Oxide Nanosheets and Function Design**

Authors : Takayoshi Sasaki; Yasuo Ebina; Minoru Osada; Renzhi Ma; Tadashi C. Ozawa
Affiliations : International Center for Materials Nanoarchitectonics (MANA), National Institute for Materials Science (NIMS), 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan

Resume : A variety of layered metal oxides have been successfully exfoliated into molecularly thin two-dimensional crystals via reaction with an aqueous solution containing quaternary ammonium ions. The resulting oxide nanosheets are monodisperse polyanions and they can be assembled layer-by-layer into various nanostructures through solution-based processes such as electrostatic self-assembly and Langmuir-Blodgett deposition. Assembly under optimized conditions can lead to multilayer and even superlattice films with precisely controlled nanostructures. Based on this what we call 2D nanoarchitectonics, we have artificially designed various nanostructures, which show attractive functionalities. For example, multilayer films of Ti0.87O20.52- and Ca2Nb3O10-nanosheets exhibit superior dielectric properties even at a nanometer scale thickness. In addition, superlattice assembly of LaNb2O7-/Ca2Nb3O10- develops ferroelectric properties. Function design via this strategy like these examples will be presented.

I.14.2

15:00 **Preparation of nanosheet pn-junction and their photocatalytic activity**

Authors : Shintaro Ida
Affiliations : Kyushu University

Resume : Hydrogen production using semiconducting photocatalysts has attracted attention as a clean solar hydrogen-generation system. High crystallinity and high surface area are important properties required for high efficiency photocatalysts. A two-dimensional single crystal sheet (nanosheet) prepared by exfoliation of a layered metal oxide is an ideal material that can satisfy both of these requirements. For instance, several oxide nanosheets have been reported to exhibit higher catalytic efficiency than the parent layered compounds. The creation of p-n junction structure in photocatalysts is an also smart approach to improve the photocatalytic activity, as p-n junctions can potentially act to suppress the recombination reaction. On the surface of a photocatalyst with the p-n junction structure, it is considered that the surface potential has a gradient at the junction parts due to the diffusion of charge carriers (hole and/or electrons). In this presentation, we introduce several types of nanosheet with high photocatalytic activity, and show a relationship between the photocatalytic activity and potential gradient of pn-junction surface prepared from p-type and n-type nanosheets. The ultrathin (ca. 2nm) junction structure and the surface potential were analyzed using low energy ion scattering spectroscopy and Kelvin probe force microscopy.

I.14.3

15:30 **Science and Technology of Dealloyed Nanoporous Metals**

Authors : Mingwei Chen
Affiliations : WPI-AIMR, Tohoku University, Sendai 980-8577, Japan

Resume : Historically de-alloying is well known in corrosion science and refers to the selective dissolution of one or more components out of an alloy. It was received significant attention in the context of corrosion but has recently been receiving renewed attention because nanoporous metals can be fabricated by this traditional method. De-alloyed nanoporous metals represent a new class of functional materials with the unique structural properties of large surface area,

I.14.4

mechanical rigidity, electrical conductivity and high corrosion resistance. Coupled with their rich surface chemistry for further functionalization, nanoporous metals have great potential for applications in catalysis, sensing, surface enhanced spectroscopy, energy storage and conversion, and so on. Nanoporous metals possess a very flexible porous structure with feature dimensions tuneable from a few nanometers to several micrometers. With advanced electron microscopy, three-dimensional structure and surface atomic configuration of nanoporous metals have been realized, which yield quantitative characterization of the key structure parameters involved in the intricate 3D nanoporous structure. Catalytic and electrocatalytic investigations demonstrate that nanoporous metals are catalytically active for many important energy- and environment-related reactions and organic transformations. Nanoporous metals are also proved to be excellent plasmonic substrates for ultra-sensitive chemical detection and biomolecular diagnostics. By utilizing the high electric conductivity and large internal surface, nanoporous metals have also been successfully utilized as robust electrodes of supercapactiors and batteries for energy storage.

add to my program (close full abstract)

16:00 **Coffee & tea**

Printing & patterning II : Isabel Van Driessche

16:30 **Polymer-templated large-pore mesoporous metal oxide thin films for application in energy storage and nanomagnetics**

Authors : Christian Reitz, Christian Suchomski, Torsten Brezesinski
Affiliations : Institute of Nanotechnology, Karlsruhe Institute of Technology, Germany.

Resume : Both ferroic and redox-active oxides are ubiquitous in today's society and have been studied for decades. They are constantly undergoing changes to adapt to modern device requirements, and in recent years particularly, nanostructures of these materials are in the focus of interest. This is due, in part, to the fact that many such materials have been shown to be able to outperform their bulk counterparts. Advances in polymer templating over the past years have enabled the fabrication of a myriad of nanocrystalline (non-silicate) oxides with different pore structures and ordering lengths. Their formation essentially relies on the coassembly of inorganic sol-gel precursors with an organic structure-directing agent (SDA). Despite the simplicity of this solution processing route, the difficulty of controlling the crystallization process has limited the preparation of multimetallic oxides with a well-defined pore-solid architecture so far. In this talk, I will specifically focus on the evaporation-induced self-assembly synthesis of ternary (and even more complex) metal oxide thin films having both a cubic mesoporous morphology and highly crystalline walls by using tailor-made polymer SDAs with improved templating properties. Overall, I will show that the integration of mesoporosity with texture -specific properties might pave the way to broaden the scope of application of these oxide materials, particularly when considering the wealth of opportunities for novel device design.

I.15.1

add to my program (close full abstract)

17:00 **Understanding the surface chemistry of metal oxide nanocrystals as pinning centers in ink-jet printed YBa2Cu3O7-x thin films**

Authors : Jonathan De Roo, Freya Van den Broeck, Katrien De Keukeleere, Jonas Feys, Hannes Rijckaert, Jose C Martins, Isabel Van Driessche, Zeger Hens
Affiliations : Ghent University, Department of Inorganic and Physical Chemistry, Ghent University, Department of Organic Chemistry, Ghent University, Department of Inorganic and Physical Chemistry, Ghent University, Department of Inorganic and Physical Chemistry, Ghent University, Department of Inorganic and Physical Chemistry, Ghent University, Department of Organic Chemistry, Ghent University, Department of Inorganic and Physical Chemistry, Ghent University, Department of Inorganic and Physical Chemistry

Resume : Although the solution processing of YBa2Cu3O7-x (YBCO) coated conductors is extensively optimized, the critical current density remains too low for high field applications. A possible solution is the introduction of nanocrystals (NCs) of inert metal oxides in the YBCO layer. For this, the NCs are to be stabilized in the YBCO precursor solution, which requires an in depth knowledge of their surface chemistry. In this contribution, we focus on HfO2 NCs as a model system. NCs of 5 nm are solvothermally synthesized in benzyl alcohol using microwave heating. The surface of the charge-stabilized NCs thus obtained

I.15.2

can be subsequently modified with fatty acids and oleylamine to disperse them in nonpolar solvents. Concomitantly, aggregates are broken up into the constituting NCs. We present a detailed study of the fundamental (acid/base) processes during the surface modification using 2D NMR techniques like NOESY and DOSY . We also demonstrate that there is no difference in steric stabilization between our system and a surfactant-based synthesis. Importantly, identical results were obtained for ZrO2 NCs. Using these insights, it proved possible to transfer the hafnia NCs to the YBCO precursor solution. The resulting ink was processed via ink-jet printing and after deposition and epitaxial film growth, the superconducting nanocomposite was retrieved. This demonstrates how fundamental insights can have a direct impact on applications.

add to my program (close full abstract)

17:15 **Metal Oxide Nanoparticle Engineering for Printed Electrochemical Applications** I.15.3

Authors : P.J. Wojcik, L. Santos, L. Pereira, R. Martins, E. Fortunato
Affiliations : Departamento de Ciencia dos Materiais, FCT-UNL, Cenimat – I3N and Cemop-Uninova, Campus de Caparica, 2829-516 Caparica, Portugal

Resume : One of the most active trends in material science is the development of inorganic nanoparticles (NPs) with structural, electrochemical and optical properties tailored to the specific application. Features of those nanostructures are equally as important as their processability, enabling thin film formation with desired composition. The combination of these two requirements implies a need for a set of engineering rules combining NPs synthesis/selection and deposition process into one consistent theory. The advent of novel wet deposition techniques such as inkjet printing has led to new possibilities in a field of electrochemically active thin solid films based on nanocrystalline metal oxides (MOX). However, many multidisciplinary challenges related to this topic emerged simultaneously. In this talk, following topics will be covered: (I) A theoretical approach to understand the impact of size and shape of NPs on a printable mixture formulation and electrochemical performance of resulting film; (II) Engineering procedures governing the selection or development of printable nanostructured MOX NPs for chromic, photovoltaic, photocatalytic, sensing, electrolyte gated TFTs and power storage applications; (III) NPs processability in printing systems; (IV) A case study of nanostructured WO3 via hydrothermal synthesis for printed electrochromic devices.

add to my program (close full abstract)

17:45 **Inkjet-printed high conductivity, low temperature reduced graphene oxide film** I.15.4

Authors : Pei He, Brian Derby
Affiliations : School of Materials, University of Manchester, Manchester, United Kingdom

Resume : Graphene is a promising potential material to replace indium tin oxide as the transparent conductor for electronic applications because of its exceptional electrical and optical properties. For manufacturing applications, it is desirable to have the ability to make large scale production of graphene materials. One method for the preparation of large quantities of graphene is through the chemical reduction of graphene oxide. This is a solution based method with a long history of development. The resulting reduced graphene oxide dispersions can be processed as inks for use in manufacturing processes, e.g. inkjet printing. In this work, we present a study of high conductivity reduced graphene oxide films produced by inkjet-printing combined with a low temperature reduction process. The as-prepared graphene oxide ink was stabilised and used in an inkjet-printer to pattern glass substrates at a substrate temperature of 70 °C. In order to form high conductive graphene oxide films the printed structures were reduced in the gas phase using hydriodic acid at 50 °C. By using large area graphene oxide flakes (with an average diameter of 20.4 μm) and adjusting the number of printing layers, films with electrical sheet resistance of 95±3 Ω/□ could be achieved. The measured conductivity of this reduced graphene oxide films was 3.5 × 104 ± 0.2 × 104 S/m, which is higher than that previous reported for inkjet-printed solution exfoliated graphene with high temperature (250 °C) post treatment.

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Poster session 3 : An Hardy

18:00 **Sol gel derived nanocrystalline ZnO-TFT: Fabrication and transistor parameters** I.P3.1

Authors : Yasemin Caglar, Saliha Ilican, Mujdat Caglar, Seval Aksoy, Fahrettin Yakuphanoglu
Affiliations : Department of Physics Anadolu University Eskisehir 26470 Turkey,Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of

Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Firat University Elazig 23169 Turkey

Resume : Thin film transistors (TFTs) with oxide active channel layers are presently attracting strong interest in relation to electronics applications. In this study, nanocrystalline ZnO thin films have been prepared onto p-Si/SiO2 substrates by sol gel spin coating method. Then, aluminum source/drain top electrodes onto this film were deposited by thermal evaporation method. These electrodes were made through the shadow mask. The output and transfer characteristics of ZnO-TFT having source/drain interdigitated-finger geometry were investigated. The transistor shows a transition from linear to saturation behavior. The saturation current takes place due to a pinch-off of the conductive channel of the transistor. The μ and Vth value of the ZnO-TFT transistor is determined from the plot of Ids1/2 versus Vg. The obtained Vth value for the transistor indicates the value of the gate-source voltage beyond which a conductive channel forms at the ZnO surface. The Ion/Ioff ratio for the ZnO-TFT transistor was also determined. Keywords: ZnO-TFT, sol-gel spin coating, nanostructure thin films, transistor parameters. Acknowledgement This work was supported by Anadolu University Commission of Scientific Research Project under Grant No: 1101F009.

add to my program (close full abstract)

18:00 **Investigation of the effects of spin speed on XRD and SEM characterization of sol gel derived nanocrystalline ZnO films**

Authors : Mujdat Caglar, Yasemin Caglar, Saliha Ilican, Seval Aksoy, Fahrettin Yakuphanoglu

Affiliations : Department of Physics Anadolu University Eskisehir 26470 Turkey,Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Anadolu University Eskisehir 26470 Turkey,Department of Physics Firat University Elazig 23169 Turkey

Resume : By using ZnO based TCOs, thin film transistors (TFTs) used as switching devices for displays have been fabricated by using sol-gel process, PLD and CVD. In this study, nanocrystalline ZnO films have been prepared onto p-Si/SiO2 substrates by sol-gel method using spin coating technique in an aqueous solution that contained zinc acetate dihydrate, 2-methoxyethanol and monoethanolamine at 0.35M. The coating solution was dropped into substrate, which was rotated between 1000 and 5000 rpm for 30 s using a spin-coater. After the spin coating process the film was dried at 300 oC for 10 min in a furnace. This coating/drying procedure was repeated for five times, before the film was inserted into a tube furnace and annealed at 850 oC in air for 2 h. Effects of spin speed on the structural and morphological properties of the ZnO films have been investigated. The important changes in crystalline structure of the ZnO films were observed due to the spin speed. The structural parameters were calculated. The most well-crystallized film is determined. This film may be considered to be suitable film for fabrication of ZnO-TFT. Keywords: ZnO, sol-gel spin coating, nanostructure thin films, structural properties. Acknowledgement This work was supported by Anadolu University Commission of Scientific Research Project under Grant No: 1101F009.

I.P3.2

add to my program (close full abstract)

18:00 **Sol gel derived nanocrystalline ZnO Films: The role of pH value on the XRD and SEM studies**

Authors : Saliha Ilican, Mujdat Caglar, Yasemin Caglar, Seval Aksoy, Fahrettin Yakuphanoglu

Affiliations : Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Anadolu University Eskisehir 26470 Turkey, Department of Physics Firat University Elazig 23169 Turkey

Resume : Recently, thin film transistors (TFTs) have attracted considerable attention for use in electronic device applications requiring low cost preparation techniques such as solution process. In this study, nanocrystalline ZnO thin films have been prepared onto p-Si/SiO2 substrates by sol-gel spin-coating method. ZnO sol was prepared using zinc acetate dihydrate, 2-methoxyethanol and monoethanolamine as the starting material, solvent and stabilizer, respectively. The pH value of the sol was adjusted with ammonia (pH=7-11). The sol was stirred by a magnetic stirring apparatus at 40oC for 2h. The coated films were dried at 300 oC for 10 min. This coating/drying procedure was repeated for five times, before the film was annealed at 550 in air for 1h. Effects of pH value on the structural properties of the films were analyzed by an XRD. XRD analysis

I.P3.3

revealed that the films consist of single phase ZnO with wurtzite structure and polycrystalline nature. The important changes in crystalline structure of the films were observed due to the pH value. The microstructure of the films has been investigated by using a SEM. The suitable film for fabrication of ZnO-TFT was determined. Keywords: Nanostructure, ZnO thin film, sol-gel spin coating, XRD, SEM. Acknowledgement This work was supported by Anadolu University Commission of Scientific Research Project under Grant No: 1101F009.

add to my program (close full abstract)

18:00 **Photocatalytic properties of carbon nanotubes/titania nanoparticles composite layers deposited by electrophoresis** I.P3.5

Authors : S. Scalese(1), V. Scuderi (2), D. D'Angelo (1), M. M. G. Buscema (1), S. Libertino (1), R. A. Puglisi (1), M. Miritello (2), V. Privitera (2)

Affiliations : (1) CNR-IMM, Ottava Strada n.5, Zona Industriale, 95121 Catania (Italy), (2) CNR-IMM, via S. Sofia 64, 95123 Catania (Italy)

Resume : A large-scale use of nanotechnology for photocatalysis-based water purification requires to identify simple, reliable and low cost processes for the production of the photocatalytic materials. To this aim we have investigated the possibility to deposit, by electrophoresis, composite layers formed by multi-walled carbon nanotubes (MWCNTs) and titanium dioxide nanoparticles (np-TiO2), with different weight ratios. This method allows one to obtain photocatalytic layers, on any conductive substrates, that in principle can be re-used several times. The photocatalytic efficiency for each MWCNT/np-TiO2 composite layer is evaluated by measuring the degradation of methylene blue (MB) dye induced by UV-Vis light irradiation. The composite layers were characterized by scanning electron microscopy (SEM), Energy Dispersive X-ray analysis (EDX), and photoluminescence (PL) measurements in order to explain the different photocatalytic behaviours observed for each material.

add to my program (close full abstract)

18:00 **Structural and optical properties of ZnO:V and SiO2/Zn2SiO4:V nanocomposites synthesized by sol-gel method** I.P3.6

Authors : J. El Ghoul (a,b)* and L. El Mir (a,b)

Affiliations : a Laboratoire de Physique des Matériaux et des Nanomatériaux Appliquée à l'Environnement, Faculté des Sciences de Gabès, Cité Erriadh Manara Zrig 6072 Gabès, Tunisie. b Al Imam Mohammad Ibn Saud Islamic University (IMSIU), College of Sciences, Departement of Physics, Riyadh 11623, Saudi Arabia.

Resume : Vanadium-doped Zn2SiO4 particles embedded in silica host matrix were prepared by a simple solid-phase reaction after the incorporation of ZnO:V nanoparticles in silica monolith using sol-gel method with supercritical drying of ethyl alcohol in two steps. In the case of V-doped ZnO, the powder with an average particle size of 25 nm shows a strong luminescence band in the visible range. In the case of V-doped Zn2SiO4, the PL reveals a band centered at about 540 nm attributed to the vanadium in the interfaces between Zn2SiO4 particles and SiO2 host matrix. The PLE band (~3.5-5.2 eV) may be understood as an energy transfer process from O2- to V5+ which occurs intrinsically in the vanadyl group. The photoluminescence decay shows that the lifetimes obtained are of the order of a few nanoseconds.

add to my program (close full abstract)

18:00 **Sol-gel synthesis, optical and magnetic properties of vanadium doped ZnO nanoparticles** I.P3.7

Authors : J. El Ghoul (1,2)* and L. El Mir (1,2)

Affiliations : 1 Laboratoire de Physique des Mat?riaux et des Nanomat?riaux Appliqu?e ? l?Environnement, Facult? des Sciences de Gab?s, Cit? Erriadh Manara Zrig 6072 Gab?s, Tunisia. 2 Al Imam Mohammad Ibn Saud University (IMSIU), College of Sciences, Department of Physics, Riyadh 11623, Saudi Arabia.

Resume : We report the synthesis of Zn1-xVxO nanoparticles prepared by a sol -gel processing technique for x ranging from 0 to 0.08. In our approach, the water for hydrolysis was slowly released by esterification reaction followed by a supercritical drying in ethyl alcohol. The obtained nanopowder was characterized by various techniques such as particle size analysis, scanning electron microscopy (SEM), transmission electron microscopy (TEM), X-ray diffraction (XRD) and photoluminescence (PL). In the as-prepared state, the powder with an average particle size of 25 nm presents a strong luminescence band in the visible range. From photoluminescence excitation (PLE) the energy position of the obtained PL band depends on the excitation wavelength and this PL band can be also observed under visible excitations. Magnetic measurements at room temperature showed a diamagnetic for undoped ZnO and ferromagnetic

behavior after doping with vanadium. The mechanism of nanoparticles formation and the comparison with recent results are discussed.

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18:00 **The structural and optical properties of N-doped MgZnO thin film prepared by sol–gel**

Authors : Tien-Chai Lin, Wen-Chang Huang
Affiliations : Department of Electro-Optical Engineering, Kun Shan University

Resume : ZnO has attracted considerable attention for its potential applications, such as ultraviolet light-emitting diodes, laser diodes, solar cells and thin film transistors, because of its wide direct band gap of 3.37 eV and large exciton binding energy of 60 meV at room temperature. The band gap energy of MgZnO can be tuned from 3.37 eV to 7.8 eV by incorporating Mg into ZnO. For the study of the doping effects of MgZnO films, Ga and Al were used to obtained n-MgZnO. For the study of p-type dopant of MgZnO, Cu and N have been discussed. In this study, we are interested in the discussion of the microstructural and optical characteristics of the N doped MgZnO films. The nitrogen-doped MgZnO thin films were prepared on Si substrate by sol-gel spin coating process. The undoped Mg0.1Zn0.9O thin film shows high quality crystallinity after RTA annealing at 800□C for 45 sec. It is found that the crystallinity of the Mg0.1Zn0.9O thin film and the preferred c-axis orientation was enhanced through the incorporation of nitrogen doping and heat treatment. The surface morphology of the nitrogen doped Mg0.1Zn0.9O thin film was observed by SEM and showed obviously change after various temperature annealing. The incorporation of nitrogen doping also causes the blue shift of optical band gap energy and the enhancement of transparency of the Mg0.1Zn0.9O thin film.

I.P3.8

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18:00 **Light emitting TiO2: Eu thin films produced by matrix assisted pulsed laser evaporation from colloidal sols**

Authors : I. Camps,(1) L. Duta,(2) C. Nita,(2) E. György,(2,3) M. Borlaf,(4) R. Serna,(1) C. Logofatu,(5) M. T. Colomer,(4) R. Moreno (4)
Affiliations : (1)Laser Processing Group, Instituto de Óptica, CSIC, C/Serrano 121, 28006 Madrid, Spain; (2) National Institute for Lasers, Plasma and Radiation Physics, PO Box MG 36, 76900 Bucharest V, Romania; (3) Instituto de Ciencia de Materiales de Barcelona, Consejo Superior de Investigaciones Científicas (ICMAB-CSIC), Campus UAB, 08193 Bellaterra, Spain; (4)Instituto de Cerámica y Vidrio CSIC, Kelsen 5, 28049, Madrid, Spain; (5) National Institute for Materials Physics, PO Box MG. 7, 77125 Bucharest, Romania

Resume : Rare-earth doped TiO2 nanoparticles via colloidal so-gel route have been the focus of intense research due to their potential optical application in filters, solar cells and light emitters. These applications require the preparation of good quality thin films from the colloids. Therefore different procedures have been used ranging from simple dipping, and spin coating to electrophoretic deposition. However, these techniques do not allow a precise, nanometric control of the thickness of the deposited layers required for the targeted applications. In this work we report the successful production of optically active thin films using a non-conventional laser based method, called matrix assisted pulsed laser evaporation (MAPLE). TiO2 nanoparticles doped with Eu have been produced using a colloidal sol gel route [1]. The obtained solutions were frozen in liquid nitrogen to form a solid target further used in the MAPLE experiments. The thin film deposition was performed in vacuum or controlled oxygen atmosphere. The films have been characterized by X-ray photoelectron spectroscopy and X-ray diffraction to determine their chemical composition and crystalline structure. Optical properties have been determined by UV-visible spectroscopy and photoluminescence in the visible region. The as-grown films show good uniformity, and efficient Eu light emission in the 600-700 nm range. The enhancement of the films light emission and improvement of the optical response as a function of the post-deposition thermal annealing treatments will be discussed. [1] M. Borlaf, M.T. Colomer, F. Cabello, R. Serna, R. Moreno, J. Phys.Chem C. B 117, 1556 (2013).

I.P3.10

add to my program (close full abstract)

18:00 **Photon Management in All Metal Oxide Solar Cells**

Authors : Natalia Yantara (1,2), Thu Trang Thi Pham (1,2), Nripan Mathews (3), Subodh Mhaisalkar (1,2)
Affiliations : (1. School of Materials Science and Engineering, Nanyang Technological University, Singapore, Singapore.) (2. Energy Research Institute @NTU (ERI@N), Nanyang Technological University, Singapore, Singapore.) (3. Singapore-Berkeley

I.P3.11

Research Initiative for Sustainable Energy, Singapore-Berkeley Research Initiative for Sustainable Energy, Singapore, Singapore.)
Resume : The advantages of inverse opal ZnO structure on electrodeposited ZnO / Cu2O devices are explored. The solar cells are fabricated on fluorine doped tin oxide coated glass substrates by using cheap solution based method mainly spin coating and electrodeposition. ZnO inverse opal structure enhances the short circuit current. Optical simulation by using finite difference time domain method is engaged to simulate the light propagation inside the devices.

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18:00 **Nano- and Microstructured Optical Coatings by Phase Separation in Sol-Gel Solutions** I.P3.12

Authors : Triin Kangur, Martin Timusk, Martin Järvekülg
Affiliations : Institute of Physics, University of Tartu, Estonia; Estonian Nanotechnology Competence Centre
Resume : We present our results in nano- and microstructural design of oxide materials by synthesis strategies based on phase separation in sol-gel system. Condensation of hydrolyzed silicon or metal alkoxides progressively decreases the solubility between the gel-forming component and a polar solvent, leading to the formation of spatially separated phase domains. This mechanism has been used for preparing oxide films with continuous pore network [1]. We have applied similar approach to develop high-performance electro-optical hybrids in which LC droplets are encapsulated in gel matrix [2]. Possible applications include privacy glass, optical sensors, light modulators and angular discriminating filters. We have also used the same phase separation principles in a novel method for patterning substrates with round silica features with diameters tunable from nano to micro scale [3]. In addition to non-wetting properties of such surfaces, optical functionality is also achieved as each surface feature acts as a lens. These patterned surfaces can thus be used as structured diffusive, light trapping or anti-glare coatings. References: [1] Nakanishi K., Tanaka N., Accounts of Chemical Research 40 (2007) 863. [2] Timusk M., Järvekülg M., Salundi A., Lõhmus R., Kink I., Saal K., J. Mater. Res. 27 (2012) 1257. [3] Kangur T., Nurmis, L., Järvekülg M., IOP Conf. Ser.: Mater. Sci. Eng, 49 (2013) 012035.

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18:00 **Post-annealing effect on the enhancement of 1.54μm emission from Er3+ and SnO2 nanoparticles co-doped silica films** I.P3.13

Authors : Xiaowei Zhang, Tao Lin, Pei Zhang, Shaobing Lin, Ling Xu, and Jun Xu*
Affiliations : National Laboratory of Solid State Microstructures and Jiangsu Provincial Key Laboratory of Advanced Photonic and Electronic Materials, School of Electronic Science and Engineering, Nanjing University, Nanjing 210093, China
Resume : Recently, Er3+ doped silica films have attracted much attention due to their potential applications in Si-based photonic devices. However, the small excitation cross-section of Er3+ ions in silica leads to insufficient emission efficiencies of these materials. By co-doping with wide-band semiconductor quantum dots (QDs) with larger excitation cross-section, it can sensitize rare-earth ions to improve the luminescence properties. In the present work, post-annealing treatment in the temperature range of 650-1150oC is used to fabricate silica thin films co-doped with SnO2 QDs and Er3+ ions in order to enhance the 1.54um emission intensity. It is found that the post-annealing treatment is an effective way to enhance the 1.54μm emission at the optimized annealing temperature. Meanwhile, temperature-dependent PL measurements indicate the energy transfer process from SnO2 QDs to the Er3+ ions. Moreover, the electronic property of co-doped silica thin film is studied. It is found that the carrier transportation is mainly dominated by the direct tunneling mechanism at the low voltage and FN tunneling mechanism at higher forward voltage, respectively. Our results indicate that the high efficient near-infrared luminescence from the silica thin films co-doped with SnO2 QDs and Er3+ ions after suitable annealing treatment can be obtained for applications in optoelectronic devices. This work was financially supported by "973" Project (2013CB632101) and NSFC (11274155).

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18:00 **Tunable photoelectric properties by magnetic fields in Pr0.7Sr0.3MnO3/ZnO heterojunctions** I.P3.14

Authors : W.Y. Huang, J.F. Wang, C.C. Ling* and J. Gao*
Affiliations : University of Hong Kong
Resume : The p-n junctions, consisting of p-type Pr0.7Sr0.3MnO3 (PSMO) and n-type ZnO layers, have been fabricated on Al2O3 (012) substrates by using pulsed laser deposition. The x-ray diffraction pattern of PSMO/ZnO/sapphire

heterostructure implies high degree of epitaxy and good crystallinity. No secondary phase could be found. Such junctions also exhibited excellent and reproducible rectifying behaviors over the temperature range 180K-300K. By applying different magnetic fields, the junction properties can be modified significantly. The influences of optical and strain fields on the junction behaviors were also investigated. Moreover, from the photoluminescence spectra of these heterojunctions, the wavelengths were observed to shift considerably at the magnetic field of H=1T. These phenomena can be attributed to the high magnetic sensibility of PSMO, which causes the dependence of photoluminescence of the junctions on external magnetic fields.

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18:00 **Plasmonic TiO2 films with gold nanoparticles by chemical spray pyrolysis**

Authors : I. Oja Acik1, G. N. Oyekoya1, A. Mere1, M. Krunks1, V. Mikli2, L. Dolgov3, I. Sildos3

Affiliations : 1 Tallinn University of Technology, Department of Materials Science, Laboratory of Thin Film Chemical Technologies, 19086 Tallinn, Estonia; 2 Tallinn University of Technology, Department of Materials Science, Chair of Semiconductor Materials Technology, 19086 Tallinn, Estonia; 3 University of Tartu, Institute of Physics, 51014 Tartu, Estonia;

Resume : The sol-gel chemical spray pyrolysis method was used to deposit TiO2 films with gold nanoparticles. The TiO2 spray solution was composed of titanium(IV) isopropoxide (0.2 mol/L) and acetylacetone in a molar ratio of 1:2 in ethanol. HAuCl4·3H2O (0, 2.6 or 5.4 mol%) was added into the spray solution for incorporation of Au-nanoparticles into TiO2 films. TiO2 and Au:TiO2 layers were deposited onto glass substrates at substrate temperatures in the range of 260-400 °C using pulsed spray solution feed followed by the annealing at 400°C in air. The effect of the deposition and annealing temperature on the plasmonic effect in the Au:TiO2 layers with various Au concentrations was characterized. According to XRD, TiO2 films are amorphous at temperatures below 400 °C; metallic Au was observed in Au:TiO2 layers deposited in the temperature range of 260-300 °C. The mean crystallite size of the Au-nanoparticles remained between 10 and 20 nm. Au:TiO2 layers deposited in the temperature range of 260-300 °C show plasmonic light extinction in the spectral range of 570- 580 nm, which shifts to 620 nm after annealing at 400°C in air. It is planned to adapt TiO2 layers with gold-nanoparticles for thin plasmonic coatings for photovoltaic applications.

I.P3. 15

add to my program (close full abstract)

18:00 **Broadband anti-reflective sol-gel coatings with easy-to-clean performance for concentrating photovoltaics**

Authors : Cecilia Agustín, José Ángel Sánchez-García, Maider Machado, Jiri Nohava, Marta Brizuela, Naiara Yurrita, Oihana Zubillaga

Affiliations : TECNALIA R&I;TECNALIA R&I;TECNALIA R&I;CSM Instruments;TECNALIA R&I;TECNALIA R&I;TECNALIA R&I

Resume : The aim of this work is to develop a broadband anti-reflective, easy-to-clean, abrasion resistant coating with high performance stability for the cover glass of concentrating photovoltaic systems. Porous silica thin films were prepared by sol-gel dip-coating using tetraethyl orthosilicate (TEOS) as precursor in acidic medium and a block copolymer as pore generating agent. Different sintering temperatures and multilayer structures were studied. In order to achieve easy-to-clean surfaces, the films were treated with hexamethyldisilazane (HMDS) solution. According to low-angle X-ray diffraction measurements, the pore order disappears when increasing sintering temperature, but this does not affect transmittance values. Best optical and durability results were obtained for a dense-porous bi-layer sintered at 550°C, showing integrated total transmittance values up to 96.5% after 1000 hours of damp heat test. The HMDS does not significantly affect the transmittance, whereas the contact angle is increased up to 100°. Water does not penetrate in pores even at high relative humidity. Nanoindentation measurements showed hardness values up to 36GPa. A cyclic abrasion test was performed simulating the real cleaning process and no surface damage was observed after 25.000 cleaning cycles.

I.P3. 16

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18:00 **Structural, electrical and optical properties of sprayed Nd-F codoped ZnO thin films**

Authors : A. Elfakir1, A. Belayachi1 , T. S. Tlemçani1 and M. Abd-Lefdil1, G. Schmerber2, M. Balestreiri2, S. Colis2 and A. Dinia2 K. Bouras3 and A. Slaoui3 E. G-Berasategui4

Affiliations : 1University of Mohammed V-Agdal, Materials Physics Laboratory, P. B.

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1014, Rabat, Morocco; 2 IPCMS , 23 rue du Loess, F-67037 Strasbourg cedex 2, France; 3 Laboratoire ICube, MaCEPV, 23 rue du Loess, F-67037 Strasbourg cedex 2, France; 4IK4-Tekniker Research Centre, c/ Iñaki Goenaga, 5, 20600 Eibar, Guipuzcoa, Spain

Resume : Undoped ZnO and Nd-F codoped ZnO (NFZO) thin films were synthesized at 350 °C on glass substrates by chemical spray pyrolysis method. The effects of cationic and anionic atoms (Nd and F) on the structural, optical and electrical properties were studied. X-ray diffraction analysis indicates that all the films have polycrystalline nature and exhibit hexagonal wurtzite crystal structure. The surface morphology was investigated using atomic force microscopy. The addition of fluorine induced an increase in the optical band gap of the films. Photoluminescence measurements showed that all the films have a strong emission band at around 380 nm. In addition some lines are also observed around 900 nm that are characteristics of Nd3+. This is an experimental evidence of an electronic transfer between ZnO and Nd3+. Finally, a minimum electrical resistivity value, of about 4.0×10-2 Ω.cm was obtained after the insertion of F in the ZnO matrix.

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18:00 **Influence of preparation conditions on the properties of electrospun ZnO fibers**

Authors : C. Busuioc, A. Evanghelidis, C. Florica, A. Costas, I. Enculescu
Affiliations : National Institute of Materials Physics, RO-077125, Bucharest-Magurele, Romania

Resume : In this work, ZnO fibers were obtained by electrospinning technique using zinc acetate (Zn(Ac)2) and poly(methyl methacrylate) (PMMA) as starting materials and dimethylformamide (DMF) as solvent. Silicon plates were employed as substrates. The concentration of Zn(Ac)2 solution was varied between 2 and 7.5 %, while the calcination was performed at 450, 600 or 800 ° C. The compositional, structural, morphological and luminescent properties of the resulting fibers were investigated by using X-ray diffraction (XRD), scanning electron microscopy (SEM) and photoluminescence (PL) spectroscopy. SEM investigation revealed a fibrous microstructure both before and after the thermal treatment, the average fiber diameters being 500 nm before calcination and 250 nm after calcination. The thermally treated samples exhibit polycrystalline single -phase structure, assigned to hexagonal ZnO. The position and intensity of ZnO fibers photo emission band is strongly influenced by the calcination temperature, as PL analysis indicated. Further, electrical contacts were fabricated by photolithography and electric characteristics were measured. A correlation of transport properties and preparation conditions was made. Such thin semiconducting fibers prepared by a straightforward approach can be easily employed as building blocks for bio or chemical sensors.

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18:00 **Increasing the surface area of nanocrystalline TiO2 for dye-sensitized solar cells with a novel wet processing-based method**

Authors : Giuseppina Palma [1], Luca Cozzarini [1], Alessandro Fraleoni Morgera [1,2]*
Affiliations : [1] Organic OptoElectronics Laboratory, Sincrotrone Trieste SCpA – SS 14.5, km 163.5 – 34149 Basovizza (TS), Italy; [2] Flextronics Laboratory, Dept. of Engineering and Architecture – Univ. of Trieste. V. Valerio 10, 34100 Trieste (TS), Italy - Email: * afraleoni@units.it

Resume : Dye-sensitized solar cells (DSSCs) are an effective and low-cost photovoltaic technology [1]. The core of DSSCs is a layer of titanium dioxide (TiO2) nanocrystals hosting a photosensitizer dye (that generates photoexcited electrons via solar light harvesting). The relatively high efficiencies (up to >12% [2]) reached up to now in these devices are possible thanks to the high surface area of the nanostructured TiO2, that allows to absorb a high number of dye molecules. Here, we present a novel wet processing-based method [3,4] able to produce an enhanced TiO2 surface area available for the dye adsorption. The so-obtained nanostructured TiO2 layers absorbed up to up to 0.78 dye molecules/nm2, versus 0.28-0.31 molecules/nm2 values found in literature [5] and confirmed in our laboratories, i.e. a 250+% increase in number of dye molecules/surface area even with respect to state-of-the-art devices. DSSCs based on the novel approach delivered current densities (hence efficiencies) about 30% higher than those based on conventional TiO2 layers. Incident Photon Conversion Efficiency (IPCE) measurements suggest that charge recombination phenomena occurring in these high surface area photoanodes are stronger than in conventionally fabricated ones. [1] Graetzel, J. Photochem. Photobio. A 164(2004),3 [2] Yella et al., Science 334(2011),629 [3] Fraleoni-Morgera, Small 7(2011),321 [4] Fraleoni-Morgera et al., RSC Adv. 3 (2013),15664 [5] Zukalová et al., Inorg. Chim. Acta 361(2008)656

I.P3. 19

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18:00 **Effects of the chemical precursors on the growth of ZnO nanowires by chemical bath deposition**

Authors : R. Parize*, J. Garnier, S. Guillemin, E. Appert, V. Consonni*
Affiliations : R.Parize, LMGP, Grenoble INP-CNRS, CS 50257 Grenoble and SiMAP, Grenoble INP-CNRS, F-38402 St Martin d'Heres; J.Garnier, LMGP, Grenoble INP-CNRS, CS 50257 Grenoble; S.Guillemin, LMGP, Grenoble INP-CNRS, CS 50257 Grenoble and INL, CNRS, UMR5270 Lyon; E.Appert, LMGP, Grenoble INP-CNRS, CS 50257 Grenoble and SiMAP, Grenoble INP-CNRS, F-38402 St Martin d'Heres; V.Consonni, LMGP, Grenoble INP-CNRS, CS 50257 Grenoble

Resume : *Email of corresponding author: vincent.consonni@grenoble-inp.fr romain.parize@simap.grenoble-inp.fr ZnO nanowires (NWs) grown in solution have attracted much attention over the last decade for a large number of optoelectronic and photovoltaic devices. However, one critical point for including ZnO NWs in these devices is still the precise control of their structural morphology such as their density, diameter, length or vertical alignment for instance. These structural properties depend both on the structural morphology of the ZnO seed-layer required for the nucleation of ZnO NWs [1,2] as well as on the growth conditions used in chemical bath deposition (i.e., chemical precursors, concentration, temperature). In this context, the study of the effects of the chemical precursors on the structural properties of ZnO NWs is carried out. Several types of chemical precursors such as standard zinc nitrate and HMTA (in equimolar and non-equimolar ratios), polyethylenimine (PEI) with low, medium and high molecular weight, or NH3 are used. Both the density, diameter, length and vertical alignment of ZnO NWs as a function of the chemicals in solution are determined by scanning and transmission electron microscopy as well as by x-ray diffraction, leading to a better understanding of their growth mechanisms. A special emphasis is also made on the role of each chemical precursor in solution for the growth of ZnO NWs. [1] S. Guillemin V. Consonni, E. Appert, E. Puyoo, L. Rapenne, H. Roussel, J. Phys. Chem. C 116, 25106 (2012). [2] S. Guillemin, L. Rapenne, H. Roussel, E. Sarigiannidou, G. Brémond, V. Consonni, J. Phys. Chem. C 117, 20738 (2013).

I.P3. 20

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18:00 **Highly branched RuO2 Nanorods on Electrospun TiO2 Nanofibers toward Electrochemical Catalysts**

Authors : Yukyung Cho1, Su-Jin Kim1, Nam-Suk Lee2, Myung Hwa Kim1*, Youngmi Lee1
Affiliations : 1 Dept. of Chemistry and Nano Science, Ewha Womans University, Seoul 120-750, Korea; 2 National Center for Nanomaterials Technology (NCNT), Pohang University of Science and Technology (POSTECH), Pohang 790-784, Korea

Resume : We report a facile growth route to synthesize hierarchically grown single crystalline metallic RuO2 nanorods on electrospun TiO2 nanofibers via a combination of a simple vapour phase transport process with an electrospinning process. This synthetic strategy could be very useful to design a variety of highly branched network architectures of the functional hetero-nanostructures for electrochemical applications. Particularly, Ruthenium oxide (RuO2) 1-dimensional nanostructures can be used as the effective catalysts or electrochemical electrode materials. Thus, we first synthesize TiO2 nanofibers from mixture of titanium isopropoxide precursor and polymer and then ruthenium hydroxide precursor on TiO2 nanofibers are transformed into RuO2 nanorods by thermal treatment at 250oC in air. The crystalline structures of products are confirmed using scanning electron microscopy (FE-SEM), X-ray diffraction (XRD) spectrum, Raman spectroscopy, and high resolution electron microscopy (HRTEM). The fundamental electrochemical performances are examined using cyclic voltammetry (CV).

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18:00 **Ultra-fast microwave assisted synthesis of Tb3+: GdOOH hierarchical structures, thermal conversion to oxide structures and photoluminiscent studies**

Authors : Shafquat Majeed and S.A. Shivashankar
Affiliations : Materials Research Centre Centre for Nanoscience and Engineering Indian Institute of Science Bangalore-560012 INDIA

Resume : We report a novel, rapid, and low-temperature method for the synthesis of undoped and Tb-doped GdOOH spherical hierarchical structures, without using any structure-directing agents, through a facile microwave irradiation route. The as-prepared product consists of nearly monodisperse microspheres measuring about 1.35 μm in diameter. SEM imaging reveals that each microsphere is an assembly of two-dimensional nanoflakes (about 30 nm thin) which, in turn, result from the assembly of crystallites measuring about 9 nm in diameter. Thus, a three-degree hierarchy can be seen in the formation of

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these microspheres: from nanoparticles to 2d nanoflakes to 3d spherical structures. When doped with Tb3+ ions, the GdOOH microspheres show a strong green emission, making them promising candidates as phosphors. Finally, thermal conversion at modest temperatures leads to the formation of corresponding oxide structures with enhanced luminescence, while retaining the spherical morphology of their oxyhydroxide precursor.

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18:00 **Highly Efficient Electrocatalysts of RuO2-Co3O4 Composite Nanofibers**

Authors : HYESU JANG, YEJIN YANG, CHONGMOK LEE, MYUNG HWA KIM
Affiliations : Department of Chemistry and Nano Science Ewha Womans University, Seoul, 120-750, Korea

Resume : Electrospinning is a facile synthetic method for nano-scaled materials by treating solutions into continuous fibers. Ruthenium oxide is a rutile-type tetragonal oxide that exhibits the metal-like electrical conductivity and excellent stability. Owing to these properties, it can be applied to electrochemical sensor and electrocatalyst. Cobalt oxide is well known for its interesting properties as an electrocatalyst for oxygen reduction and evolution. When composite nanofibers are made from these two metal oxides, we can expect remarkable synergistic effect of electrocatalyst for oxygen reduction reaction as well as stability. We synthesized pre-RuO2-Co3O4/PVP nanofibers from mixture of their inorganometallic precursors and PVP via electrospinning. Then calcined the fibers to remove the polymer and generate oxidized structure of RuO2-Co3O4 composite nanofibers. The crystalline structures were characterized using scanning electron microscopy (FE-SEM), X-ray diffraction (XRD) spectrum and Raman spectroscopy. The as-prepared nanofibers were applied to construct an electrocatalyst for oxygen reduction reaction.

I.P3.23

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18:00 **Erbium-Implanted Vanadium Dioxide Thin Films**

Authors : Jeffrey C. McCallum 1, Herianto Lim 1, Nikolas Stavrias 1, Brett C. Johnson 1, Robert E. Marvel 2 and Richard F. Haglund 2
Affiliations : 1 School of Physics, University of Melbourne, Melbourne, Victoria, 3010, Australia. 2 Department of Physics and Astronomy, Vanderbilt University, Nashville, Tennessee, 37240, USA.

Resume : The insulator–to–metal transition (IMT) in VO2 is accompanied by dramatic increases in electrical conductivity, magnetic susceptibility and infrared reflectivity. It is also accompanied by structural transformation from monoclinic (M1) to rutile (R) structure. The transition is reversible and can be induced in a variety of ways including thermal heating, electrical pumping, or pulsed-laser excitation. In pure VO2 the IMT occurs at about 67C during thermal heating. Due to these features, VO2 is a promising material for optical switching. Incorporation of optically active impurities such as Er3+ into VO2 is of interest for possible integration of optical switching and amplification at telecommunication wavelengths in a single device. We have studied incorporation of Er into VO2 films. Films were formed by pulsed laser deposition. Er incorporation was achieved by ion implantation and thermal annealing. Er photoluminescence (PL) was measured for various Er fluences and annealing treatments. The effects of implantation on the IMT and VO2 structural properties were characterised by Raman spectroscopy and infrared reflectometry. We have found that Er can be incorporated in its optically active state in VO2 for anneals above 800C. The IMT in the Er-doped films occurs at slightly increased critical temperature and the width of the transition is somewhat broadened. We present results of our studies and discuss the implications for incorporation of optically active Er into VO2.

I.P3.24

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18:00 **Studies on structural and optical properties of Ga-doped ZnO thin films deposited by spin coating technique**

Authors : Sharul Ashikin Kamaruddin1, Mohd Zainizan Sahdan1, Kah-Yoong Chan2, Nafarizal Nayan1, Hashim Saim1
Affiliations : 1 Microelectronic and Nanotechnology-Shamsuddin Research Centre, UniversitiTun Hussein Onn Malaysia, 86400 BatuPahat, Johor, Malaysia. 2 Faculty of Engineering, Multimedia University, 63100 Cyberjaya, Selangor, Malaysia.

Resume : In this investigation, zinc oxide (ZnO) and gallium-doped zinc oxide (Ga:ZnO) thin films were synthesized by sol-gel spin coating technique and the dependence of structural as well as optical properties on the gallium (Ga) concentrations was deeply studied. The investigation of these films properties were examined by a series characterization technique including X-ray diffraction (XRD) and ultraviolet-visible (UV-Vis) spectroscopy. The structural analysis revealed that, all films are polycrystalline ZnO having hexagonal wurzite

I.P3.25

structure which dominated by (002) peak. In addition, upon Ga was employed, the films demonstrate degradation of crystallinity as compared with the un-doped ZnO films. The optical results show highly transmittance at visible region around 96 % and the UV absorption edge is slightly shifted to the lower wavelength. Meanwhile, the optical band gap were turn out between 3.30 eV to 3.32 eV and it is proportional to the Ga content. Overall, we realized that, both properties of Ga:ZnO films are strongly dependent on the Ga concentration.

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18:00 **Zinc oxide electrodeposition using metallic/polymer nanofiber webs as electrodes** I.P3. 26

Authors : Alexandru Evanghelidis, Cristina Busuioc, Elena Matei, Ionut Enculescu
Affiliations : National Institute of Materials Physics, Magurele, Romania

Resume : Large-area webs of conductive metallic/polymer fibers can be easily obtained by electrospinning and subsequent metal deposition. Thus, layers of polymer (e.g. PMMA or nylon) nano and microfibers were electrospun and subsequently coated with a 200 nm thick Au layer by DC magnetron sputtering. The resulting composite mesh, flexible and with good optical transmittance, was straightforward transferred and thermally attached onto different substrates including glass and transparent polymer foils. Further, the conductive webs covered substrates were employed as working electrodes for electrochemical deposition of ZnO. By adjusting the deposition conditions such as deposition potential and bath composition one can easily control the morphological, structural and optical properties of the resulting material. Such complex nanostructured materials can be successfully employed in applications in fields such as solar energy conversion or catalysis.

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18:00 **Printable InTiO films for printable optoelectronic devices** I.P3. 27

Authors : Jin-A Jeong and Han-Ki Kim
Affiliations : Kyung Hee University; Kyung Hee University

Resume : We have demonstrated that simple brush-painted Ti-doped In2O3 (TIO) films can be used as a cost effective transparent anodes for organic solar cells (OSCs). We examined the RTA effects on the electrical, optical, and structural properties of the brush painted TIO electrodes. By the direct brushing of TIO nanoparticle ink and rapid thermal annealing (RTA), we can simply obtain TIO electrodes with a low sheet resistance of 28.25 Ohm/square and a high optical transmittance of 85.48 % under atmospheric ambient conditions. Furthermore, improvements in the connectivity of the TIO nanoparticles in the top region during the RTA process play an important role in reducing the resistivity of the brush-painted TIO anode. In particular, the brush painted TIO films showed a much higher mobility (33.4 cm2/V-s) than that of previously reported solution-process transparent oxide films (1-5 cm2/V-s) due to the effects of the Ti dopant with higher Lewis acid strength (3.06) and the reduced contact resistance of TIO nanoparticles. The OSCs fabricated on the brush-painted TIO films exhibited cell-performance with an open circuit voltage (Voc) of 0.61 V, shot circuit current (Jsc) of 7.90 mA/cm2, fill factor (FF) of 61 %, and power conversion efficiency (PCE) of 2.94 %. This indicates that brush-painted TIO film is a promising cost-effective transparent electrode for printing-based OSCs with its simple process and high performance.

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18:00 **Incorporation of gold nanoparticles in a TiO2 matrix for surface plasmonic properties** I.P3. 28

Authors : L. Avril, J. Boudon, P. Simon, L. Imhoff
Affiliations : Laboratoire Interdisciplinaire Carnot de Bourgogne (ICB), UMR 6303 CNRS-Université de Bourgogne, 9 Av. A. Savary, BP 47 870, F-21078 Dijon Cedex, France

Resume : A special interest in the nanoparticles embedded in a matrix was investigated to form nanocomposite films in recent years. Noble metal nanoparticles often exhibit novel properties which are different from the bulk materials properties. Many of these properties show strong dependence on size, shape and surface. Research in this area is motivated by the possibility of designing nanostructured materials that possess novel electronic, optical, photochemical and catalytic properties [1-2]. In this work, we reported on the preparation and characterization of gold nanoparticles formed in a TiO2 matrix. Nanometer sized gold particles embedded in TiO2 film were prepared on silicon and quartz glass substrates by direct liquid injection chemical vapour deposition from preformed gold nanoparticle suspension and titanium precursor. The nanostructured films have been studied by SEM, TEM, XRD and optical absorption techniques for morphology, crystallographic and plasmonic characterizations. [1] K.M. Mayer, J.H. Hafner, Localized surface plasmon

resonance sensors, Chem. Rev., Vol. 111 (2011), p. 3828-3857. [2] J. Mungkalasiri, L. Bedel, F. Emieux, J. Dore, F.N.R. Renaud, C. Sarantopoulos, F. Maury, CVD elaboration of nanostructured TiO2-Ag thin films with efficient anti-bacterial properties, Chem. Vap. Deposition, Vol. 16 (2010), p. 35-41.

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18:00 **Synthesis of ZnO Nanorods and Nanotubes with Hydrothermal Process For Improving Surface to Volume Ratio** I.P3. 29

Authors : S. OZTURK1*, A. KOSEMEN1,2, N. KILINC1, Z. Z. OZTURK1,3
Affiliations : 1Gebze Institute of Technology, Faculty of Science, Department of Physics, 41400 Gebze-Kocaeli, Turkey 2 Mus Alparslan University, Department of Physics, 49100 Mus, Turkey 3 TUBITAK Marmara Research Center, Materials Institute, P.O. Box 21, 41470 Gebze Kocaeli, Turkey

Resume : Due to the direct wide band gap (3.37eV) and large exciton binding energy zinc oxide (ZnO) is an oxide semiconductor and it is very suitable candidate for using as a photodetectors or light emtting devices, thin film transistors and gas sensors. with a large exciton binding energy of 60 meV. On the other hand, nanostructured ZnO with high aspect ratio have been investigated for increasing device performance. To fabricate ZnO nanorods two main process called hydrothermal process and electrochemical deposition technique were used. We focused on improving surface facilities of ZnO nanostructures by chemical and electrochemical etching process for converting ZnO nanorods to nanotubes. On the other hand in electrochemical process was performed by ZnCl2 and KCL aqueous solution. Fabricated samples were etched by two ways; first, samples were placed in KOH aqueous solution at 80C for different aging times, secondly called electrochemical etching, constant anodic potential were applied and effect of applied potential were investigated. In all etching process, for converting nanorods to nanotubes we observed a key parameter is the diameters of nanorods must be bigger than 150nm. Moreover Etching time must be 3h or longer and for electrochemical etching, anodic potential must be 1V and etching time must be smaller than 2000s.
Acknowledgement:This study was supported by Scientific and Technological Research Council of Turkey (TUBİTAK) with Project Number: 111M261.

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18:00 **ZnO nanostructures by chemical spray as building blocks for next generation solar cells** I.P3. 30

Authors : M. Krunks1, T. Dedova1, I. Oja Acik1, V. Mikli2, E. Kärber1, A. Katerski1, A. Mere1
Affiliations : 1 Tallinn University of Technology, Department of Materials Science, Laboratory of Thin Film Chemical Technologies, 19086 Tallinn, Estonia 2 Tallinn University of Technology, Department of Materials Science, Chair of Semiconductor Materials Technology, 19086 Tallinn, Estonia

Resume : The preparation and properties of novel ZnO nanostructures - nanorods, nanoneedles, hierarchical nanorods and scrolled nanobelts made by simple, robust and low cost chemical spray pyrolysis method will be introduced. ZnO nanostructures are grown on glass and/or polymeric substrates using aqueous or alcohol based solutions of zinc salts. Solution is pulverised in form of fine droplets onto a preheated substrate. The morphology of ZnO nanorod layers, dimensions and orientation of ZnO crystals are controlled by the growth temperature, precursor concentration and additives in the spray solution which could retard the crystal lateral growth. The density of nanorods is controlled by the substrate type and number of the nucleation centers. The growth and nucleation mechanisms of ZnO nanorods and scrolled nanobelts, and formation of hierarchical nanostructures will be discussed. Examples on growth of metal oxide or sulfide shells by solution methods on ZnO nanorod core will be presented. ZnO nanorod based structures with different morphology are proposed as efficient building blocks for dye, organic and inorganic absorber sensitized solar cells.

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18:00 **CdSe/ZnS-doped silicate and silicophosphate films prepared by sol-gel method** I.P3. 31

Authors : M. Elisa1, I. C. Vasiliu1, I. Feraru1, R. Iordanescu1, R. D. Trusca2, E. Vasile3
Affiliations : 1Optospintronics Department, National Institute of R & D for Optoelectronics INOE 2000, 409 Atomistilor Str., Magurele 077125, Romania 2METAV-CD, 31 C.A. Rossetti, Bucharest, Romania 3University Politehnica of Bucharest, 313 Spl. Independentei, Bucharest, Romania

Resume : Silicate and silicophosphate films doped with CdSe/ZnS quantum dots (QDs) have been deposited by sol-gel method, spin coating technique. A precursor solution (PS) composed of tetraethoxysilane (TEOS) and ethanol (EtOH) has been prepared in the case of silicate films (T) and in the case of

silico-phosphate films (TPT), the same precursors and triethilphosphate (TEP) were used. In each precursor solution, dimethylformamide (DMF) and CdSe/ZnS (QD) were added. The following compositions have been prepared: (i) TCdSe3, TEOS/EtOH = 0.04 molar ratio; (ii) TPTCdSe3-10, molar ratios: TEOS/EtOH=0.02, TEOS/TEP=1.92 and TEP/EtOH=0.01; (iii) TPTCdSe3-20 – the same molar ratios as TPTCdSe3-10. The films have been deposited on silicon substrates as follows: 10 coatings for silicate film and 10 and 20 coatings for silicophosphate films, 2000 rpm substrate rotation rate, 20 s deposition duration, each layer was heat treated at 200oC, for 2 min. Raman spectra were recorded by 785 nm excitation, putting in evidence specific bands to the inorganic matrix. Fourier Transform Infrared (FTIR) absorption spectra recorded in the range 500-1300 cm-1 revealed specific bands to silicophosphate matrix. The fluorescence spectra of CdSe/ZnS doped films found an emission band at about 535 nm, provided by 350 nm excitation. The morphology of the films was investigated by Transmission Electron Microscopy (TEM) revealing semiconductor dopant dots with dimensions 2-9 nm.

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18:00 **Formation of Si1-xGex nanocrystals and the composition shifting of the direct and indirect bandgaps** I.P3.32

Authors : N. N. Ha1, 3*, N. T. Giang1, N. T. Thuy1, N. N. Trung2, S. Saeed3, and T. Gregorkiewicz
Affiliations : 1 International Training Insitute for Materials Science, Hanoi University of Science and Technology, No.1 Dai Co Viet, Hanoi, Vietnam; 2 Institute of Engineering Physics, Hanoi University of Science and Technology, No.1 Dai Co Viet, Hanoi, Vietnam; 3 Van der Waals-Zeeman Institute, University of Amsterdam, Science Park 904, 1098XH Amsterdam, The Netherlands;

Resume : We report results of a study on SixGe1-x (x = 0, 0.2, 0.4, 0.6, 0.8, 1) nanocrystals prepared by co-sputtering method. By observing the vibrational modes in the alloys via Raman spectroscopy, we track the formation of the nanocrystals upon annealing at different temperatures. We demonstrate formation of core-shell nanocrystals out of the Si1-xGex alloys. Average sizes of the Ge cores are calculated from x-ray diffractometer (XRD) patterns using Debye-Scherer equation. We estimate the average sizes of 0, 2.6, 3.7, 4.5, 5.2, and 5.8 nm corresponding to the samples with x = 1, 0.8, 0.6, 0.4, 0.2, 0, respectively, upon annealing at 1000oC for 30 minutes in continuous-flow N2 gas. We present also absorption spectra (in the energy range below 3.5 eV) and discuss shifting of the indirect and direct bandgaps in the SixGe1-x nanocrystals of different composition as induced by quantum confinement and the core-shell configuration.

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18:00 **GAS SENSING APPLICATION OF ZNO-BASED MATERIALS PREPARED BY SOL-GEL** I.P3.33

Authors : M. Hjiri1*, R. Dhahri1, L. El Mir1,2, S. G. Leonardi3, N. Donato3, G. Neri3
Affiliations : 1 Laboratory of Physics of Materials and Nanomaterials Applied at Environment, Faculty of Sciences of Gabes, 6072 Gabes, Tunisia;2 Al Imam Mohammad Ibn Saud Islamic University (IMSIU), College of Sciences, Department of Physics, Riyadh 11623, Saudi Arabia;3 Department of Electronic Engineering, Chemistry and Materials Engineering, University of Messina, Messina 98166, Italy.

Resume : Sol-gel technique is a wet method suitable for preparing large-scale metal oxide materials with functional properties for a wide range of advanced applications. Electrical properties of ZnO prepared by sol-gel were largely exploited for gas sensing. Here, we provided helpful information about doping of ZnO with different dopant (Ca, V, Al, In, etc.) in order to optimize the properties of ZnO-based samples for sensing applications. ZnO-based nanopowders were prepared by the sol-gel method and characterized by means of different techniques such as X-ray diffraction, transmission and scanning electron microscopy, X-ray photoemission and Raman spectroscopy, providing complementary information about the composition, morphology and microstructure of the samples. The characterization results have shown that the wurtzite structure of ZnO is maintained after doping, however, the electrical and sensing properties of the doped sensors were in some cases deeply changed, indicating a marked electronic interaction among the Zn and dopant atoms in the structure. Then, the possibility of a fine-tuning of the sensing characteristics by simply controlling the doping process, will be demonstrated and discussed.

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18:00 **STRUCTURAL AND OPTICAL PROPERTIES OF ZnO/PS NANOCOMPOSITES** I.P3.34

Authors : M.-B Bouzourâa(1), A. Moadhen(1), A. Chaillou(3), M.-A Zaïbi(1&2), M. Guendouz(3), M.-L. Haji(3), M. Oueslati(1)
Affiliations : (1) Université de Tunis El Manar, Faculté des Sciences de Tunis, Unité de

nanomatériaux et photonique, 2092 El Manar - Tunis – Tunisie. (2) Ecole Nationale Supérieure d'Ingénieurs de Tunis, Université de Tunis, 5 Avenue Taha Hussein, 1008 Tunis - Tunisia. (3) Université Européenne de Bretagne, CNRS FOTON-UMR 6082, 6 rue de Kérampont, BP 80518, 22305 Lannion, Cedex, France.
Resume : Abstract. The porous silicon (PS) is a good substrate for ZnO deposition. Indeed, PS material has a wide specific surface which minimizes the stress and the defect of ZnO incorporated into the pores thanks to the phenomenon of quantum effect [1]. The PS was formed by electrochemical anodization and the ZnO was elaborated by sol-gel process, which is a low cost and well-controlled method. The ZnO layers were embedded in the pores of PS substrate using spin coating in order to enlarge the absorption range of PS. We confirmed by XRD, SEM and EDX analysis, that ZnO crystallizes in the hexagonal structure into the pores of PS, with the (002) preferred orientation along the pores axis. We note that ZnO oriented along the c-axis is desirable for application in the optoelectronic devices [2-3]. The effect of pores size in the ZnO amount into the PS due to capillarity effects has been identified with EDX analysis [4]. Moreover, the ZnO layers deposited on PS have been characterized by microscopy of photoluminescence (PL). We founded a blue-shift and increasing intensity in PL of nanostructures ZnO/PS as compared with luminescence of PS [5]. References. [1] C. Hong, S. Honglie, Y. Yugang, L. Linfeng, S. Jiancang, T. Zhengxia, Journal of physics and Chemistry of solids 70 (2009) 967. [2] L. Znaidi, Journal of Materials Science and Engineering B 174 (2010) 18. [3] K. A. Salman, K. Omar, Z. Hassan, Journal of Solar Energy 86 (2012) 541. [4] Q.L. Ma, R. Xiong, Y. Ming Huang, Journal of

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18:00 **Nano and macro porous membranes ? la carte**

Authors : Petra Goering, Monika Lelonek
Affiliations : SmartMembranes GmbH
Resume : Nano porous anodic alumina is a widely studied material that is used for corrosion protection of aluminum surfaces or as dielectric material in microelectronics applications. For more than 40 years porous alumina has been the subject of investigations. It exhibits a homogeneous morphology of parallel pores which grow perpendicular to the surface with a narrow distribution of diameters and interpore spacings, the size of which can easily be controlled between 20 and 400 nm. Monodomain porous alumina templates with very high aspect ratios can also be synthesized by using lithographic preparation. The combination of self-assembly and lithography allows the preparation of porous alumina templates with various configurations of pore arrangement that are not accessible by other state-of-the-art methods. Macro porous silicon, prepared by an electrochemical process, has also gained interest in research for many applications which have a demand for mechanical and chemical stability as well as a high order of the pores. The pore diameters can differ from 700 nm up to 10 ?m using lithographic pre-structuring. The standard deviation of pore diameter and interpore distance is lower than 5 %. Be-cause of the lithographic pre-structuring technique macro porous silicon with its high ordered struc-ture represents an ideal 2-D photonic crystal (PC) exhibiting novel properties for the propagation of infrared light within the pores. Because of the above mentioned unique properties, nano porous alumina and macro porous silicon can be used in a wide range of applications, such as filters, as platforms for muliti-functional sensors, for fuels cells, and especially as templates for the fabrication of nanometer-scale composites, such as nanotubes or nanowires by electrochemical deposition or by using polymer melts.

I.P3.35

add to my program (close full abstract)

18:00 **Flower-like TiO2 / Nanorod RuO2 Hierarchical Structure and Its Application in Photoelectrochemical Water Splitting**

Authors : Wei-Hsiang Lina,b, Po-Chin Chena, Jen Chun Choua, Jon-Yiew Gana, Hsin-Tien Chiub, Chi-Young Leea
Affiliations : aDepartment of Materials Science and Engineering, National Tsing Hua University, Hsinchu 30013, Taiwan;bDepartment of Applied Chemistry, National Chiao Tung University, Hsinchu 30010, Taiwan
Resume : Hierarchical flower-like TiO2 / RuO2 nanorod heterostructure was synthesized. Amorphous TiO2 layer was firstly spin-coated onto RuO2 nanorods on Si wafer prepared by RF sputtering. The amorphous layer was transformed to flower-like titanate under acetic acid solvothermal reaction. After heating at 700 oC for 1 h, the titanate further transfer to anatase without morphology change. Furthermore, the TiO2 flower / RuO2 nanorods heterostructure was used as working electrode for photoelectrochemical water splitting in 1 M KOH aqueous solution. It showed enhanced photocurrent (3.63 mA/cm2 at 1.23 V vs RHE)

I.P3.36

compared with that of TiO2 nanoparticles / RuO2 nanorods (0.91 mA/cm2 at 1.23 V vs RHE) under the irradiation of a Xe lamp. The enhanced performance can be ascribed to the large surface area of flower-like TiO2, and the good conductivity of RuO2 nanorod. Furthermore, the TiO2 / RuO2 heterostructure can reduce the recombination of excited electrons and holes significantly. These suggest the hierarchical heterostructure that TiO2 flower / RuO2 nanorods can be employed as a potential electrode material for photoelectrochemical water splitting.

add to my program (close full abstract)

18:00 **Surface structure of ZnO(0001) nanoplates grown by a microwave assisted aqueous solution method: An AFM and STM study**

Authors : L K E Ericsson, K O Magnusson, H M Zhang
Affiliations : Department of Engineering and Physics, Karlstad University, S-651 88 Karlstad, Sweden

Resume : Hexagonal ZnO plates dominated by their highly chemically active polar surfaces were grown in a rapid process in a domestic microwave oven. The aspect ratio of the grown crystals was controlled by adding different concentrations of KCl to an aqueous solution of Zn(NO3)2 and HMTA. A uniform growth product consisting of only ZnO platelets was achieved by tuning the growth solution composition. The chemical composition and the crystal structure of the grown ZnO platelets were characterized using Auger electron spectroscopy and HR-TEM respectively. The surface morphology and electronic structure were studied using AFM and STM. It was found that the nanoplates are terminated by their polar (0001) surfaces. The AFM investigation was performed in ambient conditions with the nanoplates "as grown". The AFM images of the top surfaces revealed an interesting triangular reconstruction, which was earlier observed only after cycles of sputtering and annealing of the ZnO(0001) surface in Ultra High Vacuum (UHV) systems. The surface atomic and electronic structures of these nanoplates were further studied using STM and Scanning Tunneling Spectroscopy (STS) in UHV. The STM images, captured after a few sputtering and annealing cycles, also showed a triangular structure with single atomic steps and, in addition, a 2x2 surface reconstruction. This reconstruction agrees well with a recently proposed model that involves the removal of 1/4 of the topmost Zn atoms from the ZnO(0001) surface.

I.P3. 37

add to my program (close full abstract)

18:00 **Functional Nanocomposite materials prepared by alkali solution treatment as environmentally friendly and efficient phototocatalysts**

Authors : Binas V.1,3, Zachopoulos A.,1 and G.Kiriakidis1,2
Affiliations : 1Institute of Electronic Structure and Laser (IESL), FORTH, P.O. Box 1527, Vasilika Vouton, 711 10 Heraklion, Crete, Greece 2University of Crete, Physics Department 710 03 Heraklion, Crete, Greece 3 Quantum Complexity & Nanotechnology Center (QCN), Department of Physics, University of Crete, GR – 71003, Heraklion, Greece

Resume : Titanium dioxide (TiO2) is the most extensively studied transition metal oxide and the most widely used photocatalyst, as an environmental friendly, safe and chemical stable material along with its high photocatalytic activity. As a photocatalyst, it induces the generation of very reactive molecules (i.e. OH free radicals) under exposure to an appropriate energy of light in the presence of water and oxygen-rich air, subsequently breaking down harmful pollutants such as formaldehyde into usually harmless products such as CO2 and H2O. However, for effective photocatalytic applications, it is crucial to maximize its specific surface area to achieve the highest possible efficiency. Therefore, nanosized geometries, and in particular nanocomposites, are expected to allow for much higher control of the photochemical behavior. The present work focuses on the synthesis and characterization of functional nanocomposites based on titania, following alkali solution treatment. The crystal structureand particle size were examined by XRD. Surface morphology and elemental analysis of the samples were carried out using scanning electron microscopy (SEM) with an energy dispersive spectrometer (EDS). Nanocomposites were observed by TEM. The photocatalytic activity of the synthesized functionalized nanocomposites was tested by the degradation of Methylene Blue and has shown 100% decolonization in 10min.

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add to my program (close full abstract)

18:00 **Soft chemical route to band gap control of layered perovskite via electron beam irradiation**

Authors : Won-Jae Lee, Seung-Min Paek
Affiliations : Department of Chemistry, Kyungpook National University, Taegu 702-701, Korea.

I.P3. 39

Resume : Transition metal oxides with perovskite structures have attracted intense research interests owing to their promising application in photocatalysis. Especially, layered derivatives such as Dion-Jacobson phases also have a wide range of versatile applications including photocatalytic degradation of organic pollutants. In this study, we demonstrate the intercalation of organic molecules into the interlayer spaces of layered perovskite oxides. According to X-ray diffraction patterns and transmission electron microscopic studies, the basal spacing of layered perovskites was remarkably increased upon the intercalation reaction. Subsequent electron beam irradiation resulted in the control of electronic structures such as band gap of perovskites, which led to the enhanced photocatalytic activities in the degradation reaction of various organic pollutants. It is expected that this synthetic methodology could be extended to the fabrication of new photocatalysts with enhanced activities.

add to my program (close full abstract)

18:00 **Large-area ZnO nanogenerator fabricated by Sol-gel method**

Authors : Gao Zhi Qiang, Wang Rui , Li Taoa, Qin Wei Wei, Hu Xue Feng, Xu Meigui, Huang Shengming, Liang Qi, and Wei Zhang,*
Affiliations : a State Key Laboratory of Material-oriented Chemical Engineering and School of Chemical Engineering, Nanjing Tech University, Nanjing, Jiangsu 210009, PR China b School of Physical Science, Hefei University of Technology, Hefei, Anhui 230009, PR China

Resume : ZnO nanogenarator, to utilize the environmental mechanical energy, which is available from irregular vibrations and human activity with a wide spectrum of frequencies and time-dependent amplitudes, have demonstrated to produce micro-watt power output and to drive micro-sensor. .However so far the power output from NW nanogenarator based on chemical synthesis ZnO nanowire is still far away from a milli-power output source , which requested by most applications of individual sensor. Physical vapor deposition of ZnO can largely improve the crystal graphical property of the grown ZnO but limit with small growth area. To achieve good ZnO piezoelectric property and grow large area with high power output is desirable. In this paper, Sol-gel technology was used to prepare ZnO thin film on Si substrate, the characteristic of the samples was measured by XRD, AFM, and SEM. The XRD patterns showed that ZnO thin film had a high (002) orientation with compact hexagonal wurtzite structure. The AFM and SEM microphotograph showed ZnO thin film had a smooth and dense surface, the thickness of the sample was approximately 80 nm. The grain size gradually increased with annealing temperature. Sol-gel grown ZnO film are then patterned into a micro power source. The power output from ZnO micro-power sourse can reach upto 3mW. *Corresponding author, zhangw@njut.edu.cn

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add to my program (close full abstract)

18:00 **Solution Approach in Textured Oxide Films Manufacturing for 2G HTSC Tapes**

Authors : Kharchenko A., Kuimov A., Grigoriev A.
Affiliations : Lomonosov Moscow State University

Resume : High temperature superconductivity was discovered in the end of the 1980's. Today, this phenomenon has found practical implementation in Second Generation High Temperature Superconducting tapes. The work includes following textured oxides CeO2, La2Zr2O7, La2Hf2O7, which serve as buffer layers in 2G HTSC and YBa2Cu3O7-x as superconductor. Buffer layers are necessary part of tapes. First, they must prevent chemical interaction at high temperature between the metal substrate and the superconductor layer. Therefore, they must be a diffusion barrier (especially relative to nickel). Secondly, in case of epitaxial growth, crystallographic parameters of buffer layers are very important for texture transmitting. Third, the thermal expansion coefficients of substrate, buffer layer and superconductor layer should not differ greatly. A thin film of high-temperature superconductor is the working element of all complex system by which electric current is transferred. Therefore, the quality of YBa2Cu3O7-x is a quality of 2G HTSC tape. All previous components and the superconductor deposition process have an effect on it. Chemical solution deposition method was selected for preparation of different oxide layers. IR, NMR spectroscopy, thermogravimetry, X-ray diffraction, SEM and TEM microscopy were chosen for their characterization.

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add to my program (close full abstract)

18:00 **Growth of ZnO Films by Atmospheric Spray Pyrolysis**

Authors : Kenji Yoshino1, *, Akiko Ide1, Akiko Mochihara1, Yujin Takemoto2, Minoru Oshima2, Kouji Toyota2, Koichiro Inaba2, Ken-ichi Haga2 , Toshio Naka2
Affiliations : 1Department of Electrical and Electric Engineering, University of Miyazaki,

I.P3. 42

Miyazakii 889-2192, Japan 2Reserach and Development Division, Tosoh Finechem Corporation, Shunan, Yamaguchi 746-0006, Japan

Resume : ZnO exhibits a wurtzite hexagonal structure and a direct optical bandgap and has been studied for use in many attractive applications such as gas sensors, transport electrodes, piezoelectric devices, varistors and surface acoustic wave devices. Its direct optical bandgap of 3.4 eV at RT is wide enough to transmit most of the useful solar radiation in ZnO/CuInSe2 based solar cells. Furthermore, doped ZnO such as AZO (Al-doped ZnO) is a good candidate to substitute for ITO (Sn-doped In2O3) and FTO (F-doped SnO2) in transparent conductive electrodes. Low-temperature growth method for ZnO is important for compatibility with photovoltaic device fabrication processes. However, it is known that low-temperature growth is difficult in non-vacuum processes. There are few reports on low-temperature growth, less than 200 °C under non-vacuum condition. Recently, Blumstengel et al. reported that a low-temperature growth of ZnO epitaxil film on ZnMgO/sapphire (11-20) by plasma-assisted MBE at 50 °C [1]. Furthermore, Nishinaka et al reported low temperature growth of ZnO at 180 °C by an ultrasonic-spray assisted mist CVD using zinc acetate dehydrate in a mixture of methanol and water [2]. They indicated that the deposition at low-temperature was attributed to water-activated precursor reactions. In our previous work [3], non-doped ZnO films were successfully grown on a polyethylene terephthalate film by a conventional spray pyrolysis at 150 °C using a diethylzinc (DEZ)-based solution under an air atmosphere. The samples average optical transmittance had more than 80%, flat surfaces and a predominately a-axis orientation determined from optical transmittance, scanning electron microscopy (SEM) and x-ray diffraction (XRD) measurements, respectively. It is well known that the DEZ reacts with water and/or oxygen at low temperature, and ZnO can be generated [4, 5]. However, the DEZ reacts violently with water and easily ignites upon contact with air. Therefore, in its pure state, it should be handled using inert atmosphere techniques. In this work, the DEZ solution was diluted by diisopropyl ether in order to control its reactivity towards an air and water. The diisopropyl ether is a secondary ether that is used as a solvent. The solution is a colorless liquid that is slightly soluble in water, but miscible with most organic solvents. Non-doped ZnO films were grown on a glass substrate by a spray pyrolysis under an air atmosphere. The conventional spray pyrolysis system described in previous work [3] was used. The substrate temperature was between RT and 300 °C and the DEZ, in solution form, was used as the Zn source material. The thickness of the samples was approximately 0.6 □m. The growth rate was approximately 50 nm/min in this study. The samples were examined by XRD and SEM for structural characterization. Optical transmittance was measured at room temperature (RT) for wavelengths between 300 and 2000 nm. Furthermore, Hall measurements were carried out at RT using Van der Pauw method. Indium was used as an ohmic contact. It is clearly observed that peaks of (10-10) at 31.75° which represents a-axis orientation, (0002) at 34.39° which represents c-axis orientation and (10-11) at 36.19° are dominant in the XRD spectrum of the ZnO. Their peak positions correspond to those of the JCPDS ZnO reference. This indicates that the non-doped ZnO film, with a hexagonal wurtzite structure was successfully grown on a glass substrate at low temperature using DEZ-based solution under an air atmosphere. The lattice constants of both a- and c-axes are calculated from the three peaks in the XRD spectrum. It is clear that the lattice constants of both a- and c-axes correspond to those of the JCPDS ZnO reference. The average optical transmittance is clearly above 80% in both samples. The transmittance in the IR region is also above 80%. This indicates poor absorption due to free carriers in the IR region. The carrier concentration of is 2 × 1018 cm-3 obtained by Hall measurement. A fundamental absorption is clearly observed approximately at 350 - 370 nm. This value is similar to that reported Gao et al., indicating that the sample has a high level crystallinity [6]. An interference wave can be observed, which means that the sample grown at 150 °C has a smoother and more homogenous surface. The ZnO films are nearly uniform over the entire substrate surface area. ZnO films have been grown using a non-vacuum process at low temperature. It is known that growth using DEZ solution at low temperature (150 °C) is attributed to atmospheric oxygen and/or steam [4, 5]. In the sample grown at 150 °C, however, it is assumed that atmospheric steam plays dominant role in comparison to the atmospheric oxygen because DEZ reacts violently with water and easily ignites upon contact with air at low temperature [3]. It is well known that ZnO films can be obtained at low temperature by the reaction of water and DEZ: (C2H5)2Zn + 2H2O = Zn(OH) 2 + 2C2H6. Zn(OH) 2 = ZnO + H2O However, from the quantum chemical method as well as from the experiments [7], it is suggested

that ZnO film can be obtained by the reaction of water and DEZ, which, when driven to completion, is given by: (C2H5)2Zn + H2O = (C2H5)Zn(OH) + C2H6 (C2H5)Zn(OH) + H2O = Zn(OH)2 + C2H6 Zn(OH) 2 = ZnO + H2O In this chemical reaction, the DEZ reacts violently and exothermically with water at low temperature. [1] S. Blumstengel, S. Sadofev, H. Kirmse, and F. Henneberger, Appl. Phys. Lett. 98 (2011) 031907. [2] H. Nishinaka, Y. Kamada, N. Kameyama and S. Fujita, Jpn. J. Appl. Phys. 48 (2009) 121103. [3] K. Yoshino, Y. Takemoto, M. Oshima, K. Toyota, K. Inaba, K. Haga, and K. Tokudome, Jpn. J. Appl. Phys. 50 (2011) 040207 [4] C. K. Lau, S. K. Tiku, and K. M. Lakin, J. Electrochem. Soc. 127 (1890) 1843. [5] S. K. Ghandhi, R. J. Field, and J. R. Shealy, Appl. Phys. Lett. 37 (1980) 449. [6] X. D. Gao, X. M. Li, W. D. Yu, L. Lei, J. J. Qiu, and F. Peng, Sol. Energy Sol.cells 91 (2007) 467. [7] K. Maejima, H. Kawabata, and S. Fujita, Jpn. J. Appl. Phys. 46 (2011) 7885.

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18:00 **Cathodoluminescence study of Al-doped ZnO nanofilms at 80 K and RT.**

Authors : A.I. Popov (1,2), V. Savchyn (3) , J. Purans (1), A. Dabrowska(4) , A. Huczko (4), Birendra Pathak (5) and D. P. Subedi (5)
Affiliations : (1) Institute of Solid State Physics, University of Latvia, Kengaraga 8, 1063 Riga, Latvia; (2) Institute Laue-Langevin, F-38042 Grenoble, France; (3) Dept. Electronics, Ivan Franko National University of Lviv, 79017 Lviv, Ukraine; (4) Department of Chemistry, Warsaw University, 1 Pasteur str., 02-093 Warsaw, Poland; (5) Department of Natural Sciences, School of Science, Kathmandu University, Dhulikhel, Nepal

Resume : Nowadays, Al-doped ZnO is one of the most widely used materials for transparent conductive oxide coatings. Here we report on temperature dependent cathodoluminescence characterization of Al-doped (mole concentration of Al within 0-10%) and un-doped ZnO nanofilms on quartz substrate which were obtained by ultrasonic spray pyrolysis. It was demonstrated that the relative intensity of the 10 keV-electron-beam induced luminescence bands at 1.9; 2.3 eV and complex band at 3.3 eV depends on both temperature and Al dopant content. The influence of quartz substrate on cathodoluminescence emission spectra is evaluated. Finally, on the base of ab-initio calculations, the model of the radiative recombination in Al-doped ZnO is proposed.

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18:00 **Structural and optical properties of manganese doped zinc oxide thin films synthesized by sol-gel method**

Authors : A.I. Savchuk, P.M. Tkachuk, G.I. Kleto, I.D. Stolyarchuk, S.A. Savchuk, O.A. Shporta, V.V. Makoviy
Affiliations : Department of Physics of Semiconductors and Nanostructures, Chernivtsi National University, 2 Kotsubynsky Str., 58012 Chernivtsi, Ukraine

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Resume : Sol-gel method is promising technique for fabrication of oxide thin films first of all because of its low cost and the possibility to control chemical composition. In this work, we report on application of sol-gel method for synthesis of Mn-doped ZnO thin films. Zn(1-x)Mn(x)O thin films with Mn content in range of 0

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18:00 **Solution Synthesis of High Density ZnO Hierarchical Nanostructures**

Authors : A.Resmini, I.Tredici, U.Anselmi-Tamburini
Affiliations : Department of Chemistry University of Pavia, Italy

Resume : The synthesis of complex hierarchical nanostructures has been extensively investigated in relation with their possible use in several relevant technological applications. Particularly interesting is their potential in gas sensing, where their high surface area and open structure allow in principle to attain higher sensitivities and lower response times than more traditional nanostructures. Since the sensitivity of gas sensors is proportional to the surface density of sensing material, this application requires the develop of high density hierarchical nanostructures. In this communication we present the synthesis of hierarchical nanostructures based on high-density nanorods of ZnO and obtained by solution chemistry. The primary nanorods have been grown on a seed layer represented by a thin film of nanostructured ZnO obtained by the thermal degradation of metal-loaded hydrogels. These nanorods are 10 and 14 microns in length and 130-150 nm in diameter. A complex secondary nanostructure represented by thin lamellae of an organometallic precursor 2-10 nm thick 150 nm wide has been grown on the surface of these nanorods from a solution of Zinc Nitrate in presence of HMT and Sodium Citrate. Upon thermal annealing this nanostructure evolve towards the formation of ultra thin porous ZnO

I.P3. 45

lamellae or a layer of ZnO nanoparticle 3-5 nm in diameter. The dependence of the final nanostructure from the preparation conditions has been investigated.

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18:00 **Fabrication of Titania Nanofibers by Solution Blow Spinning**

Authors : F.R. de Paula, T. C. Gimenes, E. A. Pereira, M. A. Montanhera1, L. Zadorosny, Edna R. Spada

Affiliations : Universidade Estadual Paulista, Departamento de Física e Química, Ilha Solteira, SP, Brazil; Instituto de Física de São Carlos – Universidade de São Paulo – USP, Brazil

Resume : The developing of one-dimensional (1D) nanostructure metal oxide have been a subject of research because of their potential application in many areas that include electronic, photonics, and sensing devices[1]. A variety of methods have been used for generating nanoscale wires such as, template and electrospinning method[2,3]. Recently, another method of low cost and high efficiency, known as solution blow spinning[4], was developed. Similar to electrospinning, this new method not require high voltages. In this work, we demonstrate that titania nanofibers can be prepared by solution blow spinning method. TiO2 nanocrystalline in the crystallographic forms, anatase and rutile, prepared by chemical method, was directly added to an alcohol solution containing polyvinylidene difluoride (PVDF) to prepare TiO2/PVDF nanofibers. The nanofibers were calcined in air at 500 ºC for 2 h. After such proceeding, titania nanofibers with diameter of about 100 nm were obtained. In summary, we presented a simple and versatile method to obtain titania nanofibers that can be made of other oxides such as, In2O3, ZrO2, and SiO2. References [1] M.H. Huang; S. Mao; H. Feick; H. Yan; Y. Wu; H. Kind; E. Weber; R. Russo; P. Yang. Science 292 (2001) 1897. [2] J. Duan, J. Liu, T.W. Cornelius, et al. Nucl. Instrum. Methods Phys. Res. B 267 (2009) 2567–2570. [3] S. A.Theron, E. Zussman, and A. L. Yarin, "Experimental investigation of the governing parameters in the electrospinning of polymer solutions," Polymer, vol. 45, no. 6, pp. 2017– 2030, 2004. [4] J. E. Oliveira, et al. Hindawi Publishing Corporation Advances in Materials Science and Engineering. Volume 2013, article ID 409572.

I.P3.46

add to my program (close full abstract)

18:00 **Characteristics of ZnO nanorods grown by simple chemical method**

Authors : N. Roy & A. Roy

Affiliations : Department of Physics, NIT Silchar Assam, India

Resume : Hexagonal ZnO nanorods were grown on P-Si (100) substrates by simple chemical method by using precursors as ammonium persulphate (NH4) 2S2O8, sodium hydroxide NaOH and zinc metal powder (Merck chemicals). X-ray diffraction, field emission scanning electron microscope, high resolution transmission electron microscope and photoluminescence have been used to characterize the structural and optical properties of the grown ZnO nanorods. Structural and photoluminescence properties of ZnO nanorods were investigated as a function of growth temperatures. X-ray diffraction patterns of ZnO nanorods reveal the formation of hexagonal wurtzite structures. Room temperature photoluminescence spectrum of ZnO nanorods showed the emission peak at 3.254 eV, originate from the recombination of free excitons. Origin of green emission at 2.470 eV has been explained in light of oxygen vacancy mediated deep donor levels transition to valence band edge. Reference 1. Z. L. Wang, J. Phys. Condens. Matter. 2004,16, 829-858 2. U. Ozgur, Y. I. Alivov, C. L. A. Teke, M. A.Reshchikov, S Dogan, V Arutin, S. J Cho, H. Morkoc, J. Appl. Phys., 2005, 98, 41301 3. H. Yu, E. A. Azhar, T. Belagudu, S Lim, and S. Dey, 2012, 111, 102806 4. R. Viswanatha, H. Amenitsch, and D. D. Sarma, J. Am, Chem. Soc., 2007, 129, 4470-4475

I.P3.47

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18:00 **The influence of Pt/Au nanoparticles' shape on activity of commercial TiO2 photocatalysts**

Authors : Szilvia FODOR & Zsejke Réka TÓTH-1, Zsolt PAP-1,2,3, Lucian BAIA-2,4, Virginia DANCIU-1, Adriana VULPOI-2,4, Klára MAGYARI-2,4, András DOMBI-3, Klára HERNÁDI-3, Gábor KOVÁCS-1,2

Affiliations : 1 Faculty of Chemistry and Chemical Engineering, Babeş-Bolyai University, Arany János 11, RO-400028 Cluj-Napoca, Romania; 2 Faculty of Physics, Babeş-Bolyai University, M. Kogălniceanu 1, RO-400084 Cluj-Napoca, Romania; 3 Research Group of Environmental Chemistry, Institute of Chemistry, University of Szeged, Tisza Lajos krt. 103, HU-6720 Szeged, Hungary; 4 Institute for Interdisciplinary Research on Bio-Nano-Sciences, Treboniu Laurian 42, RO-400271 Cluj-Napoca, Romania

I.P3.48

Resume : Nowadays the elimination of environmental pollution is getting more and more attention, in which the photocatalytic processes are considered as a cost effective and promising solution. In the present work, we studied the

influence the noble metal nanoparticles shape on the commercially available TiO2-based nanoparticles. Consequently, by variation of synthesis parameters (e.g. concentration of precursors/surfactant, temperature, reduction) two type of Pt and three form of Au nanoparticles were synthetized. The NP's were deposited on commercial titanias and their photocatalytic efficiencies was evaluated (pollutant degradation/H2 evolution). These nanomaterials were successfully characterized applying different techniques such as XRD, HRTEM and DRS. Acknowledgements: The following projects are acknowledged: PN-II-ID-PCE-2011-3-0442, financed by Romanian National Authority for Scientific Research, CNCS—UEFISCDI and the Romanian-Hungarian bilateral project nr.661/2013/K-TÉT_12_RO-1-2013-0109966.

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18:00 **Plasma treatment of hydrothermally grown ZnO nanocolumns**

Authors : Neda Neykova* (1) (2),Jakub Holovsky (1), Karel Hruska (1), Zdenek Remes (1), Milan Vanecek (1)
Affiliations : (1) Institute of Physics, Academy of Sciences of the Czech Republic, Cukrovarnicka 10, 16200 Prague 6, Czech Republic;(2) Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering Trojanova 13,120 00 Prague 2, Czech Republic

Resume : Hydrothermal growth offers a possibility to deposit ZnO nanorods, nanocolumns or nanopillars at low temperature at high optical and electronic quality and over large areas that can find their application in 3-dimensional nanostructured solar cells [1, 2]. Due to the small dimensions, their electronic properties are dominated by surface defects. Hydrogen plasma treatment has recently been proven to passivate defects at grain boundaries in polycrystallines ZnO films. In this study, single (or multi)-crystalline ZnO vertically aligned nanocolumn arrays were grown from an aqueous solution of zinc nitrate hexahydrate and hexamethylenetetramine at 90 ?C, at the growth rate 0.5? 1μm/h. Hydrogen and oxygen plasma treatment were applied at different power and pressure regimes. Defect density and free carrier absorption was studied by photothermal deflection spectroscopy and strong effects were observed. Surface chemical termination was monitored by Fourier transform infrared vibrational spectroscopy. Effective carrier lifetime was assessed by photoluminescence intensity. Both surface defect passivation and plasma-induced defects were observed at different regimes. This work was carried out in the framework of the FP7 project Fast Track, funded by the EC under grant agreement no. 283501 and supported by MSMT 7E12029 and LH12186. [1] M. Vanecek, et al., Appl. Phys. Lett. 98, 163503 (2011). [2] N. Neykova, et al. Thin Solid Films 543, 110 (2013).

I.P3. 49

add to my program (close full abstract)

18:00 **TITANIUM DIOXIDE THIN FILMS FOR PHOTOVOLTAIC APPLICATION**

Authors : T. Potlog1, V. Botnariuc1, P. Dumitriu1, L. Dmitroglo1, M. Dobromir2 and D. Luca2
Affiliations : 1Physics Department and Enginerring, Moldova State University, Chisinau, Republic of Moldova, E-mail: tpotlog@gmail.com 2 Faculty of Physics, Al. I. Cuza" University, Iasi, Romania

Resume : Considerable investment has and continues to be made in the development of new transparent and conductive oxides for photovoltaic applications. During last decade, basic and applied research is focused on the preparation and characterization of TiO2 thin films, with large energy band gap, excellent visible and near-IR transmittance, high refractive index (2.75 at 550 nm) and dielectric constant (r~170). For improving the transparent electrode properties of transparent conductive oxides (TCO) in general and of TiO2 especially, it is widely accepted, that the best approach is to increase the carrier mobility. This approach can be solved by doping and applying annealing in different atmospheres on thin films. TiO2 thin films were prepared on glass substrates by magnetron sputtering of Ti target of 99.99% purity. In order to obtain doped TiO2 thin films oxide powder Nb2O5 of 99.999% purity was used. The as-prepared and Nb-doped TiO2 films were vacuum- and in hydrogen atmosphere annealed. All films were characterized by atomic force microscopy (AFM), x-ray diffraction (XRD) and x-ray photoelectron spectroscopy (XPS) to determine the microstructures and chemical compositions, respectively. XRD studies showed that as-deposited TiO2 films are polycrystalline and crystallize in two forms: anatase and rutile. The doping and subsequent annealing of the films conduct to anatase crystalline phase formation, only. Also, in this presentation the properties of the TiO2 films, such as absorption and conductivity will be discussed.

I.P3. 50

add to my program (close full abstract)

18:00 **Shaping of TiO2 and WO3 nanocrystals for achieving high photocatalytic activity**

Authors : Kata Saszet-1 & István Székely-1 & Zsolt Kedves-1, Zsolt Pap-1,2,3, Gábor Kovács-1,2, Klára Magyari-2,4, Teodora Radu-2,4, Adriana Vulpoi-2,4, Virginia Danciu-1, András Dombi-3, Klára Hernádi-3, Lucian Baia-2,4
Affiliations : 1 Faculty of Chemistry and Chemical Engineering, Babes-Bolyai University, Arany János 11, RO-400028 Cluj-Napoca, Romania; 2 Faculty of Physics, Babes-Bolyai University, M. Kogălniceanu 1, RO-400084 Cluj-Napoca, Romania; 3 Research Group of Environmental Chemistry, Institute of Chemistry, University of Szeged, H-6720, Szeged, Tisza Lajos krt. 103, Hungary; 4 Institute for Interdisciplinary Research on Bio-Nano-Sciences, Treboniu Laurian 42, RO-400271 Cluj-Napoca, Romania;

Resume : Photocatalytic materials' latest challenge nowadays is the fine tuning of their activity, selectivity towards a given pollutant. To achieve this scope there are several ways. One of them is the shape tailoring of the semiconductor oxides. In the present work TiO2 and WO3 nanocrystals shape was varied using different hydrothermal synthesis approaches. The obtained differently shaped (nanoeggs, nanostars, nanorods) semiconductor oxides were characterized by XRD, TEM, SEM, XPS and DRS. The obtained nanomaterials photocatalytic activity was evaluated for phenol and oxalic acid removal. Their degradation intermediates profile was registered and structural entities-degradation intermediates relation was successfully explored. This latter process makes possible the safe application of these photocatalytic materials.
Acknowledgements: The following projects are acknowledged: PN-II-ID-PCE-2011-3-0442, financed by Romanian National Authority for Scientific Research, CNCS-UEFISCDI and the Romanian-Hungarian bilateral project nr.661/2013/K-TÉT_12_RO-1-2013-0109966. Also the research grant nr. GTC 34027 is thanked, which was provided by the Babes-Bolyai University for young researchers

I.P3.51

add to my program (close full abstract)

18:00 **Structural and optical properties of TiO2 thin films prepared by spin-coating technique**

Authors : I. Sta*1, M. Jlassi1, M. Hajji1,2, M.F.Boujmil1 , M. Kompitsas3, H. Ezzaouia1
Affiliations : 1 Laboratoire de Photovoltaïque, Centre de Recherche et des Technologies de l'Energie, Technopole de Borj-Cédria, BP 95, 2050 Hammam-Lif, Tunisie. 2 Institut Supérieur d'Electronique et de Communication de Sfax, Université de Sfax, BP 868, 3018 Sfax, Tunisie. 3 National Hellenic Research Foundation, Theoretical and Physical Chemistry Institute, 48, Vasileos, Konstantinou Ave., 11635 Athens, Greece.

Resume : Transparent semiconductor thin films of Titanium oxide (TiO2) were deposited onto glass substrates by the sol–gel method and spin-coating technique. The physical properties of the prepared films were studied as a function of the number of layers. The microstructural and surface morphology of TiO2 films were characterized by x-ray diffraction (XRD) and atomic force microscopy (AFM), as a function of film thickness. The X-ray diffraction analysis revealed that films are polycrystalline with an anatase crystal structure and a preferred grain orientation in the (101) direction. The morphological properties were investigated by atomic force microscopy (AFM) which shows a porous morphology structure for the films. Films are highly transparent in the visible region. The dependence of the both refractive index (n), extinction coefficient (k) and the absorption coefficient on the wavelength, has been reported for the films. A shift in the optical band gap from 3.75 to 3.54 eV has been observed.
Keywords: Titanium oxide, Thin films; Sol-gel method; Structural analysis; Optical properties.

I.P3.52

add to my program (close full abstract)

18:00 **Nano-patterning of index-matched indium tin oxide sol-gel in light-emitting diodes for eliminating total internal reflection**

Authors : Sungjoo Kim and Jong-Lam Lee
Affiliations : POSTECH

Resume : In the field of Group III-nitride light-emitting diodes (LEDs), much room remains for enhancement of light extraction efficiency because most of the generated photons from the active layer remain inside the LEDs because of the total internal reflection (TIR) at the semiconductor-air interface. To circumvent this problem, nano-imprint lithography has been offered for significant improvements of light extraction efficiency of the GaN LED device. However, reported imprinted materials such as SU-8 and PDMS are polymeric which have lower refractive index then that of top transparent electrode, indium-tin-oxide (ITO). Therefore, TIR and Fresnel reflection are occurred at the interface of ITO and soft resin, which limit the overall efficiency of the LEDs. In this respect, we demonstrated the fabrication of novel hexagonal pyramid-shaped nanostructures with nano-imprinted index-matched ITO to eliminate TIR. Based

I.P3.53

on Monte-Carlo 3D ray tracing, we clearly confirm that light output intensity was increased with refractive index matching. Through refractive index matched nano structure, we enhanced the out-coupling efficiency of GaN based light emitting diodes (LEDs) about 12%. The 300C annealed ITO sol-gel has refractive index of 1.95, remaining the transparency (92%) and nano-structure. The nano-structured ITO sol-gel increases the diffused transmittance from 0.76% to 38%, leading to extract the wave-guided light from total internal reflection and fresnel reflection.

add to my program (close full abstract)

18:00 **Polymer-Ceramic Nanocomposites for High Energy Density Applications**

Authors : S. Adireddy, V.S. Puli, B. Riggs, and D.B. Chirsey

Affiliations : S. Adireddy, Tulane University; V.S. Puli Tulane University; B. Riggs Tulane University; and XD.B. Chirsey

Resume : Next-generation capacitive energy storage requires novel materials with engineered architectures to meet the requirements of high performance, range of operation, and low cost. However, while current processing strategies produce capacitors with enhanced dielectric permittivity, their breakdown,strengths are low. This new fabrication route provides flexible, free-standing nanocomposite films with high dielectric permittivity and high breakdown strength. The monodispersed ceramic fillers (BaTiO3, Ba0.7Ca0.3TiO3 and BaZr0.2Ti0.8O3) were initially synthesized via solvothermal method. Surface-exchanged nanoparticles were combined with polyvinylidene fluoride (PVDF) to fabricate stable polymer-ceramic blends. The PVDF/ceramic nanocomposites resulting from this approach have high dielectric permittivity, lower loss tangent, and high electric breakdown strength. The calculated maximum energy densities for BaTiO3, Ba0.7Ca0.3TiO3 and BaZr0.2Ti0.8O3 are 3.24 Jcm-3, 4.72 Jcm-3, and 7.74 Jcm-3 respectively, as a result of the interplay of the dependencies of permittivity and breakdown strength on volume fraction. It is suggested that the strong interaction between ceramic and polymer components is the main reason for the improved dielectric properties. This approach is quite versatile and should be readily extendable to other combinations of polymer and ceramics so that cooperative properties can be exploited.

I.P3.54

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18:00 **Passivating TiO2 Nanotube Anti-Reflection Layers for silicon solar cells**

Authors : P Prathap1, D Praveen Kumar2, G. Sumana1, M V Shankar2

Affiliations : b CSIR-National Physical Laboratory, Dr. K.S. Krishnan Marg, New Delhi-110012, India a Nanocatalysis Research Lab, Department of Materials Science & Nanotechnology, Yogi Vemana University, Kadapa ? 516 003, India

Resume : For efficient silicon solar cells fabrication, anti-reflective coating facilitates transmission of majority of the light and less scattering. One dimensional Nanostructures and Nanoporous material play vital role to improve anti-reflection properties due to their wave guiding and/or grade refractive index nature. In this connection, TiO2 nanotubes (TiNT) were synthesized by alkaline hydrothermal method at 130□C for 20 h using commercial TiO2 bulk particles as precursor. In the following, TiNT films were deposited on polished as well as textured silicon substrates using electrophoretic deposition. The films showed a minimum reflectance of ~ 6% at the wavelength of 600 nm. Quasi-steady state photoconductivity measurements on the TiNT coated samples showed a considerable improvement of minority carrier lifetime in n-type silicon is considerable after a short annealing in forming gas at 400oC for 30 min. Capacitance ? Voltage measurements suggested that the TiNT layers contain negative fixed charge, which led to passivate n-type silicon. The dual property of TiNT layers such as anti-reflection as well as passivation is promising for the enhancement of the photovoltaic conversion efficiency of silicon solar cells.

I.P3.55

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18:00 **Photoluminescence enhancement in self-assembled CdTe/CdS core/shell quantum dots thin films incorporation with Au nanoparticles**

Authors : Hongyu Wang, Ling Xu□, Jing Chen, Rengqi Zhang, Rui Li, Jun Xu, Yao Yu, Weining Su, Zhongyuan Ma, and Kunji Chen

Affiliations : National Laboratory of Solid State Microstructure and School of Electronic Science and Engineering, Nanjing University, Nanjing 210093, People's Republic of China

Resume : Hybrid structures containing semiconductor quantum dots and metal nanoparticles have attracted great interests and may find potential applications in opto-electronic devices. In this letter, we investigated optical properties of Au nanoparticles /CdTe/CdS core-shell QDs nanocomposite films. These films were fabricated by assembled colloidal QD nanocrystals solids and Au NPs using a layer-by-layer self-assembly. The morphology of the Au NPs/QDs

I.P3.56

nanocomposite films were characterized using a scanning electron microscope (SEM), which revealed CdTe/CdS nanocrystals solids were uniformly distributed on the Au NPs monolayer. PL emission spectra show that the Au NPs incorporation resulted in an increase of PL emission intensity of sixteen-fold comparison with that of the samples without Au NPs. The absorption spectra measurements shows that the Au NPs incorporation increased the absorption of samples. The fluorescence decay curve reveal that the lifetime at the emission peak of CdTe/CdS core-shell QDs is 11.6 ns, while in the presence of Au NPs, the lifetime decreased to 6.8 ns. We thought this was attributed to localized surface plasmonic effects of the Au NPs. The results of our experiments of Au NPs/QDs nanocomposite films suggest that these films are promising candidates for LED and laser devices applications.

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PROGRAM VIEW : 2014 Spring
MY PROGRAM : 2014 Spring

Symposium : I

Solution processing and properties of functional oxide thin films and nanostructures

26 May 2014 | 27 May 2014 | 28 May 2014 | 29 May 2014 | **30 May 2014**

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start at	Subject	Num.
	Processing and scale-up : An Hardy	
08:30	**Nanostructured sol-gel films, from amorphous silica to low quartz** **Authors :** David Grosso **Affiliations :** Laboratoire Chimie de la Matière Condensée de Paris, Group SIMPLE, UMR UPMC-CNRS 7574, Université Pierre et Marie Curie (Paris 6), Collège de France, 11, place Marcelin Berthelot, 75231 Paris. **Resume :** Complex hierarchical nano structures can be achieved when combining chemical advanced bottom-up strategies, such as self-assembly and sol-gel chemistry, together with liquid solution processing, such as dip-coating. It will be demonstrated that dip-coating is an extremely versatile tool to prepare thin nanostructured and mesoporous metal oxide films from liquid solutions and that it has been used for many decades without taking advantage of its whole potentiality. Many types of oxide can be prepared and will thus be mentioned, but the present communication will focus mainly on SiO2 (from amorphous to epitaxial alpha-quartz) and on photoactive TiO2. Their interests in optics, in microelectronic, in photovoltaic, in photocatalysis, in nano fluidics, or in nano construction will also be discussed. The usefulness of the ellipsometry analytical techniques in determining thin films optical properties, porosity characteristics, mechanical properties, photocatalytic activity, or thermal and chemical stabilities will also be presented all along the presentation. Finally, we will show that the described "bottom-up" approaches can be combined with conventional "top-down" technologies, such as reactive ions etching or optical and nano imprint lithography, to construct even more complex morphologies with multi scales features and motifs. 1) D. Grosso et al. special issue 25th years anniversary of Chem Mater. 2014 2) M. Faustini et al. J. Mater. Chem. (highlight) 2011 3) M. Faustini et al. Acta Materiala (feature) 2013 4) A. Carretero Genèvrier et al. Science 2013 5) M. Faustini et al. Chem. Mater. 2010 6) C. Schulze, et al. Nanotechnology 2010 7) N. L. Rowell et al. J. NanoSc. and Nanotech. 2011 8) M. Faustini, et al. J. Mater. Chem. 2011 9) A. Carretero-Genevrier et al. JACS 2012 10) M. Faustini et al. Nanoscale 2013 11) M. Faustini et. al. Small - submitted	I.16.1
	add to my program (close full abstract)	
09:00	**Stabilization of aqueous nanoalumina suspensions** **Authors :** F. Petrakli (1), D. Sioulas (2), A. Tsetsekou (1) 1. School of Mining and Metallurgical Engineering N.T.U.A, Iroon Polutexneiou 9, 157 80 Athens 2. Department of Materials Science and Engineering, University of Ioannina, 451 10 Ioannina **Affiliations :** F. Petrakli (1)? D. Sioulas (2)? A. Tsetsekou (1) 1. School of Mining and Metallurgical Engineering N.T.U.A, Iroon Polutexneiou 9, 157 80 Athens 2. Department of Materials Science and Engineering, University of Ioannina, 451 10 Ioannina **Resume :** The strong tendency of nanoparticles for agglomeration concerns a major problem limiting their applications. In this respect, the development of stable, well-dispersed aqueous suspensions of nanopowders with high solids content is a difficult task. In this work, stable aqueous suspensions of alumina nanopowder were developed through a hybrid sol-gel method that uses hyperbranched dendritic poly(ethylene)imine (PEI) as template material and complexation agent for aluminium ions. The method involves firstly the complexation reaction between the Al precursor and PEI followed by the hydrolysis and polycondensation reactions. The study was aiming to investigate the effect of solids content and pH during reactions on both the stability of the	I.16.2

final suspension and the morphology of the resulting nanocrystals. For this purpose, the suspensions were evaluated through viscosity measurements, zeta potential analyses and precipitation studies, whereas after the proper centrifugation and drying steps the as received nanocrystals were evaluated using SEM, TEM and XRD studies. The investigation showed that the conditions employed affect greatly both the morphology of nanocrystals as well as the dispersion and the stability of the suspensions.

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09:15 **Electrospinning of Ceramics: a Facile Route to Produce Advanced Ceramic Nanofibers**

Authors : G. Cadafalch Gazquez, B. A. Boukamp, L. Moroni, J. E. ten Elshof
Affiliations : Inorganic Material Science Group, MESA + Institute for Nanotechnology, University of Twente, Enschede, The Netherlands; Inorganic Material Science Group, MESA + Institute for Nanotechnology, University of Twente, Enschede, The Netherlands; Tissue Regeneration, MIRA Institute for Biomedical Technology and Technical Medicine, University of Twente, Enschede, The Netherlands; Inorganic Material Science Group, MESA + Institute for Nanotechnology, University of Twente, Enschede, The Netherlands

Resume : Nanostructured materials such as nanofibers have recently gained a lot of interest for their enhanced properties and applicability. However, current expensive and complicated techniques used for fabrication of nanomaterials may lead to hindering the commercialization of final products. Therefore, there is a need for cheap alternatives to fabricate nanomaterials. Electrospinning is a deposition technique that produces fibers in nano and micro scales by applying a high voltage between a needle, which releases a solution, and a collector plate. Electrospun ceramic nanofibers can be also formed when a precursor-containing solution is used. The present work studies the fabrication of ceramic nanofibers and nanotubes using electrospinning and the tuning of fiber diameter, morphology and arrangement. Fabrication of several sol-gel-derived materials namely yttrium stabilized zirconia, lead zirconia titanate and zinc oxide was successfully done using electrospinning. We observed that the surface morphology of the fibers could be tuned by applying different annealing treatments. We also adjusted the fiber diameter by changing the formulation of the starting solution. Calcium phosphate fibers were also fabricated by eletrospinning stabilized solutions of solvated ionic species. Moreover, aligned fibers and nanotubes were produced with simple setup modifications. In summary, electrospinning is a facile and versatile alternative to produce nanofibers with highly controlled microstructure.

I.16.3

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09:30 **Large volume continuous synthesis of IZO nanoparticles and processing into semiconducting thin films**

Authors : Susanne Oertel *, Michael P. M. Jank *, Sean Butterworth **, Callum Crawshaw **, Peter N. Gooden **
Affiliations : * Fraunhofer Institute for Integrated Systems and Device Technology IISB, Schottkystr. 10, 91058 Erlangen, Germany; ** Promethean Particles Ltd, 6 Faraday Building, Nottingham Science Park, University Boulevard, Nottingham, NG7 2QP, UK

Resume : In contrast to lab-scale approaches, industrial manufacturing requires large-volume, inexpensive, and well-controllable processes. Mixed metal nanoparticle based thin films offer a wide range of functionalities and electrical properties tunable by composition. An ink for the solution processing technique semiconducting thin films is developed based on a continuous solvothermal synthesis. IZO nanoparticles with a medium size of 50 nm show intrinsic stabilization in a mixed polyol/alcohol solvent. The ink is further modified for spin and ink-jet processing. Bottom-gate thin-film transistors (TFTs) were fabricated by spin coating and ink-jet printing of IZO films on p+- Si/SiO2 stacks and successive contacting by electron beam evaporated aluminum S/D electrodes for completion of devices. Annealing the semiconducting layer at 350°C for 30 minutes in ambient air yields TFT devices with an ON/OFF ratio between 1e5 and 1e6 and a saturation mobility of 0.6 cm2V-1s-1. Due to the unpatterned semiconductor layer, the observed gate leakage is only two orders of magnitude below the ON current (1e-5 A). TFTs with IZO semiconductor patterned by ink-jet printing show a gate leakage reduction of four decades and an ON/OFF ratio between 1e6 and 1e7 at a reduced saturation mobility of 0.014 cm2 V-1 s-1 (Vd=40 V). The controlled and continuous production of mixed oxide nanoparticles delivers a versatile and facile basis for industrial-scale solution processing of inorganic semiconductors. The presented approach yields performance values close to amorphous silicon and has a high potential for further improvements.

I.16.4

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09:45 **Best poster award Symposium I**

10:00 **Coffee & tea**

Photovoltaic materials : Renzhi Ma & David Grosso

10:30 **Low temperature, aqueous solution deposition of high performance ZnO:Al TCO thin films on polymer and temperature sensitive substrates**

Authors : H. Hagendorfer1, P. Fuchs1, A. Paracchino2, S. Nishiwaki1, Y. E. Romanyuk1, and A. N. Tiwari1
Affiliations : 1 Laboratory for Thin Films and Photovoltaics, Empa, Swiss Federal Laboratories for Materials Science and Technology, 8600 Duebendorf, Switzerland; 2 Laboratory for Functional Polymers, Empa, Swiss Federal Laboratories for Materials Science and Technology, 8600 Duebendorf, Switzerland;

Resume : A low temperature and "green chemistry" aqueous solution route to fabricate aluminum doped zinc oxide (ZnO:Al) thin films is presented, employing ammonia as complexing agent for the Zn precursors and metallic aluminum as self-controlled dopant source [1]. To improve the optoelectronic properties without appliance of a high temperature annealing step, post-deposition UV radiation treatment was investigated and optimized. Uniform, polycrystalline, highly transparent and conductive (transmission 400 - 1000 nm > 85%, sheet resistances of 20-30 Ω/sq) ZnO:Al thin films were prepared with temperatures below 150°C at any process step. The new facile route was utilized to fabricate a front electrical contact in a Cu(In,Ga)Se2 (CIGS) thin film solar cell, where high temperature processing is infeasible. Solar cells with efficiencies of 15 % were obtained. To further corroborate the feasibility of the low temperature process, deposition of AZO layers on PET films using nanoparticles as seed layer was achieved. That opened up the possibility for the fabrication of an ITO-free and flexible inverted polymer solar cell (PTB7:PC71BM) with solution processed AZO on PET as cathode, exhibiting efficiencies of 6.5-8%. As further improvements are expected, this work establishes new opportunities for non-vacuum deposition of doped ZnO based thin films on temperature sensitive, flexible and non-conductive substrates. [1] H. Hagendorfer et al., Adv. Mater., (2013), DOI: 10.1002/adma.201303186

I.17.1

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11:00 **Development of EBL Perovskite Layer for ZnO Nanorod Solid State Dye-Sensitised Solar Cell**

Authors : L Loh, J Briscoe, S Dunn
Affiliations : Nanotechnology, Nanyang Polytechnic, Singapore; School of Engineering and Materials Science, Queen Mary University of London

Resume : Recent reports on the influence of performance of perovskite-type materials on photovoltaics have led to increased interest. The photovoltaic (PV) effect of ferroelectric materials like perovskite BaTiO3 was studied in the 1970s. One particular multiferroic material, coupling both ferroelectric and magnetic properties, is perovskite bismuth ferrite (BiFeO3, BFO). Interest in BFO has gathered pace due to inherent properties and recently reported anomalous photovoltage. A ZnO:sensitiser photovoltaic device without BFO (ZnO/N719/CuSCN) produced a Jsc of 0.64 mA/cm2, Voc of 0.38 V giving an overall efficiency of 0.1% giving equivalent results to that reported previously. For ZnO/BFO/N719/CuSCN structures with partial BFO coverage (50-60% of ZnO exposed), the Jsc and Voc increased to 0.79 mA/cm2 and 0.47 V, and efficiency to 0.2%. The efficiency increased to 0.38 % with conformally covered BFO at 2.5 nm average thickness, but dropped with a thicker BFO coating that averaged 7 nm. The Voc increased to 510 mV when the surface of the ZnO was conformally coated. In contrast, Jsc increased with BFO coverage up to a maximum of 1.38 mA/cm2 2.5 nm thick BFO. It then decreased for the thicker BFO coating. In all cases fill factors (FF) were around 0.55. We describe the evaluation of device enhancement and conclude that for our structures we have produced an effective BFO solid-state electron blocking layer that is responsible for a ca 400% enhancement in performance.

I.17.2

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11:15 **High efficiency inverted polymer solar cells with solution-processed ZnO buffer layer** I.17.3

Authors : P. Morvillo, R. Diana, R. Ricciardi, E. Bobeico, C. Minarini
Affiliations : ENEA - P.le E. Fermi, 1 - 80055 Portici (NA) - Italy
Resume : In this work, we report the application of a sol-gel derived ZnO thin film as a buffer layer for high efficiency inverted polymer solar cells (PSC). ZnO films are widely used in inverted devices because they have a relatively high electron mobility, high transparency and environmental stability. The ZnO precursor was prepared by dissolving zinc acetate and ethanolamine in the 2-methoxyethanol. ZnO thin films were then deposited on ITO/glass substrates by spin casting the above solution. Different annealing temperature were at relatively low annealing temperatures (<200°C). Inverted polymer solar cells whit the configuration ITO/ZnO/PBDTTT-C:[70]PCBM/MoO3/Ag were realized in order to test the performance of ZnO thin film. We made a comparative study of the electrical behaviour of different devices in order to investigate the influence of different annealing temperature of the ZnO layer on the solar cells performances. All the devices were characterized by UV-VIS spectroscopy, IV light, IV dark and quantum efficiency measurements. The best device reached a power conversion efficiency of 7%.

11:30 **An analysis of new architectures using ZnO nano-rod arrays in chalcopyrite thin film solar cells**

Authors : Sophie Gledhill, Wiebke Ohm, Wiebke Riedel, Ümit Askünger, Martha Lux-Steiner, Thomas Goislard, Helga Szambolics
Affiliations : Free University of Berlin-Helmholtz Zentrum Berlin-NEXCIS-CEA Liten
Resume : It is critical for the next generation of thin film solar cell devices that the absorption in the active layers is enhanced, enabling thickness reduction and maximising photoconversion. ZnO nano-rods placed within the architecture of the Cu(In,Ga)Se2 solar cell present promising concepts to achieve this. The ZnO nano-rods are electrodeposited, the advantage being this can be applied to large scale modules. The nano-rod dimensions are controlled via growth parameters such as the precursor solution, seed layer (a pre-deposition film or treatment which helps establish nano-rod density and diameter), deposition time and potential. If the nano-rod arrays are grown with sub-wavelength spacings and dimensions they act as an anti-reflection coating by means of the moth eye effect. The nano-rods are incorporated into the chalcopyrite solar cell as an anti-reflection coating (ARC) on the ZnO window layer at the front of a substrate solar cell. A second concept is the incorporation of ZnO nano-rod arrays into a superstrate cell as an anti-reflection surface at the absorber / TCO (transparent conducting oxide) interface. In this architecture they can be coated with a buffer layer and perform a critical electronic function, being located at the pn-junction. The third concept is a bi-facial solar cell where the nano-rods form a textured but transparent back contact. Larger, more randomly orientated nano-rods which are grown have high haze factors. The nano-rods when coated with a metal layer create a textured reflector that back-scatters the photons that are not absorbed during their first passage through the absorber. The optical characteristics of the different concepts are presented here. Complete devices exhibit increased photocurrent.

I.17.4

11:45 **Solution processing towards titania buffer layers for dye sensitized solar cells: Electrochemical characterization**

Authors : Ladislav Kavan
Affiliations : J. Heyrovsky Institute of Physical Chemsitry, Dolejskova 3, CZ-18223 Prague 8, Czech Republic
Resume : Compact thin films of TiO2 are required for recombination blocking in DSSCs. They are grown on FTO by electrochemical deposition from solutions of TiCl3 or by sol-gel dip-coating from solutions containing poly(hexafluorobutyl methacrylate) as the structure-directing agent. The films are quasi-amorphous, but crystallize partly to anatase upon heat treatment. Cyclic voltammetry using ferri/ferrocyanide or spiro-OMeTAD as the model redox probes indicates selectively the pinholes, if any, in the layer. The pinhole-free films on FTO represent excellent rectifying interface, at which no anodic Faradaic reactions occur in the depletion state. The flatband potentials of the electrodeposited films, determined from Mott-Schottky plots, are comparable to those of anatase single crystal. The values of sol-gel films are upshifted by ca. 0.2-0.4 V, yet still follow the Nernstian pH dependence. The optimized buffer layer embodies interplay of quasi-amorphous morphology, responsible for the electrochemical blocking function, and the calcination-induced crystallinity, responsible for the fast electron injection and transport in the conduction band. The latter manifests itself by reversible charging of chemical capacitance and band-gap trap states of

I.17.5

TiO2 in its accumulation state. The solution-processed layers are outperforming those made by standard methods, i.e. spray pyrolysis and ALD. This work was supported by the Czech National Foundation, contract No. 13-07724S.

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12:00 **Colloidal solution of Transition Metal Oxides as charge harvesting layers in photovoltaics**

Authors : Mireille Richard-Plouet, Luc Brohan, Hélène Terrisse, Vincent Jouenne, Jean-Luc Duvail, Moustafa El Kass, Solenn Berson*, Noëlla Lemaitre*
Affiliations : Institut des Matériaux Jean Rouxel, Université de Nantes CNRS, 2, rue de la Houssinière, BP 32229, 44322 Nantes Cedex 03, France *CEA, LITEN, Laboratoire des Modules Photovoltaïques Organiques, INES 50 avenue du Lac Léman, 73375 Le Bourget du lac, France

Resume : Breakthroughs in the field of solar-to-electricity conversion are intimately related to the progress in materials research and development. In particular, materials obtained using the potential of nanotechnologies should give rise to new advances. The photoactive properties of transition metal oxides are very attractive allowing many applications in the environmental domains (photocatalysis, photovoltaics…). Their integration in hybrid solar cells requires the elaboration of films to optimize collection and transport of the photogenerated charge carriers. We develop solvothermal syntheses of nanostructured transition metal oxides leading to stable colloidal solutions. In order to remain compatible with low temperature processes on plastic substrates, the solvent is selected to monitor the physico-chemical properties of the obtained solutions. They can be deposited as thin films by printing processes or by electrodeposition [1], without annealing at high temperature. Some examples of oxide layers processed from solutions will illustrate the potentials of our approach in the field of organic bulk heterojunction solar cells. [2] [1] Jouenne, V.; Duvail, J.-L.; Brohan, L.; Richard-Plouet, M., MRS Online Proceedings Library, 1578, 2013 [2] Karpinski, A.; Berson, S.; Terrisse, H.; Mancini-Le Granvalet, M.; Guillerez, S,; Brohan, L.; Richard-Plouet, M. Solar Energy Mater. & Solar Cells 116, 27-33, 2013

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12:15 **Impact of photonic light-trapping on photoelectrochemical water splitting in hematite coated mWO3 microspheroids**

Authors : Florent Boudoire, Rita Toth, Jakob Heier, Artur Braun, and Edwin C. Constable
Affiliations : Laboratory for High Performance Ceramics Empa, Swiss Federal Laboratories for Materials Science and Technology Überlandstr. 129, CH-8600, Dübendorf, Switzerland. Laboratory for Functional Polymers Empa, Swiss Federal Laboratories for Materials Science and Technology Überlandstr. 129, CH-8600, Dübendorf, Switzerland. Department of Chemistry University of Basel Spitalstr. 51, CH-4056 Basel, Switzerland.

Resume : Hematite and mWO3 are two oxides of interest as photoanode material in a photoelectrochemical water splitting cell. Implementing these oxides in a heterojunction proved to be a succesfull strategy to improve charge diffusion in those materials. Nevertheless the efficiency of such photoanode is still hindered by the low conductivity of semiconducting metal oxides. To solve this limitation, light management using plasmonic or scattering nano to micro-structures has raised interest in recent years. Photonic effects can be tailored to confine light inside the film and increase the propagation length inside the material. Light absorption becomes independant of the film thickness, and thinner films with higher conductivities can be implemented. By using a micelle-templated technique, we were able to develop photoanodes composed of mWO3 spheroids coated with a hematite ultra-thin film overlay. By tuning the spheroids dimension, in the micrometric to submicrometric range, different photonic effects were observed experimentally. Finite-difference time-domain simulations of light propagation inside the film microstructure allowed a quantitative analysis of the different photonic regimes observed experimentally. Both experimental and mathematical studies allowed us to better understand how photonic effects triggered by the spheroid-like microstructure influenced the photoactivity of both oxides implemented in our photoanodes.

I.17.7

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