Symposium A: Carbon-based nanostructured composite films

This symposium is in the line of the European Science Foundation (ESF) Exploratory Workshop organized in 2006 under the auspices of the E-MRS. The major objective is to provide exchanges between scientists working in different areas and with different methods in the widely interdisciplinary research field of materials and thin films for micro- and nano-technologies.

Scope:
Carbon-based nanostructured composite (CBNC) films consisting of nanosize particles embedded in a carbon-containing host matrix (hydrogen-free or hydrogenated amorphous carbon, diamond-like carbon or polymer matrix) exhibit a variety of attractive properties in solid-state physics and are promising for various applications in advanced technologies (electronics, catalysis, wear protection, data storage, optical devices and sensors). These films may possess unique physical and/or chemical properties depending on the size of embedded particles and interface effects. CBNC films can be produced by physical and chemical vapor deposition techniques, pulsed laser ablation, plasma-assisted techniques and other hybrid techniques as well as by solution chemistry methods such as sol-gel, electrodeposition and electroless deposition. These films may exhibit specific mechanical and tribological properties attractive for microelectromechanical systems (MEMS), electrical and dielectric properties for microelectronic devices, optical properties as selective absorber films for flat plate solar collectors, and magnetic properties required for high-density magnetic recording data.

Papers dealing with the preparation of CBNC films by physical or chemical vapor deposition as well as by other techniques are solicited. Contributions related to the advanced characterization of the composition and structure of BCNC films and relationships between nanostructure and properties of films are encouraged.

A particular emphasis will be placed on mechanical and tribological properties, electrical and dielectric properties, optical and magnetic properties associated with the structure and texture of films. Topics such as process modeling and diagnostic techniques, surface interaction and nucleation phenomena, degradation mechanisms, and testing are requested. More engineering- and application oriented contributions which would include, for example, applications in the automotive, chemical, electrical, magnetic storage data, optical, pharmaceutical or biomedical industry are also solicited.

For this Symposium, **ten hot topics** would be particularly highlighted:
1) Physical and chemical vapor deposition of CBNC films
2) Synthesis of CBNC films by other techniques
3) Structural characterization of CBNC films
4) Determination of the composition and electronic structure of CBNC films
5) Mechanical and tribological properties of CBNC films
6) Electrical and dielectric properties of CBNC films
7) Optical properties of CBNC films
8) Magnetic properties of CBNC films
9) Chemical properties of CBNC films
10) Devices, sensors and applications of CBNC films

Tentative list of invited speakers:
1) G. Dennler, Johannes Kepler University of Linz, Austria
2) M. Farle, University of Duisburg-Essen, Germany
3) W. Gulbinski, The Technical University of Koszalin, Poland
4) H.C. Hofsäss, University of Göttingen, Germany
5) U. Jansson, Uppsala University, Sweden
6) Y.J. Li, Nanyang Technological University, Singapore
7) T.-P. Nguyen, University of Nantes, France
8) J.-E. Park, Tokyo University of Agriculture and Technology, Koganei 184, Japan
9) K.I. Schiffmann, Fraunhofer Institute, Braunschweig, Germany
10) M. Stüber, Forschungszentrum Karlsruhe, Germany

Tentative list of scientific committee members:
J.M. Albella (Spain), M. Benlahsen (France), I. Bertoti (Hungary), E. Bertran (Spain), K. Bewilogua (Germany), H. Biederman (Czech Republic), V. Bursikova (Czech Republic), M. Bystrzejewski (Poland), N.J.M. Carvalho (Belgium), A. Cavaleiro (Portugal), M. Cekada (Slovenia), C. Donnet (France), I. Efeoglou (Turkey), A. Gonzalez-Elipe (Spain), R. Groenen (Belgium), Z. Kutnjak (Slovenia), N. Laidani (Italy), P. Lobotka (Slovakia), S. Logothetidis (Greece), C. Meunier (France), S. Novak (Czech Republic), P. Oelhafen (Switzerland), K. Oskomov (Russia), P. Ossi (Italy), I. Panagiotopoulos (Greece), P. Patsalas (Greece), J. Patscheider (Switzerland), Y. Pauleau (France), N. Radic (Croatia), G. Radnoczi (Hungary), J.-P. Rivière (France), R. Sanjines (Switzerland), T. Suszko (Poland), A. Sylvestre (France), S. Tamulevicius (Lithuania), M.T. Vieira (Portugal), S. Zhang (Singapore).

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PROGRAM VIEW : 2008

MY PROGRAM : 2008

Symposium : A

Carbon-based nanostructured composite films

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start at	Subject	Num.
	Deposition I: Novel synthesis techniques of CBNC : Albano Cavaleiro, Nikola Radic	
10:30	Nanostructured carbide surfaces prepared by surfactant sputtering Authors : H. Hofsäss, K. Zhang and H. Zutz II. Physikalisches Institut, Universität Göttingen Friedrich-Hund-Platz 1, 37077 Göttingen, Germany **Resume :** Surfactant sputtering is a novel ion beam erosion technique, recently introduced by Hofsäss and Zhang. This technique utilizes the steady state coverage of a substrate surface with a steady state thin layer of foreign or self atoms simultaneously during sputter erosion by combined ion irradiation and atom deposition. These surfactant atoms strongly modify the substrate sputter yield on atomic to macroscopic length scales. Depending on the surfactant-substrate combination, the technique allows enhanced smoothing of surfaces, the generation of novel surface patterns and nanostructures and the controlled shaping of surfaces on the nanometer scale. Ion beam erosion at grazing incidence leads to the formation of rippled surface structures which are strongly modified by the surfactant layer and the interaction between surfactant and substrate atoms. We will give an introduction to the novel sputter technique and we apply the technique to prepare thin nano-structured carbide layers on a-C substrates. As substrates we use ion beam deposited ta-C films. We present results for e.q. titanium carbide and tungsten carbide nanostructured surface layers which were analyzed using scanning probe microscopy techniques, high resolution RBS, SEM and XRD. add to my program (close full abstract)	A1 1
11:00	Up-scaling the production of modified DLC coatings in the framework of plasma polymerization processes Authors : Carles Corbella, Fraunhofer IST Ingmar Bialuch, Fraunhofer IST Marc Kleinschmidt, Fraunhofer IST Klaus Bewilogua, Fraunhofer IST **Resume :** Diamond-Like Carbon (DLC) films with Si and O additions, which exhibit mechanical and tribological properties adequate for protective coating applications, have been synthesized at room temperature in a small- (0.1 m3) and in a large-scale (1 m3) coater by low-pressure Plasma-Activated Chemical Vapour Deposition (PACVD). Hence, a-C:H:Si and a-C:H:Si:O coatings were produced in atmospheres of tetramethylsilane (TMS) and hexamethyldisiloxane (HMDSO), respectively. The substrate electrodes were excited either by radiofrequency (RF) or by asymmetric bipolar pulsed-DC power. Argon was used as a carrier gas to stabilize the glow discharge. Several series of 2 to 5 µm-thick coatings have been prepared at different mass deposition rates, Rm, by varying the total gas flow, F, and the input power, W. The Arrhenius plots of Rm/F vs W/F show linear behaviours for both plasma reactors, as expected for plasma polymerization processes at moderated energies. The calculation of the generalized activation energy, Ea, in each series permitted us to define the regimes of energy-deficient and monomer-deficient PACVD processes as a function of the key parameter W/F. Moreover, the properties of the modified DLC coatings, such as contact angle, abrasive wear rate and hardness, appear also correlated to this parameter. This work shows an efficient method to scale up PACVD processes from small, lab-scale plasma machines to industrial plants by the unique evaluation of macroscopic deposition parameters add to my program (close full abstract)	A1 2
11:20	The synthesis of free-standing films of polymer/nanocarbon composites based on carbon nanopowder's buoyancy Authors : I. Sandu, I. Morjan, I. Voicu, R. Alexandrescu, F. Dumitrache, O. Cretu, L. Gavrila-Florescu, C. Fleaca, M. Scarisoreanu, C. Luculescu, E. Popovici National Institute for Lasers, Plasma and Radiation Physics, Bucharest, Romania **Resume :** In this work we rapport the synthesis of free standing films of polymer/nanocarbon composites. The method consists in forming a thin film of carbon nanoparticles onto the water's surface. Through the free infiltration of the polymer between the nanoparticles which form the film, after the polymer is cured, we obtain free-standing films of polymer/nanocarbon composites. The composite films are homogenous; they have 5% wt. carbon nanoparticles within the polymer matrix and are 2 µm in thickness. The carbon nanoparticles were synthesized through the laser pyrolysis of an ethylene/acetylene gaseous mixture. The mean dimension of the primary particles is 30 nm. The polymers which form the composite's matrix are: Synthalat A 077, an acrylic polymer, and High Density Polyethylene (HDPE). The carbon nanopowder, carbon films, and the polymer/nanocarbon composites were investigated through: transmission electron microscopy (TEM), scanning electron microscopy (SEM), optical microscopy, Raman spectroscopy, etc. As particular properties of the composite films we mention: homogeneity, low density, and the existence of an infinite percolation cluster in the film's volume. These characteristics can be useful in optical and electrical applications. add to my program (close full abstract)	A1 3
11:40	A novel form of hard hydrogenated amorphous carbon grown under high rate conditions in absence of ion bombardment Authors : S.V. Singh1, T. Zaharia1, M. A. Creatore1, R. Groenen2, K. Van Hege2 and M.C.M. van de	

Sanden1 1 Eindhoven University of Technology, Department of Applied Physics, P.O. Box 513, 5600 MB Eindhoven, The Netherlands 2 NV Bekaert SA, Dept. of Advanced Coating Technologies, Bekaertstraat 2, 8550 Zwevegem, Belgium

Resume : A novel form of diamond-like hydrogenated carbon deposited utilizing the expanding thermal remote Ar/C2H2 plasma is reported. The plasma is generated in a cascaded arc at subatmospheric pressure in argon. The discharge expands into a low pressure (remote) chamber where acetylene is introduced downstream by means of an injection ring. The downstream plasma is characterised by a low electron temperature which leads to ion driven chemistry and negligible physical effects like ion bombardment (< 2 eV) on the substrate. Furthermore, no external bias was applied discarding any possibility of high energy ion bombardment. Distinct from previous works, relatively low argon to acetylene gas flow ratio has been used in this study. Infrared absorption shows a reduced concentration of CH stretching and in addition, it is also evident that the endgroups (sp2 - CH2 and sp3 – CH3) are absent in the films. A distinct dispersion relation of optical constants is also obtained in the photon energy range of 1.24 eV to 5 eV. These films posses relatively low optical band gap and hydrogen content (< 25%), high refractive index and a nanohardness exceeding 16 GPa. Above all these films are deposited at growth rates exceeding 15 nm/s. Further characterizations by means of Raman spectroscopy, spectroscopic ellipsometry (SE) and Rutherford back scattering (RBS) indicate that the films are well cross-linked graphite like hydrogenated amorphous carbon. The film properties will be interpreted in view of the specific plasma chemistry taking place in the expanding thermal plasma.

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Deposition II: Magnetron sputtering and related techniques : Roland Groenen, Hans Hofsäss

14:00 Microstructural evolution and properties of magnetron-sputtered TiC/a-C and (Ti,Al)(N,C)/a-C nanocomposite coatings

Authors : M. Stueber1, U. Albers1, C. Ziebert1, M. Rinke1, M. Lattemann2, E. Lewin3, S. Ulrich1, L. Hultman2, U. Jansson3 , M. O`Sullivan4, P.Polcik4 1Forschungszentrum Karlsruhe, Institute of Materials Research I, Hermann-von-Helmholtz-Platz 1, D-76344 Eggenstein-Leopoldshafen (Germany) 2Linköping University, Plasma and Coatings Physics Division, Department of Physics, Chemistry and Biology, SE-581 83 Linköping (Sweden) 3Uppsala University, Department of Materials Chemistry, The Angström Laboratory, P.O. Box 538, SE-751 21 Uppsala (Sweden) 4Plansee GmbH, Research & Development HVD, Siebenbürgerstr.23, D-86983 Lechbruck am See (Germany)

Resume : Carbon-based nanocomposite thin films are attracting continuously increasing scientific and technical attention due to their promising property profiles. Current research activities address for example the development of wear resistant, low friction surfaces for engineering applications or issues related to energy technologies. This paper reports on TiC/a-C and (Ti,Al)(N,C)/a-C protective coatings synthesized by magnetron-sputtering. It reviews the correlation between the constitution, microstructure and properties of these coatings and discusses results obtained from a variety of analytical methods including electron probe microanalysis (EPMA), X-ray photoelectron spectroscopy (XPS), X-ray diffraction (XRD), Raman spectroscopy, transmission electron microscopy (TEM), and atomic force microscopy (AFM). Selected mechanical properties like the hardness and the Young`s modulus of the coatings were characterized both by the classical Vickers method and by nanoindentation. In the case of TiC/a-C thin film deposition a combinatorial approach using a segmented sputtering target composed of pure ceramic TiC and graphite pieces will be described. These experiments were carried out in a laboratory PVD machine (Leybold Z 550) under stationary conditions in non-reactive atmospheres. In each experiment, 6 samples of various Ti:C elemental composition ratios were obtained. Relevant deposition parameters (i.e. the R.F. substrate bias) were varied systematically. The constitution, microstructure and properties of the coatings will be discussed as a function of the Ti:C ratio. Further issues such as the deposition from new ceramic composite targets and the scaling-up of the deposition process to industrial level by applying these new composite targets will be addressed as well. The synthesis of new (Ti,Al)(N,C)/a-C nanocomposite coatings will be described exemplarily for the reactive magnetron sputtering from metal targets with an industrial PVD equipment (Hauzer HTC 625). First, the deposition conditions were fixed for the growth of a conventional metastable (Ti,Al)N hard coating. The carbon-based nanocomposite coatings then were deposited by adding methane to the process. The constitution, microstructure and properties of these coatings will be presented in dependence of their elemental composition. The thin film concepts and results presented will be discussed with respect to the identification of recommendations for the nanoscale design of advanced multifunctional wear-resistant low friction surfaces by innovative physical vapor deposition processes.

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14:30 Nanodiamond growth in sputtered hydrogenated amorphous carbon thin films

Authors : S. Kassavetis, S. Lousinian, A. Laskarakis, S. Logothetidis, I.Tsiaoussis, N. Frangis Physics Department, Aristotle University of Thessaloniki, GR-54124 Thessaloniki, Greece

Resume : Nanostructured carbon-based thin films are ideal materials for numerous advanced technological applications, as protective and active films for optoelectronic systems, gas barrier coatings for flexible electronic devices, due to their unique properties. Lately the scientific interest was attracted to the growth of nanocrystalline forms of carbon-based thin films and especially of the embedded nanodiamond structures into amorphous carbon films. In this work rf magnetron sputtering was successfully used for the growth of nanodiamond hydrogenated amorphous carbon thin films (a-C:H). The growth of the samples was held in a high vacuum chamber on c-Si(001) substrates, using Ar as the sputtering gas and H2 as the reactive one. Previous studies have shown that these a-C:H thin films were relatively soft (Hardness = 1.8–5.7GPa), with low density (1.1-1.3g/cm3). In this study, we focus on the effect of the deposition conditions, such as the applied to the substrate bias voltage (Vb) and the hydrogen partial pressure (PH), to the surface morphology, bonding and to the nanostructure characteristics of the a-C:H thin films. The surface characterization of the a-C:H thin films was performed using various Scanning Probe Microscopy Techniques, such as AFM, Atomic Force Acoustic Microscopy and Scanning Near-field Optical Microscopy. It was found that the Vb controls the surface roughness and morphology, rather than the PH. Also, High Resolution Transmission Electron Microscopy studies showed the presence of nanosized crystals (5–10 nm) embedded in the amorphous carbon matrix close the surface and

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crystalline seeds deeper in to the thin film, in the case of the a-C:H thin film grown with Vb>0. The electron diffraction patterns were identified with the characteristic diamond d-spacings. However, for Vb<0 the samples were found to be almost amorphous.

add to my program (close full abstract)

14:50 Structure of carbon–metal nanocomposite thin films

Authors : M. Szerencsi (1), K. Sedlácková (1), A. Sylvestre (2), Y. Pauleau (2), S. Kukielka (3), W. Gulbinski (3), G. Radnóczi (1) (1) Research Institute for Technical Physics and Materials Science, Konkoly-Thege M. út 29-33., 1121 Budapest, Hungary (2) CNRS - Grenoble Electrical Engineering Lab. (G2Elab) 25 Avenue des Martyrs, BP166, 38042 Grenoble, Cedex 9, France (3) Technical University of Koszalin, Faculty of Mechanical Engineering, Department of Physics, ul. Raclawicka 15-17, 75-620 Koszalin, Poland

Resume : Carbon-metal nanocomposite films can be investigated for their promising properties in mechanical and tribological applications. Other functional properties, however, like magnetic or protective coatings (e.g. antibacterial) on soft and deformable substrates also can be of interest. Carbon-metal nanocomposite films have been deposited by DC magnetron sputtering and RF plasma assisted CVD. Metals (Ag, Cu) nonreactive with carbon were selected. Carbon atoms incorporated in the films originated from either a separate graphite target in DC sputtering or decomposition of CH4 in RF plasma. The structure of the films was determined by electron microscopy (TEM, HREM) and analytical techniques (EDS, EELS). The composition effect on the structure was also studied. The structure of films can be characterised by globular or columnar metal grains embedded in carbon matrices, having amorphous structure of random or graphitic order. The particle size of the metallic dispersed phase was found to vary in the range 4–20 nm. The thickness of the carbon matrix between metallic particles was approximately 2–4 nm. The particle size increased with increasing metal content as long as the metal became the matrix and carbon turned to be the dispersed phase. The changes of the structure as a function of the composition are discussed on the basis of the structure zone model for two-phase materials. The morphological stability of the films under electron beam was also addressed.

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15:10 Surface characterization of carbon-tungsten alloys prepared by reactive sputtering

Authors : N. Radić(a), P. Dubček(a), M. Ristić(a), S. Musić(a), A.Tonejc(b), S. Bernstorff(c) (a) Rudjer Boskovic Institute, Zagreb, Croatia (b) Faculty of Sciences, Phys. Dept., Zagreb, Croatia (c) Elettra, Basovizza, Italy

Resume : The surface features of tungsten-carbon thin films, deposited onto monocrystalline silicon substrates by reactive magnetron sputtering (argon + benzene) has been investigated by GISAXS, AFM and SEM. Benzene partial pressure was varied from 1% to 10% of the total working gas pressure in order to produce W-C films with variable fraction of incorporated unbound carbon. A series of samples were prepared, with the substrate temperature held at RT, 200°C, and 400°C, and the substrate potential held at floating potential or biased -70 V with respect to discharge plasma. Structure of the films is found to be nanocrystalline to amorphous WC1-x as the carbon content increase, with a fine dispersion of DLC-clusters imbedded between nanograins. The GISAXS analysis revealed the particle size of about 3 nm within the films. The same results indicate that the surface of the examined films is rather smooth - surface roughness is about 0,5 nm, with a very short inplane height-height correlation length. The AFM measurements and SEM results are employed to characterize the surface and subsurface layer of the films, in order to examine a degree of bulk structure propagation to the surface.

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15:30 Optical and Electrical Properties of WC-C and TiBC-C Nanocomposite Thin Films Deposited by Magnetron Sputtering

Authors : M.D. Abad 1, J.C. Sánchez-López 1, N. Cusnir 2, R. Sanjinés 2, 1) Instituto de Ciencia de Materiales de Sevilla (CSIC-US), Sevilla, Spain, 2) Ecole Polytechnique Fédérale de Lausanne, IPMC-SB, CH-1015 Lausanne, Switzerland

Resume : The aim of the present work is the investigation of the optical and electrical properties of nc-WC/a-C and nc-TiBC/a-C thin films. A combined dc-pulsed and rf-magnetron deposition process was used to deposit nanocomposite TiBC/a-C and WC/a-C films with variable content of amorphous carbon matrix phase. The films were characterized by X-ray diffraction (XRD), electron energy-loss spectroscopy (EELS), X-ray photoelectron spectroscopy (XPS) and transmission electron microscopy (TEM). In such nanocomposite thin films (nc-MXC/amorphous-C), crystallite sizes are of the order of a few nanometers. The grain surfaces and boundaries play an increased role on physical properties. In order to understanding the effect of the carbon co-deposition on the phase formation and/or segregation, crystallite size, morphology and formation of the composite material, the optical and electrical properties of these films were systematically investigated by spectroscopic ellipsometry, reflectivity and electrical resistivity measurements. The dielectric function of pure nanocrystalline nc-TiBC and nc-W2C films reveals structures near the screened plasma edge which correlate well with their associated electronic structure. The addition of carbon originates important modifications in the optical properties of these films.

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M-A-X based systems and carbon nanotubes : Imre Bertoti, Ihsan Efeoglu

16:30 Synthesis and characterization of nanolaminated MAX-phase films

Authors : Ulf Jansson Department of Materials Chemistry Uppsala University Box 538 SE-751 21 Uppsala Sweden

Resume : New thin film materials in the M-A-X systems have recently been given a considerable attention. In these systems, M represents a transition metal, A is a so-called A-element from group 13-15 (e.g. Si, Al, Ge) and X is either carbon or nitrogen. An interesting group of compounds in these systems are the nanolaminated MAX-phases with a general composition Mn+1AXn, where n=1, 2, 3. They can be described as nanolaminates of metal carbides or nitrides separated by A-layers. This structure gives rise to special chemical and physical properties that suggest a potential use of these materials in many thin film applications. Some examples are: low-friction materials, thermal protection coatings and chemically resistant coatings. A problem with the nanolaminated MAX-phases is that they usually are formed in narrow composition ranges and at rather high deposition temperatures (>600 oC). Consequently, depending on the process parameters also other

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types of thin film materials can be obtained. At reduced temperatures, nanocomposites (nc-MX:a-AX) are the most important type of competing structure. Recent studies have shown that carbide MAX nanolaminates and M-A-X nanocomposites exhibit very similar properties and that both type of materials can be used in a given application. This paper will give a general overview of the synthesis of carbide MAX-phase thin films and their properties. The relationship between nanolaminates and competing nanocomposite structures will also be discussed.

add to my program (close full abstract)

17:00 Si- and Cr-containing carbon based nanocomposite thin films: Chemical and nanomechanical properties

Authors : I. Bertoti, M. Mohai, A. Toth, K. Kereszturi, E. Kalman Institute of Materials and Environmental Chemistry Institute of Surface Chemistry and Catalysis Chemical Research Center, Hungarian Academy of Sciences, Budapest, Hungary

Resume : Modification of DLC films by silicon together with different metals is in the forefront of investigations and industrial development. Si- and Cr-containing a-C films were deposited simultaneously by dual magnetron sputtering sources onto polished silicon wafers using Cr and C targets and vapour phase (TMS) Si source. The chemical composition and the bonding states of the constituent elements were characterized mainly by X-ray photoelectron spectroscopy. Mechanical properties (dynamic hardness and reduced modulus) were estimated by using a depth-sensing instrument. The chromium content in the C-Si-Cr films varied between 1-55 atomic % while the silicon content at the same time between 25-0 atomic %. Predominant C-Si and C-Cr chemical bonds could be identified by the chemical shifts of the XP spectra and by the Auger parameters. Formation of phase-separated clusters of silicon, silicon carbide, chromium, chromium carbide or chromium silicide, however, could not be detected. The nanohardness (H) and reduced modulus (E) of the films were significantly higher than that of the silicon substrate being 10 GPa, 127 GPa, respectively. H and E values were for a-C film 16 GPa and 155 GPa, and for (Si+Cr)–(a-C) films 13-22 GPa and 100-170 GPa, respectively, depending on the chemical composition. Increase of the Cr-content in the films led to well measurable increase of the hardness of the coatings, while the latter seems to be invariant with the Si content.

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17:20 An Athermal Single-Walled Carbon Nanotube Solution

Authors : Shane D Bergin,a, b Valeria Nicolosi a, b, Zhenyu Sun a, b, & Jonathan N Coleman a, b a School of Physics, Trinity College Dublin, Dublin 2, Ireland. b Centre for Research on Adaptive Nanostructures and Nanodevices (CRANN) , Trinity College Dublin, Dublin 2, Ireland

Resume : Since their discovery in 1993, the much heralded properties of single walled carbon nanotubes (SWNTs) have not been realised to their full potential due to their propensity to bundle with one another via Van der Waals interactions and the diminished properties that result from this bundled state. The literature is peppered with various techniques to debundle SWNTs, most of which rely on covalent or non-covalent functionalisation of the SWNTs in order to change the solvent-nanotube interaction. This type of three phase system has had success. However, the effect of covalent attachments on the electronic properties of pristine SWNTs cannot be ignored. Neither too can we neglect the role this third dispersant phase may play in the implementation of the debundled SWNTs in any composite. Thus, we arrive at the situation where a simple two phase system of SWNTs being exfoliated in an appropriate solvent would be of great benefit to any possible user. Recently, work from our group has demonstrated debundling by dilution in the common amide solvent N-Methyl-Pyrrolidone (NMP) [1]. This demonstrated high populations of individual SWNTs confirmed by spectroscopic and microscopic techniques. The benefits accruing from this have been measured in various composite materials reported by our group. More recently, we have demonstrated spontaneous debundling of SWNTs in NMP: it should be stressed that this debundling occurred without the need for sonication. In this work, the trend of average bundle diameter as a function of SWNT concentration was monitored. We compare the sonicated dispersions to the non-sonicated samples and show that after a period of approximatly 150hrs the non-sonicated dispersions are debundled to the same extent as the sonicated dispersions. This spontaneity would suggest that the SWNTs are soluble in NMP. To that end, we investigated the various components of the free energy of mixing for such a reaction. The entropic component was described using Flory's model of mixing rigid rod-like molecules. Modelling the enthalapic element, we arrived at an expression with a very similar form to the famous Scratchard Hildebrand equation – the basis of the like-dissolves-like rule familiar to chemists. We show that by matching the surface energy of the solvent to the surface energy of the SWNT, we obtain optimum debundling of SWNTs: this match corresponds to a minimised enthalpy of mixing component which would again point toward a SWNT solution. To verify this, using Flory's theory for mixing, we express the conditions required for a solution in terms of the Flory Huggins parameter. An absolute measure for the Flory Huggins parameter was obtained using dynamic light scattering. Comparing this experimental value to the theoretical requirement for a solution, we confirm that SWNTs are soluble in NMP.

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17:40 A comparative study of carbon nanotubes synthesized using DC and pulsed DC low pressure glow discharge plasma enhanced CVD

Authors : D.K. Rai(b), Sanjay K. Ram(a), Paramananda Biswas(a), Suman Banerjee(a), Rajeev Gupta(a,b) and Satyendra Kumar(a) (a)Department of Physics and Samtel Centre for Display Technologies, Indian Institute of Technology Kanpur, Kanpur-208016, India (b)Materials Science Programme, Indian Institute of Technology Kanpur, Kanpur-208016, India

Resume : Carbon nanotubes (CNTs) having remarkable electrical, mechanical and thermal properties have attracted considerable scientific interest. Use of plasma enhanced chemical vapor deposition (PECVD) for synthesis of CNTs allows good control over the alignment of nanotubes by variation in different deposition parameters. In the present report, CNTs have been synthesized using DC and pulsed DC low pressure glow discharge PECVD techniques on silicon and quartz substrates with a buffer layer of titanium film, and a catalyst layer of nickel. The pulsed-DC technique with asymmetric bipolar waveform is an advanced technology that offers a good alternative to conventional DC and RF-PECVD, and provides better control on arcing and uniformity over large area. We observed that the density, diameter and other morphological features of CNTs could be controlled by varying deposition time interval, power input/biasing, substrate temperature

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and hydrogen pretreatment. The CNTs were characterized by scanning electron microscopy, Raman spectroscopy, atomic force microscopy and scanning tunneling microscopy. Uniform growth of CNTs over large area was obtained using C2H2 and H2 gases. We have compared the properties of CNTs deposited using the two different techniques and under different deposition conditions.

PROGRAM VIEW : 2008

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start at	Subject	Num.
	Optical properties I : Cathy Meunier, Rosendo Sanjines	
08:45	Hybrid nanocomposites for optical applications Authors : T. P. Nguyen1, C. W. Lee1,2, H. Simon1, H. C. Le3 1 Institut des Matériaux Jean Rouxel, 2 rue de la Houssinière, BP32229, 44322 Nantes, France 2 Department of Applied Chemistry, National Chiao Tung University, Hsinchu 30010, Taiwan, Republic of China. 3 Faculty of Engineering Physics & NanoTechnology, College of Technology, 144 Xuan Thuy Road, Hanoi, VietNam **Resume :** Incorporating inorganic particles into conjugated polymer matrices is an area of current interest in the fields of optoelectronics and solar energy. The hybrid nanocomposites exhibit interesting physical properties thanks to good optical properties of polymers and to high carrier mobility of inorganic semiconductors. A judicious combination of organic/inorganic can therefore provide materials of low cost, ease processing, high stability, with specific electrical and optical properties. Numerous experimental results have shown that devices using hybrid nanocomposites provide the potential for improving the performance of power conversion efficiency better than those using polymer only. In the present study, we briefly review the composite materials that have been successfully utilized in the field of optoelectronics and photovoltaic conversion. We shall describe in particular a family of nanocomposites using polyhedral oligomeric silsesquioxanes (POSS) of general formula (RSiO3/2)n where R is an organic group as a core. The composites are made by grafting functional polymer groups to the core, which allows the control of their optical properties. Such composites have high mechanical resistance and stability because of the special structure of the core. For illustration, we present a study of polyfluorene (PF)/ POSS materials used as an active layer in organic light emitting diodes, with improved performance as compared to those using polymer only, and we discuss the role of the particles in the transport and emission processes in the devices studied. add to my program (close full abstract)	A4 1
09:15	Carbon based nanostructured thin films as solar absorbers Authors : Viorel Braic, Mihai Balaceanu, Catalin Nicolae Zoita, Mariana Braic National Institute for Optoelectronics, Magurele-Bucharest, ROMANIA **Resume :** Carbon-based nanostructured composite (CBNC) films consisting of nanosize particles embedded in a carbon-containing host matrix exhibit a variety of attractive properties in solid-state physics. Depending on the size of embedded particles and interface effects, CBNC films may possess unique physical and/or chemical properties. Recently, films based on a a-C:H-Si matrix containing TiSiC clusters have been shown to be of interest as solar absorber coatings. The thermal stability of CBNC films is a critical issue for this application. Thin films of nanostructured composites containing TiSiC clusters in an a-C:H-Si matrix were deposited on Cu and Si substrates by the filtered cathodic vacuum arc deposition method. As carbon rich gases, acetylene and methane were used to supply carbon and hydrogen in the reactive deposition atmosphere. The aim of this paper is to understand the causes of the observed variation, in terms of adhesion, hardness, stress and VIS-IR reflectivity, when using different carbon rich gases. The films were analyzed by quantitative Auger electron spectroscopy for the elemental composition, XPS for the near-surface microchemical composition, XRD for lattice parameters and texture, AFM with nanoindentation module for surface morphology, hardness and adhesion, mechanical profilometry for thickness and film stress measurements. The films reflectivity at different angles in the VIS-NIR region was determined before and after exposure to an aging thermal treatment in air. add to my program (close full abstract)	A4 2
09:35	Preparation and Characterization of Electrospun PS/BEH-PF Fiber Mats Authors : Sutheerat Changsarn, Toemsak Srikhirin, and Pitt Supaphol **Resume :** Electrospun (e-spun) fiber mats of 9,9-Di(2'-ethylhexyl)-2,7-dibromofluorene (BEH-PF) in its blend with polystyrene (PS) with the average diameters ranging from 0.68 to 1.04 □m were successfully prepared. Electrospinnability of the PS/BEH-PF solution was improved by the addition of a volatile organic salt, pyridinium formate (PF), to the solution prior to electrospinning. Scanning electron microscopy (SEM) and Fourier-transformed infrared spectroscopy (FT-IR) were respectively used to observe morphology and chemical integrity of the e-spun fiber mats. Additionally, absorption and emission of the as-prepared solution and its corresponding e-spun fiber mats were investigated by UV-visible (UV-vis) and photoluminescence (PL) spectroscopy. The e-spun fiber mats exhibited a red shift in their emission spectra, when compared with those of the solutions, possibly due to the aggregation of BEH-PF in the e-spun fiber mats as lower energy emission peaks were observed. add to my program (close full abstract)	A4 3
	Tribological and mechanical properties : Ulf Jansson, Gyorgy Radnoczi	
10:30	Microstructural and Microtribological Characterization of Metal containing DLC Coatings Authors : Kirsten Ingolf Schiffmann Fraunhofer Institut für Schicht- und Oberflächentechnik Bienroder Weg 54E, 38108 Braunschweig, Germany	

Resume : Metal-containing diamond-like carbon hard coatings (Me-DLC) consist of nanometer size metallic particles, embedded in an amorphous hydrocarbon matrix. Their mechanical and tribological properties are of high interest for applications e.g. in tool or automotive industry and are influenced by the size and distribution of metallic clusters in the film. In this talk: (1) a systematic investigation of mean radii and centre-of-mass distances of metal clusters in Me-DLC films is presented. Films with different kinds of metals (Au, Pt, W and Fe) and metal contents ranging from 0 to 50 at% are analysed, each by four complementary analytical techniques: TEM, STM, XRD and SAXS. Increasing particle radii and particle distances in the range of 1 to 5 nm and 2 to 10 nm respectively are found with increasing metal content of the film. Cluster sizes and distances correlate to the melting-point and the carbide forming behaviour of the metal. (2) While the macroscopic tribological behaviour of Me-DLC coatings is well known there is only little knowledge of the influence of the micro- and nanostructure of the films on friction and wear. Therefore AFM-based methods have been applied to correlate microstructure with the tribological performance of the coatings. The influence of low-cycle material fatigue, columnar growth structure and particle percolation could be identified as factors influencing the wear behaviour of the Me-DLC.

A5 1

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(close full abstract)

11:00 Tribological Characterization of Me(Nb,Ti)-DLC Films Grown by Pulsed-dc Magnetron Sputtering

Authors : I. Efeoglu, Atatürk University, Turkey D. Ugur, Bogazici University, Turkey O. Baran, Atatürk University, Turkey E. Arslan, Atatürk University, Turkey S. Altıntas, Bogazici University, Turkey

Resume : Objective of this research was to investigate the tribological behaviour of Nb and Ti doped diamond-like carbon (DLC) films deposited by closed-field unbalanced magnetron sputtering method with applied pulsed-dc to the substrate. Tribo-test characterization were carried out by employing high temperature pin-on-disc system. The used test conditions are oil, distilated water and three different temperatures (RT, 150, 300oC). Resulting coatings exhibited low CoF.

A5 2

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(close full abstract)

11:20 Influence of structural composition on mechanical behaviour of Ti-DLC based coatings deposited by PECVD

Authors : D. Caschera 1,2, F. Federici 1, L. Pandolfi 1, S. Kaciulis 1, G. Padeletti 1, M. Sebastiani 2, E. Bemporad 2 1 ISMN-CNR, via Salaria Km 29,300, Monterotondo scalo, 00016 (Rm) - ITALY 2 Dip. di Ingegneria Industriale e Meccanica, Università di Roma Tre, via Vasca Navale 84, Roma, 00146 (Rm) - ITALY

Resume : Titanium-DLC based films represent extremely versatile materials for their possible applications in large industrial fields, such as mechanical, optical or biotechnological sectors. In this study, Ti-containing DLC films have been deposited by plasma decomposition of metallorganic precursor, titanium isopropoxide (Ti[OCH2CH3]4) in a CH4/H2/Ar gas atmosphere. The deposited films were found to be composed of amorphous titanium oxide and nanocrystalline titanium carbide, embedded in an amorphous hydrogenated (a-C:H) matrix (DLC). The TiC/TiO2 ratio in the DLC matrix is found to be dependent on the process parameters. The films' chemical composition, depending on gaseous fluxes and substrate\'s temperature, was investigated by XPS depth profiling; the crystallinity of TiC nanoparticles and their dimensions have been evaluated by X-ray diffraction, while the structural morphology has been analysed by AFM and SEM. Intrinsic hardness, elastic modulus and hardness to modulus ratio of obtained coatings were measured by means of nanoindentation techniques, adopting the Continuous Stiffness Measurement method: tests were performed under constant strain rate condition, while maximum penetration depth was selected as a constant ratio of the coating thickness, in order to correctly evaluate substrate effects on modulus and hardness values. Results show a correlation of mechanical properties with film\'s chemical composition and amorphous/crystalline status ratio.

A5 3

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(close full abstract)

11:40 Role of Carbon in the Oxidation Response of Nanocomposite Cr-N-C Coatings

Authors : C. Louro (a,*), A.M. Neves (a), T. Polcar (a,b) and A. Cavaleiro (a) a) ICEMS, Mechanical Engineering Department, University of Coimbra, 3030-788 Coimbra, Portugal b) Department of Applied Mathematics, Faculty of Transportation Sciences, CTU in Prague, Na Florenci 25, Prague 1, Czech Republic *corresponding author: cristina.louro@dem.uc.pt

Resume : Recently [1] and in spite of the well-known low temperature degradation of sp3 to sp2 carbon bonds, arc-evaporated Cr-N-C coatings tested tribologically in situ at high temperatures show that the wear rate was almost independent on the temperature and lower than that of CrN coatings deposited and tested under similar conditions. This is a result of the favourable thermochemical properties of this system. Thus, in order to understand the upper service temperature of Cr-N-C as wear-protection coatings, the role of C on the Cr-N-C oxidation behaviour must be addressed. Coatings were prepared by cathode arc evaporation technology using constant N2 and variable C2H2 flows. The carbon content, varied from 0 (CrN used as reference) to 25 at.%. By thermogravimetric analysis (TG) in an O-containing atmosphere, it was possible to assess either the weight gain variation, during the dynamic thermal oxidation at increasing temperatures up to 1000ºC, or the onset oxidation temperatures. In-situ high temperature XRD, Raman and FTIR spectroscopies were used for analyzing the structural changes. At elevated temperatures the oxidation mechanism proceeds by the displacement of C and N from the coating by oxygen. Therefore, the expected effusion of CO, CO2 and N2 gaseous products, detected by Mass spectrometry (coupled to TG equipment), interferes with the inward oxygen ion flux, being a factor explicative for the oxidation mechanism changes. Moreover, when the C/N content in the films is high enough, the molecular gas bubbles formed in the interface oxide/coating generate stresses in the protective Cr2O3 oxide layer leading to its destruction. This was confirmed by SEM morphological characterization. [1] - T. Polcar, L. Cvrcekb, P.Siroky, R. Novak, Vacuum 80 (2005) 113

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(close full abstract)

Poster Session CBNC-1 : Martin Balden

14:00 A multilayer approach for MAX Phase synthesis

Authors : T. Cabioch, V. Dolique, M. Jaouen, Laboratoire de Métallurgie Physique, UMR 6630 CNRS, Université de Poitiers, Bâtiment SP2MI, Téléport 2, BP30179, 86962 Chasseneuil Futuroscope Cedex, France

Resume : Stoichiometric TiN/TiAl multilayers of various modulation wavelengths (8, 13 and 32 nm) were deposited at room temperature onto Si(100) substrates by Ion Beam Assisted Deposition and then annealed in vacuum at 600°C in order to allow the formation of a Ti2AlN MAX phase thin film. The as-deposited multilayers as well as those transformed by the thermal annealing were characterized by X-Ray diffraction (XRD), High Resolution Transmission Electron Microscopy (HRTEM), Energy Filtered Transmission Electron Microscopy imaging (EFTEM) and X-Ray Photoelectron Spectroscopy (XPS) experiments. The different characterization techniques revealed that Ti2AlN/(Ti,Al)N multilayers were obtained after the thermal annealing. The formation of the MAX Phase is mainly attributed to the precipitation of nitrogen atoms, already present in the TiAl layers after the deposition, in TiAl. Depending on the nitrogen concentration CN inside TiAl layers, and thus of the modulation wavelengths; the annealing induces a solid state transformation which involves a complex diffusion mechanism of Al and N atoms that will be mostly discussed on the basis of in situ XRD and TEM experiments.

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14:00 Characteristics of Ti-Nb, Ti-Zr and Ti-Al containing hydrogenated carbon nitride films

Authors : Mihai Balaceanu, Viorel Braic, Mariana Braic, Catalin Nicolae Zoita, Adrian Kiss, Alina Vladescu National Institute for Optoelectronics, Magurele-Bucharest, ROMANIA

Resume : In the last decade, Me-C:H or Me-C:N:H coatings have attracted a lot of attention because of their excellent properties such as low friction coefficient, high wear resistance, low residual stress level and good adhesion to steel substrates. Metal incorporation into hydrogenated amorphous carbon or carbon nitride films can provide superior properties by forming metal nanocomposites or nanoclusters. The objective of the present work is to comparatively investigate the influence of metal addition on the properties of Me-C:N:H coatings, where Me stands for three different combinations of two elements: Ti-Nb, Ti-Zr and Ti-Al. The coatings were deposited on Si and steel substrates by the cathodic arc method from Ti-Nb, Ti-Zr or Ti-Al targets, in a reactive Ar CH4 N2 atmosphere. The depositions were carried out under different working parameters (CH4 and N2 flow rates, substrate bias voltage). The films were extensively analyzed for elemental composition (Auger Electron Spectroscopy), chemical bondings (X-ray Photoelectron, Raman and FTIR spectroscopies), mechanical properties (surface roughness, residual stress, hardness and adhesion) and tribological characteristics (friction coefficient and wear resistance). The experiments showed that the coatings properties depended mainly on the type of added material, metal concentration and N/C ratio in the a-C:N:H film composition and energies of the ions striking the substrate. It was also demonstrated that metal incorporation in the a-C:N:H structure led to an improvement of the film hardness, internal stress and adhesion.

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14:00 GAMMA IRRADIATION INDUCED CHANGES OF THE PROPERTIES OF DLC FILMS

Authors : D.Adliene1, J.Laurikaitiene1, Z.Rutkuniene1, V.Sablinskas2, M.Sniureviciute1, S.Mockeviciene1 1Physics Department, Kaunas University of Technology, Studentu 50, LT-51368 Kaunas, Lithuania, 2Department of General Physics and Spectroscopy, Vilnius University, Sauletekio 9-3, LT-2040 Vilnius, Lithuania

Resume : Application of the amorphous diamond like carbon (DLC) films as protective coatings for different purposes is growing up due to their excellent mechanical, tribological, electrical and optical properties. The properties of DLC films depend on the method, which has been used for their synthesis, on the initial conditions and on the methods of their modification. The aim of this work was to investigate modification of the properties of amorphous DLC films, performed by irradiation of the films with high energy gamma photons from Co-60 source. Amorphous DLC films of different thickness and different hydrogen content were synthesized on Si<111> wafers from pure (99%) acetylene gas in two chamber plasmatron system. Produced samples were irradiated continuously and in sequences by gamma photons produced in medical therapy unit with Co-60 source up to the doses of 100 Gy. The time of relaxation between two following irradiation events has been varied. Hydrogen content in DLC films was estimated using RBS method. Optical transmittance and absorbance spectra of the investigated films were measured using GAERTNER UV/VIS spectrometer, as well as laser ellipsometer Gaertner 117 operating with a He-Ne laser (632.8nm) was used for the estimation of the thickness, refractive index and extinction coefficient of the films. Bonding structure of carbon films were analysed using Raman scattering (RS) spectroscopy. Spectra Physics Stabilite 2017 argon laser operating at 514.5 nm wavelength with 800 mW power excitation was employed as a light source for Raman scattering. Surface morphology was defined using Atomic Force Microscope NANOTOP-206 It was found that the properties of the continuously irradiated samples differed significantly from those of the samples irradiated in sequences. The role of relaxation on the properties of the irradiated DLC films was estimated varying the time intervals between two neighbouring irradiation events. Radiation induced structural changes in DLC films are discussed on the base of the obtained results of the investigation.

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14:00 Effects of substrate ion bombardment on characteristics of carbon based hard coatings deposited by filtered vacuum-arc plasma technique

Authors : Mihai Balaceanu, Viorel Braic, Mariana Braic, Catalin Nicolae Zoita, Adrian Kiss, Alina Vladescu National Institute for Optoelectronics, Magurele-Bucharest, ROMANIA

Resume : Microstructure, morphology and mechanical properties of hard coatings deposited by plasma assisted PVD techniques are known to strongly depend on the energy and current density of the ions impinging onto the substrate. In this paper, we report the results of an investigation of the influence of ion bombardment during arc plasma TiSiC/a-C:H deposition on the main film characteristics. The coatings were deposited on Si and various types of steel, using a filtered cathodic arc unit equipped with two TiSi cathodes. The reactive atmosphere consisted of a mixture CH4 and Ar gases and the working pressure was varied between 2x10-2 and 10-1 Pa. Film characterization consisted of Auger electron spectroscopy (AES), X-ray diffraction (XRD) and morphology (AFM) investigations, residual stress, adhesion, hardness and wear measurements. Various substrate current densities (in the range 1 – 6 mA/cm2) were obtained by using 1 or 2 plasma generators (1 – 2 arc cathodes). In order to keep constant elemental composition of the films, higher methane flow rates were used when employing two cathodes instead of one. The variation of substrate bias voltage from -50 to -220 V resulted in an increase in ion energies at the substrate and also in a slight enhancement in current density. Regarding the influence of the ion

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flux parameters, the coating characteristics have been shown to depend mainly on the intensity of the ion bombardment. For coatings with the same carbon content, an increase in the current density led to a significant improvement of the film quality (hardness enhancement and residual stress diminution).

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(close full abstract)

14:00 Comparative study of DLC films deposited by Thermoionic Vacuum Arc and Magnetron Sputtering methods

Authors : R.Vladoiu1, A.Mandes1, V.Dinca1, M. Contulov1, G.Musa1, C.E.A. Grigorescu2, V.Braic2, I.C. Vasiliu2, M.Braic2 1Department of Physics, Ovidius University, Constanta, 900527, Romania 2National Institute for Optoelectronics, Bucuresti 077125, Romania

Resume : The physical and mechanical properties of of DLC films make them suitable for a variety of applications, many of them exploiting the attractive characteristics of DLC. The aim of this paper is to make a comparative analysis of the different characteristics of the DLC coatings obtained by two deposition methods: Magnetron Sputtering (MS) and Thermionic Vacuum Arc (TVA). The films were extensively analyzed for elemental composition (Auger Electron Spectroscopy), chemical bondings (X-ray Photoelectron, Raman and FTIR spectroscopies), mechanical properties (surface roughness, residual stress, hardness and adhesion). A special attention has been paid to the tribological (friction coefficient and wear resistance) and hydrofobic characteristics of hydrogenated and non-hydrogenated DLC coatings obtained by the two methods.

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(close full abstract)

14:00 CARBON NANOCOMPOSITE FILMS DEPOSITED BY ELECTRON-BEAM EVAPORATION AND THEIR EMISSION PROPERTIES.

Authors : Evtukh, V. Litovchenko, T. Gorbanyuk, M. Semenenko, V. Solntsev, Institute of Semiconductor Physics, 41 prospect Nauki, 03028, Kiev, Ukraine, and B. Movchan, Yu. Kurapov, International Center of Electron-Beam Technologies of Paton Institute of Electrowelding, 68 Gorkiy str., 03150, Kiev, Ukraine.

Resume : The optimization of electron beam deposition technology for obtaining of nanocomposite carbon films suntable for electron field emission has been performed. Imporntant advantage of used deposition method is high productivity. The temperature of substrate during deposition was varied as a parameter. As a substrate were used silicon wafer with Fe or Ni catalyst. The Fe catalyst was deposited by electrochemical method from FeSO4 with following annealing for FeO clusters formation and Ni one by magnetron spattering. The catalyst promotes the carbon nanostructured film formation. It was shown that carbon nanostructured films are effective electron field mission cathodes. In case of substrate with Fe catalyst to obtain the efficient electron emission the temperature at carbon-based film deposition has to be T>365C. On the other hand at using of magnetron sputtered Ni film as a catalyst the substrate temperature at electron-beam deposition of nanocomposite carbon film can be significantly lower T>170C. The efficient field emission from carbon nanostructured films is realized at low enough effective threshold fields E=1.5x10E5 V/cm. Repeated measurements of electron field emission point out on conditioning process during electric current flow that improves the emission parameters (lowering of threshold voltage, growth of emission current,etc.).

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(close full abstract)

14:00 Optical properties of polyfluorene derivative/ cadmium selenide quantum dot nanpocomposites

Authors : M. Zemmouri 1, P. Le Rendu1, H. C. Le2, R. Capek3, I. Moreels3, Z. Hens3, T. P. Nguyen1 1 Institut des Matériaux Jean Rouxel, Université de Nantes, CNRS, 2 rue de la Houssinière, BP32229, 44322 Nantes Cedex3, France 2 Faculty of Engineering Physics & NanoTechnology, College of Technology, 144 Xuan Thuy Road, Hanoi, VietNam 3 Physics and Chemistry of Nanostructures, Ghent University, Krijgslaan 281-S12, 9000 Gent, Belgium

Resume : Due to their very small size, semiconductor quantum dots (QDs) have unique optical and electronic properties that allow their applications in light emission devices. Incorporation of QDs into luminescent polymers offers a convenient way to tune the wavelength of emission by changing the size of the particles. In the present study, we have investigated nanocomposites made by using poly(9,9-di(2'-ethylhexyl)fluoren-2,7-yleneethylylene) (PF)) as a host polymer and cadmium selenide (CdSe) quantum dots as a guest material. CdSe were prepared by a wet chemical synthesis, yielding a suspension of Q-CdSe in toluene that was mixed with a PF solution in different proportions. Thin films of composites with different QDs concentrations were deposited by spin coating toluene solutions and their optical properties were investigated. Pristine PF films exhibit blue emission of main wavelength at 470 nm. With increasing QD concentrations, modifications of the spectrum were observed by a change of the shape of the polymer components together with the onset of a QD component at 573 nm. The electronic structure of the polymer did not change however, as proved by Raman spectroscopy performed on doped samples. From scanning electron microscopy (SEM), we observed that the QDs aggregate, forming small islands in the composites at high QDs concentrations. Investigations of light emitting devices using the composites as an active layer are currently carried out.

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(close full abstract)

14:00 Optical properties of poly(2-methoxy,5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene)-zinc oxide nanpocomposites

Authors : T. P. Nguyen1, T. T. Cuong2, M. R. Philips2 1 Institut des Matériaux Jean Rouxel, Université de Nantes, CNRS, 2 rue de la Houssinière, BP32229, 44322 Nantes Cedex3, France 2 Department of Physics and Advanced Materials, University of Technology Sydney, P. O. Box 123, NSW 2007, Australia

Resume : Hybrid nanocomposites made by incorporating inorganic nanoparticles into conjugated polymer matrices exhibit high physical properties, which have enabled their applications in several industrial fields such as optoelectronics and organic photovoltaic cells [1]. In the present study, we have investigated the nanocomposites made by using poly(2-methoxy,5-(2'-ethyl-hexyloxy)-1,4-phenylene vinylene) (MEH-PPV) as a host polymer and zinc oxide particles of 25 nm size as a guest material. Thin films of composites were deposited by spin coating toluene solutions and their optical properties were investigated. From photoluminescence (PL) measurements, a blue shift of the emission spectrum was observed, which varies with the particles concentration. Because of the particles size used in this experiment, quantum size effects are excluded. Moreover, Raman

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spectroscopy performed on pristine and doped polymers show clearly that no significant structural changes of MEH-PPV have occurred. From X-ray photoelectron spectroscopy results, we explain the observed PL shift by the establishment of an electric field in the vicinity of the particle surface, which contains oxygen vacancies and facilitates the charge transfer between the host and guest materials. [1] C. Sanchez, B. Julian, P. Belleville, M. Popall, J. Mater. Chem. 15, 3359 (2005).

add to my program (close full abstract)

14:00 Photoconductivity of multi walled CNT deposited by CVD

Authors : U. Coscia1,2,3, G. Ambrosone2,3,4, A. Ambrosio2,3,4, M. Ambrosio2, V. Carillo2,3, P. Maddalena2,3,4, M. Passacantando5, E. Perillo2,3, A. Raulo2,3, S. Santucci5. (1) CNISM-Unità di Napoli, Complesso Universitario di Monte Sant\'Angelo, Via Cintia, I-80126 Napoli, Italy (2) I.N.F.N. Sezione di Napoli, Complesso Universitario di Monte Sant\'Angelo, Via Cintia, I-80126 Napoli, Italy (3) Dipartimento di Scienze Fisiche, Università di Napoli Federico II, Complesso Universitario di Monte Sant\'Angelo, Via Cintia, I-80126 Napoli, Italy (4) CNR-INFM CRS-COHERENTIA, Complesso Universitario di Monte Sant\'Angelo, Via Cintia, I-80126 Napoli, Italy (5) Dipartimento di Fisica and INFN, Università dell\'Aquila, Via Vetoio 10 Coppito, 67010 L\'Aquila - ITALY

Resume : In the last years optical and electrical properties of the carbon nanotubes (CNT) have been widely investigated in view of their device applications such as ultra fast optical switching, photo detectors and solar cells. Photoconductivity (PC) upon laser illumination has been widely studied in thin single wall carbon nanotubes (SWCNT) while much less is known about multi walled CNT (MWCNT). In this paper we present results on the steady state PC of relatively large area layers (4x4 mm2) of MWCNTs upon white light and monochromatic incident radiation. Samples have been prepared by CVD technique from acetylene – ammonia mixture at substrate temperature of 550 and 700 °C. Films, formed by interconnected CNT, have been grown on a sapphire substrates. The electrical measurements have been performed in coplanar configuration by means of two gold electrodes deposited on the top surface of MWCNT. PC of the samples exposed to white light radiation increases linearly as function of the bias voltage as well as power density radiation, in the range of -40 to + 40 V and of 10 to 700 mW/cm2, respectively. The I-V characteristics under monochromatic radiation show approximately the same trends of those obtained under white light illumination. The spectral response in the range 400-850 nm decreases as function of wavelength of the incident radiation according to the absorbance derived from spectrophotometric measurements.

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14:00 Optical properties of amorphous carbon of Deuterated Diamond-Like-Carbon (DDLC) thin films

Authors : N.Mathis a, C.Meunier a, G.Guibert b, S.Mikhailov b a : FEMTO-ST, CNRS-UMR 6174, 4 place Tharradin, BP 71427, 25211 Montbéliard , France b : CAFI, NEODE, 17 éplatures-grises, CH 2300, La Chaud de Fond, Switzerland.

Resume : This present study aims to determine the hydrogen influence on the electrical gap of Diamond-Like-Carbon (DLC) film. DLC thin layers were deposited on silicon wafer by Plasma Enhanced Chemical Vapour Deposition (PECVD) and Filtered Cathodic Vacuum Arc (FCVA). With theses methods we obtain a-C:H or D and ta-C:D film structure. To understand the mechanisms of the deposition, the local structure and the hydrogen effect in the DLC films, we replace our methane plasma gas by deuterated methane one. In this article, hydrogen content is obtained by Elastic Recoil Detection Analysis (ERDA), bulk densities are calcultated from the electron density in the X Ray Reflectometry (XRR) data, the qualification of the threefold and fourfold carbon atoms (sp2 and sp3) are performed by Raman and X-ray photoelectrons (XPS) spectroscopies and the determination of optical gap is carried out using Ultraviolet-Visible absorption spectrometry and ellipsometry. A detailed attention is paid to the self bias voltage and time variations to get different DLC and D-DLC film compositions and also different electrical properties. We find that replacing hydrogen by deuterium in amorphous carbon increases the Tauc energy of the films while keeping the same densities and the same threefold/fourfold carbon atoms ratios to them.

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add to my program (close full abstract)

14:00 Optical properties of hydrogenated amorphous carbon thin films obtained by PECVD

Authors : A.C. Galca1, C. Stancu2, C.S. Petrone1, R. Pascu2, B. Mitu2, M. Filipescu2, M. Dinescu2, G. Dinescu2 1. National Institute of Materials Physics, Atomistilor 105bis, PO-Box MG-7, 077125, Magurele, Romania 2. National Institute for Lasers, Plasma and Radiation Physics, Atomistilor 409, PO-Box MG-16, 077125, Magurele, Romania

Resume : Optical properties of hydrogenated amorphous carbon thin films have a great importance mainly due to a-C:H potential application in optical devices. Moreover, the dielectric function of the host matrix is prerequisite for the further optical analysis of the CBNC films. Hydrogenated amorphous carbon films were obtained by PECVD with carbon species supplied by acetylene gas injected into argon remote plasma generated by an expanding radiofrequency discharge. The optical properties of obtained thin films are presented. The spectroscopic ellipsometry measurements in a wide spectral range,1-5 eV, made on films deposited on Si and Al substrates, give the dielectric function of a-C:H material and its optical band gap. Complementary FTIR spectroscopy and AFM measurements give information about the chemical structure and topography. The thicknesses of the films determined by step-AFM and ellipsometry are in accordance with each other.

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14:00 Light-emitting properties of amorphous Si:C:O:H layers fabricated by oxidation of carbon-rich a-Si:C:H films

Authors : A.V. Vasin, V.S. Lysenko, A.N. Nazarov, G.Yu. Rudko Lashkaryov Institute of Semiconductor Physics, Kiev, Ukraine Y. Ishikawa Japan Fine Ceramics Center, Nagoya, Japan

Resume : Amorphous hydrogenated carbon-rich silicon-carbon alloy films (a-Si:C:H) was deposited by reactive magnetron sputtering of silicon target in argon-methane gas mixture. After the deposition the samples were thermally treated at 4500C for 30 minutes in Ar+H2O and O2 flow. As-deposited film exhibited white-green photoluminescence (PL) well visible to the naked eye at room temperature under Ar+ (351 nm) irradiation. After thermal treatment in wet Ar intensity of the white-green PL increased by factor of about 7. Thermal treatment in dry oxygen causes increasing of the light-emission intensity by a factor of about 10 and PL became blue-white. Measurements of PL intensity as a function of temperature for as-deposited film showed rapid drop of the IPL(T) as the temperature increased from 4.2 to 15 K followed by slow decrease at higher temperatures. IPL

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(T) of the samples thermally treated in wet Ar exhibited complicated behavior with drop in range of 4.2–15 K followed by increase with maximum at about 50 K and monotonic decrease at higher temperatures. Dry oxidation resulted in IPL(T) with small increase as T increased up to about 50 K followed by tendency to decrease. XPS and FTIR measurements give an evidence of formation of a-SiOx/C:H nano-composite material after oxidation treatments. Higher fraction of silicon oxide was found after the dry oxidation. The physical mechanisms that can be involved in strong enhancement of visible photoluminescence in Si:C:O:H layers are discussed.

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14:00 A STUDY OF THE CRYSTALLYZATION PHASE OF INTRINSIC AND PHOSPHORUS-DOPED a-SiCx:H LAYERS BY ANNEALING AT HIGH TEMPERATURES

Authors : I. Torres1, O. Gualdron2 and E. Pabon1. 1)Grupo de Investigación LOGOS, Departamento de IEEST, Facultad de Ingenierías y Arquitecturas Universidad de Pamplona, Km 1 Vía a Bucaramanga, Pamplona(N/S)-Colombia. 2)Instituto IIDTA, Vicerectoría de Investigaciones, Universidad de Pamplona, Km 1 Vía a Bucaramanga, Pamplona(N/S)-Colombia.

Resume : This paper deals with the crystallization phase and changes in the optical properties of the carbon layers of hydrogenated amorphous silicon (a-SiCx:H) 300 and 100 nm-thick after a process of annealing at high temperatures (900 ºC) using X-ray diffraction equipment (XDR) with a temperature camera. Both, intrinsic and phosphorus-doped amorphous silicon carbide layers (a-SiCx:H) were deposited using the technique of plasma enhanced chemical vapour deposition (PECVD) at 400 ºC on a crystalline silicon substrate (c-Si) type-p of 300 um-thick and crystallographic orientation <100>. To determine the change of amorphous to crystalline and to confirm the random formation of nanocrystals in intrinsic and phosphorus-doped a-SiCx:H layers in-situ measures are used during the annealing process at 900 °C with XRD equipment where a typical peak in an angle of 2(theta)=27º is formed. The presence or absence of nanocrystals in the amorphous and crystallized layer is verified by the measurements of the transmission spectrum using fourier transform infrared spectroscopy equipment (FTIR) in the range of 1500–9000 cm-1. From the fitting of the experimental curves the refractive index (n) and the extinction coefficient (k) of the different layers are obtained.

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14:00 Dispersion of elementary excitations in graphene sheets and graphite crystals

Authors : V.O.Gubanov, L.O.Komarova, M.M.Biliy, S.V.Kovrygin, L.Yu.Matzui Kyiv National Taras Shevchenko University, Department of Physics, Volodymyrs'ka str., 64, Kyiv, Ukraine

Resume : Raman scattering spectra of first and second orders of graphene sheets and the graphite monocrystals have been experimentally investigated. Dispersion of phonon excitations has been established on the basis of analysis of fine structure of experimentally obtained second order Raman spectra. These spectra has been interpreted with the help of the construction of onesignificant projective representations of wave vector groups for various Brillouin zone points of graphene and graphite crystal. For the first time the standard factor-systems for all eight projective classes of symmetry group D6h have been constructed. It is shown that the phonon excitations in point A of Brillouin zone of graphite crystals are classified with onesignificant projective representations of projective class K5 and the electronic excitations in this point – with twosignificant projective representations of projective class K4. In point H of Brillouin zone of graphite crystals projective classes for phonon and electronic excitations are K1 and K0 respectively. It is shown that the presented classification unambiguously determines the dispersion curves, compatibility conditions and degeneracy multipleness of phonon and electron excitations in all Brillouin zone points of graphene and graphite crystals. The computer calculations of energy spectra of elementary excitations for graphene have been obtained.

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14:00 Structural investigation of metal-doped carbon films

Authors : M. Balden 1, C. Adelhelm 1, M. Rasinski 1, M. Sikora 2, E. Welter 3, M. Rinke 4, M. Stüber 4 1 Max-Planck-Institut für Plasmaphysik, EURATOM Association, D-85748 Garching, Germany, 2 European Synchrotron Radiation Facility, 6 rue Jules Horowitz, 38043 Grenoble, France 3 HASYLAB at DESY, Notkestrasse 85, D-22607 Hamburg, Germany 4 Forschungszentrum Karlsruhe, Institute of Materials Research I, D-76344 Eggenstein-Leopoldshafen, Germany

Resume : Amorphous metal-doped carbon films (a-C:Me) deposited by magnetron sputtering at RT and no bias were characterized by XAFS, XRD, Raman, TEM and IBA to obtain information about the bond state of the metal and the carbon and the distribution of the metal. The influence of metal type (Me=W, Ti, V, Zr), concentration (<15 at%) and annealing temperature (up to 1300 K), e.g., on the formation of carbide phase and crystallite size were investigated. The metal has carbide-like bonding and is mainly distributed atomically disperse in amorphous environment after deposition. Annealing leads to formation of carbide crystallites of several nm; the size generally increases with annealing temperature, concentration, and type (ZrC

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14:00 Quantitative study of Au nanoparticles sandwiched between carbon layers using HAADF-STEM and GISAXS

Authors : D. Lantiat,1 S. Camelio,1 A. Michel,1 M. Drouet,1 J.P. Simon,2 and D. Babonneau1 1 Laboratoire de Métallurgie Physique, CNRS/Université de Poitiers, 86962 Futuroscope Chasseneuil, France 2 SIMAP, CNRS/INPG/UJFGrenoble, 38402 St Martin d'Hères, France

Resume : The control of the shape and organization of metallic nanoparticles embedded in nanocomposite films is of great interest for both fundamental and technological reasons (high-density magnetic data storage, optical devices, etc.). Our study is focused on the investigation of Au nanoparticles sandwiched between amorphous carbon layers grown by alternate ion-beam sputtering deposition at room temperature. Quantitative analysis of high-angle annular dark-field images obtained in a scanning transmission electron microscope (HAADF-STEM) and of grazing incidence small-angle X-ray scattering patterns (GISAXS) are used to determine the size distribution (diameter and height) and in-plane organization of the nanoparticles. Our results show that the height of the individual nanoparticles increases linearly with their in-plane diameter. This behaviour, which is believed to originate from anisotropic growth mechanisms, yields a height distribution smaller than the diameter distribution. In the framework of this study, we thus emphasize that under precise and correct analysis, the combination of HAADF-STEM and GISAXS

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experiments provides valuable information for investigating nanostructured composite films.

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14:00 Nanocomposite Ti/hydrocarbon plasma polymer films for biomedical applications

Authors : A. Grinevich 1, A. Choukourov 1, L. Grausová 2, V. Lisá 2, L. Bačáková 2 1 Department of Macromolecular Physics, Faculty of Mathematics and Physics, Charles University, Prague, Czech Republic 2 Department of Cell Growth and Differentiation, Institute of Physiology, Academy of Sciences of the Czech Republic, Prague 4-Krč, Czech Republic

Resume : DC magnetron sputtering of titanium target in n-hexane, argon or a mixture of these two gases was applied to deposit nanocomposite Ti/hydrocarbon plasma polymer films. The titanium content was controlled between 3 and 20 at. % by adjusting the argon/n-hexane ratio in the working gas. The resultant films were heterogeneous with inorganic regions of nanometer scale distributed within a plasma polymer matrix. The inorganic clusters are composed of TiO2, sub-stoichiometric titania and titanium carbide as detected by XPS. With increasing Ti content, the surface potential and hardness increase as measured by Kelvin Force Microscopy and Visco-Elastic Atomic Force Microscopy, respectively. Biological response of the nanocomposite Ti/hydrocarbon plasma polymer films was studied in terms of adsorption of proteins and cells. Fibrinogen adsorbs on the Ti/hydrocarbon plasma polymer films as a very soft layer with fibrinogen molecules adhering stronger to the Ti-rich films. Ti-deficient and Ti-rich films proved equally good substrates for adhesion and growth of cultured human osteoblast-like MG 63 cells. Furthermore, for bovine pulmonary artery endothelial cells of the line CPAE the cell population densities, the spreading area and the concentration of von Willebrand factor were significantly higher on Ti-rich than on Ti-deficient films. Thus, such films are promising candidates for coating bone implants and enhancing the endothelialization of blood contacting artificial materials.

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14:00 Plasma deposition of TiC/a-C:H multilayer with Ti-TiC graded interlayer

Authors : Mihai Balaceanu, Viorel Braic, Mariana Braic, Catalin Nicolae Zoita, Adrian Kiss, Alina Vladescu, National Institute for Optoelectronics, Magurele-Bucharest, Romania

Resume : To solve the problems related to high internal stress and poor adhesion of amorphous carbon films, the incorporation of small amounts of various metals (Ti, Cr, W, Mo etc.) in the film composition has been proved to be a successful solution. Such coatings have shown to possess high hardness and low coefficients of friction, being deposited on various workpieces. The aim of this paper is to investigate the main characteristics of a multilayered structure based on metal – containing carbon films. It consists of a Ti inner layer, four graded TiCx intermediate layers and a top multilayer formed by alternating TiC/a–C:H layers. The depositions were carried out on Si and steel substrates by the cathodic arc technique in a CH4 Ar reactive atmosphere, using a deposition unit equipped with two cathodes made of Ti and C. The individual layers (TiCx and a–C:H) were characterized in terms of elemental composition and chemical bonding state by AES, XPS, RBS, FTIR and Raman methods. The multilayer structure was analyzed for mechanical and tribological properties (hardness, adhesion, modulation periodicity, surface roughness, internal stress, friction coefficient and wear resistance). Research carried out showed that the characteristics of the C – based multilayered coatings were dependent on the bilayer period of the TiC/a–C:H sub-structure and on the substrate bias voltage. The multilayers investigated exhibited superior adhesion, hardness and tribological behavior as compared to the a–C:H films, so that it should perform well in tribological applications.

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14:00 Carbon – metal (Ti) nanocomposite thin films for functional applications

Authors : K. Sedlácková*1,2, R. Grasin1, M. Szerencsi1, I. Bertóti3, G. Radnóczi1 1 Research Institute for Technical Physics and Materials Science, Konkoly-Thege M. út 29-33, 1121 Budapest, Hungary 2 Institute of Electrical Engineering, Dúbravská cesta 9, 84101 Bratislava, Slovakia 3 Research Institute of Materials and Enviromental Chemistry, Chemical Research Center, P.O. Box 17, 1525 Budapest, Hungary

Resume : Carbon-based nanocomposite thin films have large application potential because they possess unique mechanical properties, relatively high hardness, high elasticity, and a low friction coefficient. Modern methods of vacuum deposition provide great flexibility for manipulating material chemistry and structure, leading to films and coatings with special structure and properties. A combination of carbon films with metallic nanoparticles in a nanocomposite can enhance certain physical properties. In the present work C-Ti nanocomposite films were investigated. TiC is exhibiting good corrosion resistance and high hardness, is widely used as a coating for cutting tools, wear parts and protective coatings. TiCN films are widely used for cutting tools, in parallel with relatively modern protective coatings mainly for their chemical stability and superior mechanical properties. Ti-based alloys are widely used for orthopaedic implants because of the high biocompatibility of titanium and its high corrosion resistance. C-Ti and TiCN thin films were prepared by simultaneous dc magnetron sputtering from two sources (C, Ti) in argon and nitrogen at various deposition temperatures (25 to 800˚C) and different input powder of Ti magnetron (10W, 40W). All the films consisted of the TiC or TiCN columns 10 – 20 nm wide embedded in a carbon matrix with various structures (disordered, graphite-like). Thickness of the carbon matrix between adjacent TiC columns was between ~ 1 – 5 nm. Mechanical and wetting and electrical properties of the films were correlated with structural and surface morphological properties. Mechanical properties of C-Ti films showed a distinct variation on the deposition temperature. Films deposited at 200˚C had the highest hardness of ~18 GPa and the highest reduced modulus ~ 210 GPa.

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14:00 Synthesis of N=N double bond functionalized mesoporous graphite monoliths and their use as metal-free hydrogenation catalysts.

Authors : Philippe Makowski1, Frederic Goettmann1,2, Arne Thomas1 and Markus Antonietti1 1 Max-Planck-Institute of Colloids and Interfaces, Research Campus Golm, Potsdam, 14424, Germany 2 Institut de Chimie Séparative de Marcoule, UMR 5257, ICSM Site de Marcoule, BP 17171, Bagnols sur Ceze, 30207, France.

Resume : Mesoporous graphite monoliths were synthesized by infiltrating silica monoliths with a saturated THF solution of mesophase pitch. The infiltrated silica monoliths were pyrolysed at 750°C under nitrogen. The resulting hybrids yielded, after etching of the silica, graphite monoliths

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featuring a bimodal pore distribution and high specific surface areas from 300 to 1000 m².g-1. These monoliths were then treated with pyridazine at 180°C for 120 h (5 jours). This treatment increased the average nitrogen content of the solid from 0.5 wt% to 8 to 10 wt% (les % sont en masse) without noticeably altering its pore structure or specific surface area (the structure is not changing according to SEM pictures below but we observe a drop in the specific surface and in the average pore size after functionalization). The presence of N=N double bonds in the resulting material was evidenced by FT-IR. Theoretical investigations indicted that such a material could be a potential metal-free hydrogenation catalyst, which was further demonstrated by the hydrogenation of benzaldehyde to benzyl alcohol at 150 °C under 60 bars of hydrogen. Keywords: Organocatalysis, Nitrogen rich material, Hydrogenation. 20

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14:00 Corrosion Behaviour of Dublex DLC Treated 316L Stainless Steel and Ti6Al4V Alloy Using as Implanted Materials

Authors : A.F. Yetim, Atatürk University, Turkey A. Alsaran, Atatürk University, Turkey A. Celik, Atatürk University, Turkey I. Efeoglu, Atatürk University, Turkey

Resume : 316L and Ti6Al4V are widely used as biomaterials and materials of construction. In biomedical applications, they are used as coronary and pulmonary stents, hip prosthesis, screws and external fixations. However, Cr, Al and V are released from the alloys inside the body and these ions mix in the main body stream. The release of even small amounts of these ions may cause local irritation of the tissues surrounding the implant. This situation may be prevented by the suitable surface treatments. The overall objective of the present paper is to examine the corrosion properties of duplex nitriding/DLC treated 316L stainless steel and Ti-6Al-4V alloy. DLC films were deposited on nitrided samples using CFUBMS (Closed Field Unbalanced Magnetron Sputtering) system. Corrosion behavior of the duplex treated samples is tested by potentio-dynamic method in ringer solution at 37°C. The corrosion resistance of duplex treated samples significantly improved relative to the uncoated and single treated samples. In addition, the corroded surfaces are investigated by SEM. The all treated samples were subjected to local pitting corrosion and small pits observed on the samples. A6 21

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(close full abstract)

14:00 Friction Force Microscopy Study of Annealed Diamond-like Carbon Film

Authors : Won Seok Choi1, Jinhee Heo2, Hyun-Suk Hwang3, Byungyou Hong4 1 Department of Electrical Engineering, Hanbat National University, Daejeon 305-719, Korea 2 Division of national R&D program, Korea Science and Engineering Foundation, Daejeon 305-340, Korea 3 Division of Fusion Technology, Korea Institute of Ceramic Eng. & Tech., Seoul 153-801, Korea 4 School of Information and Communication Engineering, Sungkyunkwan University, Suwon 440-746, Korea

Resume : Diamond-like carbon (DLC) films were prepared on silicon substrates by the RF PECVD (Plasma Enhanced Chemical Vapor Deposition) method using methane (CH4) and hydrogen (H2) gas. We examined the effects of the post annealing temperature on the tribological properties of the DLC films using nano-indenter and friction force microscopy (FFM). The films were annealed at various temperatures ranging from 300 to 900 oC in steps of 200 oC using RTA equipment in nitrogen ambient. The variation of structure according to the annealing treatment was examined using X-ray photoelectron spectroscopy (XPS) and high-resolution transmission electron microscopy (HRTEM). The surface morphology and surface energy of the films were examined using atomic force microscopy and contact angle measurement, respectively. The hardness of the DLC film was measured as a function of the post annealing temperature using a nano-indenter. The tribological characteristics were investigated by nano-indenter and atomic force microscopy in FFM mode. A6 22

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14:00 The tribological behaviour of W-containing DLC nanocomposite coatings

Authors : C.W. Moura e Silva a, J.R.T. Branco a, T.Polcar b,c, A. Cavaleiro b a REDEMAT/CETEC - Laboratório de Engenharia e Modificações de Superfícies, CETEC, 31.170-000, Belo Horizonte, Minas Gerais, Brazil b SEG-DEMUC, Mechanical Engineering Department, University of Coimbra, P-3030-788 Coimbra, Portugal c Department of Applied Mathematics, Faculty of Transportation Sciences, CTU in Prague, Czech Republic

Resume : In this study, the influence of the addition of W and H to pure DLC coatings on the structural, mechanical and tribological properties will be presented. The coatings were deposited by r.f. magnetron sputtering from a C target embedded with a different number of W pellets. Working in non-reactive or reactive atmosphere allowed to deposit H-free or H-containing coatings, respectively, on steel and Si substrates. A Cr adhesion interlayer was interposed between the films and the substrate. Films with W content from 0 to 12 at.% were deposited. For W contents close to 10 at.%, H was incorporated up to a maximum value close to 40 at.%. All coatings had an amorphous structure, although vestiges of crystallinity could be detected in W-containing films. The addition of W led to a significant hardening of the DLC coating (from ~10 to 18 GPa); inversely, with H incorporation the hardness drop down to values even lower than that of pure DLC films. It was possible to establish a good correlation between the hardness and the residual stresses. In spite of the significant changes in the tribological performance when alloying DLC with W (decreasing of friction and wear coefficients) almost no difference was found among the W-DLC films whatever the W content was. A similar trend was achieved with the H addition. However, in this case a decrease in the friction coefficient was registered whereas the wear rate increased. The best performance concerning the friction was obtained for a H-containing coating (0.05) whereas, for the wear resistance, H-free W-DLC films were better performing (0.3 x 10-16 m3.N-1.m-1). A6 23

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14:00 Hard coatings for wood machining tools coated by an arc processes

Authors : B. Warcholinski, A. Gilewicz, Z. Kuklinski, P. Myślinski, J. Staskiewicz, W. Gulbinski Koszalin University of Technology, Institute of Mechatronics, Nanotechnology and Vacuum Technique

Resume : The increasing importance of the wood industry is the impulse to improve the tools for wood machining. The main difficulties in the wood machining came from differences in physical and chemical structure of wood and metals. The materials currently applied in wood machining are hardened steel, high speed steel (HSS), carbides and polycrystalline diamond. An option for them are the HSS tools with hard thin films covering the cutting surfaces. Those films can be deposited

either as mono- or multilayers of CrN, CrCN and amorphous carbon films, a-C, ta-C, often named diamond-like carbon (DLC). These films show high hardness, good adhesion to the steel substrates, low friction coefficient and low wear rate in the technological processes of wood machining. In this paper, the results of studies on mono- and multi-layered films of CrN and CrCN deposited by cathodic arc evaporation method and DLC coatings deposited by pulsed arc method worked out by INOVAP Dresden are presented. The hardness, adhesion to the substate and tribological properties of these films deposited on hardened and tempered HSS substrates were investigated. The hardness was estimated by Vickers method and adhesion using scratch method with Revetest apparatus or Rockwell method. The tribological and wear tests were carried out in a pin-on-disc geometry at room temperature and normal humidity. The measurements carried out on this films pointed to higher hardness of multilayer films CrCN/CrN - 25 GPa, depending on carbon content in them with reference to CrN film - GPa. DLC coatings show much higher hardness - 40 GPa. The adhesion of CrCN/CrN - 120N films is better CrN film - 90N. Friction coefficient for CrN film - 0.6 is higher than for CrCN/CrN films - 0.55 and much higher than for DLC films – 0.1. A6 24

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14:00 The Tribological Properties of Sintered Friction Materials with Ceramic Abrasives

Authors : Yong-Taeg O, Seok-Eui Choi, Myung-Soon Kim, Hee-Bum Choi, Hang-Rae Kim, Geun-Joong Jung, Dong-Chan Shin Department of Advanced Materials Engineering, Chosun University, Gwangju, 501-759, Korea. FRIXA, 172 Guryong-ri, Byolyang-myon, Suncheon,540-871, Korea Advanced Materials Research Team, Hankook Tire, 23-1 Jang-dong, Yuseong-gu, Daejon, 305-725, Korea

Resume : The friction performance of sintered Friction materials with different ceramic abrasives was investigated. To evaluate the tribological properties four kinds of specimens with different ceramic abrasives were manufactured by newly developed sintered materials based on copper and carbon for this study. Specimens had different ceramic abrasive componets as silicon carbide(SiC), zircon silicate($ZrSiO_4$), Zinc oxide(ZrO_2), and Alumina(Al_2O_3), while the contents of other components of lubricants and fillers was kept to be constant. The specimens were manufactured by using vacuum hot pressing and hot isostatic pressing. They were tested on a 1/5 scale dynamometer. Effectiveness, fade & recovery, and Noise tests were carried out to analyze the friction characteristics. To analyze friction stability and wear rate of the three friction materials in high temperature, we developed the new test method. After the test, we observed transfer film formation on the rotor surface by SEM and the EDX analysis. It was found that the friction materials with SiC showed good wear resistance and friction stability compared to the others. A6 25

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Optical properties II : Gilles Dennler, Thien-Phap Nguyen

16:30 Optoelectronic properties of nanodiamond carbon: a tight-binding study

Authors : C. Mathioudakis,(1) G. Kopidakis,(1) and P.C. Kelires(2,3) (1) Department of Materials Science and Technology, University of Crete, P.O.Box 2208, 71003 Heraclion, Crete, Greece (2) Department of Materials Science and Engineering, Cyprus University of Technology, P.O.Box 50329, 3036 Limassol, Cyprus (3) Physics Department, University of Crete, P.O.Box 2208, 71003 Heraclion, Crete, Greece

Resume : We study the electronic and optical properties of diamond nanocrystals embedded in amorphous carbon using tight-binding molecular dynamics simulations. We calculate the electronic density of states, the dielectric function, the optical band gaps, and the Urbach energy E_U, which is a measure of structural and topological disorder in the material [1]. By separating the nanodiamond contributions from those of the amorphous matrix (AM), we show that the gap and the absorption is mainly controlled by the properties of the AM (density and sp^3 fraction) rather than the size and density of the nanoinclusions. Large values of the E_U are found, originating both from the nanodiamond and the AM contributions, indicating that significant disorder exists at the interface of the two components. We discuss possible optimum structural conditions which can minimize the disorder, in order to produce stable nanocomposites with the desired mechanical and optical properties. [1] C. Mathioudakis, G. Kopidakis, P. Patsalas, and P.C. Kelires, Diam. Relat. Mater. 16, 1788 (2007). A7 1

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16:50 Structural and optical properties of diamond like carbon thin films deposited by pulsed DC plasma enhanced CVD technique

Authors : D.K. Rai(b), Debjit Datta(a), Sanjay K. Ram(a), Surajit Sarkar(a), Paramananda Biswas (a), Rajeev Gupta(a,b) and Satyendra Kumar(a) (a)Department of Physics and Samtel Centre for Display Technologies, Indian Institute of Technology Kanpur, Kanpur-208016, India (b)Materials Science Programme, Indian Institute of Technology Kanpur, Kanpur-208016, India

Resume : In the field of plasma display panels (PDP) technology, the choice of material for dielectric emissive protective layer coating on the front panel is a key issue. Diamond like carbon (DLC) thin films are being investigated for such applications due to their high secondary electron emission (SEE) yield, which results in lowering of ignition voltage and increase in the life time of the panel. DLC films have certain advantages over other dielectric materials like MgO with respect to film stability in ambient environmental conditions, while being somewhat inferior in optical properties. In this paper, we report on our study of DLC films deposited by DC and pulsed DC plasma enhanced chemical vapor deposition technique for their suitability as dielectric layer coatings in PDPs. The films were investigated using spectroscopic ellipsometry, Raman spectroscopy, energy dispersive X-ray, optical transmission, scanning electron microscopy and atomic force microscopy techniques. Fourier transform infrared spectroscopy was used to examine the hydrogen content, absorption coefficient (□) and sp3 /sp2 ratio. The influence of deposition conditions (pressure, frequency, power of pulsed DC and hydrogen dilution in gas mixture) and techniques (constant DC and pulsed DC) on the optical and structural properties, and on the SEE yield of these films are discussed. A7 2

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17:10 Optical and photoelectric properties of nanostructured hybrid films based on functional fullerenes and metal nanoparticles

Authors : N. Dmitruk^1, O. Borkovskaya^1, S. Mamykin^1, D. Naumenko^1, N. Berezovska^2, I. Dmitruk^2, V. Meza-Laguna^3, E. Alvarez-Zauco^3, E. Basiuk^3,4 ^1 Institute for Physics of

Semiconductors, NAS of Ukraine, Kyiv, Ukraine; ^2 National Taras Shevchenko University of Kyiv, Kyiv, Ukraine; ^3 Centro de Ciencias Aplicadas y Desarrollo Tecnológico, Universidad Nacional Autónoma de México, México; ^4 School of Materials Science and Engineering, University of New South Wales, Sydney, Australia

Resume : The chemically cross-linked C60 thin films capable of binding Ag or Au nanoparticles were prepared by the gas-phase treatment with diamine for one set of samples and dithiol for another one and decoration with Ag or Au nanoparticles, respectively. The optical and photoelectric properties of the obtained nanostructured hybrid films in comparison with the undecorated films were studied. The photoluminescence (PL) spectra were measured in 4.2–300K temperature range. The low temperature PL spectra demonstrate significant changes of the band intensity and appearance of fine structure for bands connected with radiative transitions of self-trapped and localized excitons. The decoration of pristine and treated C60 films with Ag or Au nanoparticles leads to a decrease of PL intensity and to slight bandgap reduction. These phenomena can be explained both by the increase of the light absorption coefficient at the wavelengths shorter than 550 nm and by the increase of the surface recombination velocity at the fullerene–nanoparticle interface. At the same time, the nanoparticles insignificantly decrease the transmittance of light into the fullerene and Si layers, and have almost no influence on electrical and photoelectric properties of metal/fullerene/Si barrier structures.

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PROGRAM VIEW : 2008

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Carbon-based nanostructured composite films

26 May 2008 | 27 May 2008 | **28 May 2008** | 29 May 2008 | 30 May 2008

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start at	Subject	Num.
	Magnetic properties : Raul Gago, Yves Pauleau	
08:45	Magnetic interactions, magnetic anisotropy and intrinsic particle properties in nanoassembled magnetic films Authors : M. Farle, Department of Physics and Center for NanoIntegration (CENIDE), Universität Duisburg-Essen, Lotharstr. 1, 47048 Duisburg (Germany) **Resume :** Monodisperse magnetic nanoparticles (2 – 15 nm) of almost any shape and composition can be suspended in organic solvents and also transferred to bio-compatible solvents like water by using special hydron-carbon based ligands. Well controlled sizes and different shapes (rods, tubes, spheres, cubes) can be synthesized this way and used in applications ranging from thin film coatings, sensor materials and magnetic storage media to biomedical applications in diagnostics and therapy. Such nanoparticle "building blocks" also offer new exciting possibilities to create new artificial composite materials like ultra-hard (or soft) ferromagnets (or ferrimagnets), multifunctional hollow magnetic microspheres or luminescent magnetic particles [1,2,3]. In biomedical technologies magnetic hybrid or functionalized particles find applications in site-targeted therapy, diagnosis, cell separation and water purification. In this talk some of these possibilities will be briefly reviewed. While most of this work does not require a detailled understanding of the intrinsic magnetism of the nanoparticle, future nanotechnological devices based on one single nanoparticle require the knowledge of local crystal as well as electronic and magnetic structure and surface composition. Based on these microscopic results the collective magnetic response of nanostructured self-assembled layers can be understood and interaction properties be determined. Examples on how the magnetic and crystalline interior and surface structure can be calculated and experimentally analysed with sub-Angstrom resolution and with element specificity will be discussed [4,5]. And finally, challenges for magnetic and electronic structure analysis will be pointed out [6]. Work has been supported by the EU-RTN network "Syntorbmag", the DFG, Sfb 445 and the National Center of Electron Microscopy, LBL, Berkeley References [1] M. Spasova,et al , J. Mater. Chem. 15 (2005) 2095 [2] V. Salgueiriño-Maceira et al., Adv. Funct. Mat. 16 (2006) 509 [3] A. Schlachter, et al., Phase Trans. 78 (2005) 741 [4] C. Antoniak et al., Phys. Rev. Lett. 97 (2006) 117201 [5] Rongming Wang et al, Phys. Rev. Lett. 100 (2008) 017205 [6] Markus E. Gruner et al, Phys. Rev. Lett. XXX (2008) in press add to my program (close full abstract)	A8 1
09:15	Magnetic Nanoparticle Embedded in Thin Carbon Films Authors : Y.C. Sui , Y. Zhao, MidAmerican Energy Company, Omaha, NE 68124, Department of Material Science and Engineering, Rice University, Houston, TX 77005 **Resume :** Magetic nanocomposite films have many applications, such as permanent magnets, sensors magnetic recording media etc. This paper deals with various aspects of nanocomposite magnetic thin films and of the particles they contain. Relatively new approaches such as particle deposition, encapsulation, chemical synthesis and self-assembly, are involved in sample fabrication. It is found that L10 FePt/C nanocomposite can be created by the combination of hydrogen reduction and CVD; non-epitaxial growth of FePt/C is feasible by magnetron sputtering multilayer and rapid thermal annealing; Highly ordered FePt nanoelements arrays can be easily fabricated through template mediated self-assembly or sputtering deposition. Tripods and terapods embedded in carbon films exhibits distinct magnetic anisotropy. The wide variety of techniques and designs allows the fine tuning of particle size, shape, anisotropy and their interaction, which is very promising to be integrated into future industrial development and applications. add to my program (close full abstract)	A8 2
09:45	Structure and magnetic moments of Fe50Pt50 nanoparticles encapsulated in carbon Authors : N. Jaouen1, D. Babonneau2, J.M. Tonnerre3, D. Carbone3,4, F. Wilhelm4, A. Rogalev4, T. K. Johal5 G. van der Laan5, G. Abadias2 and F. Petroff6. 1. Synchrotron SOLEIL, L'Orme des Merisiers, 91192 Gif/Yvette, France 2. Laboratoire de Métallurgie Physique, UMR 6630 CNRS, Université de Poitiers, 86962 Futuroscope Cedex, France 3. Institut NEEL, CNRS & Université Joseph Fourier, Boîte Postale 166, 38042 Grenoble Cedex, France 4. European Synchrotron Radiation Facility (ESRF), Boîte Postale 220, 38043 Grenoble, France 5. Daresbury Laboratory, Warrington WA4 4AD, United Kingdom 6. Unité Mixte de Physique CNRS/Thales and Université Paris-Sud 11, RD128, 91767 Palaiseau, France **Resume :** The area density growth of recording media has been accelerated in the past decade and is expected to exceed 100 Gbit/in2 within a few years. L10 ordered metallic phases such as Fe (Co)Pt having very large magnetocrystalline anisotropy are regarded as attractive candidates. Important issues in such materials are to possess a high curie temperature when decreasing the dimension and to preserve the magnetic characteristics under long air exposition. To protect the magnetic nanoparticles, we study the potential of FePt/C granular multilayers prepared by ion-beam sputtering deposition, consisting of FePt nanoparticles embedded in a carbon matrix and regularly spaced in the vertical direction. The choice of the carbon surrounding the magnetic	A8 3

nanoparticles is not innocent and is expected to protect them against outside degradations and to reduce intergrain interactions insofar as high-density recording also requires that the nanosized grains must be magnetically decoupled. This presentation reports the recent results obtained thanks to transmission electron microscopy, grazing-incidence wide- and small-angle X-ray scattering, SQUID magnetometry, X-ray absorption (XAS) and magnetic circular dichroism (XMCD) spectroscopy of as-deposited and postannealed Fe50Pt50/C granular multilayers. The XAS and XMCD were measured at both the Fe and Pt L2,3 edges allowing to extracted separately the spin and orbital moment of both elements. We demonstrate that thermal annealing at temperatures above 600°C results in the growth of the FePt nanoparticles by coalescence and their gradual L10 ordering, which induces magnetic hardening. As a matter of fact, in comparison with the as-deposited particles, the effective spin magnetic moments are increased by 200% at the Fe site and by 65% at the Pt site, while the orbital moments are enhanced by 325% and 15% at the Fe and Pt sites. Moreover, a change in the x-ray absorption near-edge structure at the C K edge gives evidence for a preferential graphitization of the carbon matrix, which provides a better protection of the nanoparticles against external degradation as required for the application of these particles in future magnetic devices.

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(close full abstract)

Biomedical and biochemical applications I : Michae Farle, N.N.

10:30 Tribological behaviour of nanostructured Ti-C:H coatings used for biomedical applications

Authors : T. Polcar, T. Vitu, L. Cvrcek, R. Novak, J. Vyskocil, A. Cavaleiro a) Department of Control Engineering, Faculty of Electrical Engineering, CTU Prague, Czech Republic b) SEG-CEMUC - Department of Mechanical Engineering, University of Coimbra, Portugal c) Faculty of Transportation Sciences, CTU Prague, Czech Republic d) HVM Plasma Ltd., Na Hutmance 2, 158 00 Prague 5, Czech Republic e) Faculty of Mechanical Engineering, CTU Prague, Czech Republic

Resume : The development of stable systems using a graded Ti-doped C:H layer as adhesion interlayer in combination to the functional DLC coating requires the reduction or elimination of brittle phases which can induce mechanical problems in the transition from Ti to Ti-C:H. Any changes in this transition are reflected in the mechanical properties and, consequently, on the global tribological behaviour of the system as already investigated in Ti-C:H coatings. The functional Ti-C:H layers were deposited by magnetron sputtering a Ti-target in C2H2 + Ar atmosphere in dc discharge regime. The coatings were prepared varying the content of C:H components by controlling the C2H2 flow during the deposition process. The sliding tests were carried out using a pin-on-disc tribometer at room temperature and at 100 °C using 6 mm 440C balls. The tests at 100 °C were performed to investigate the effect of the sterilization temperature on the tribological properties and coating lifetime. The tribological performance was examined with respect to the friction coefficient, the wear rates of the coatings and respective counter-parts. The dominant wear mechanisms were accessed by the analysis of either the wear tracks and the wear debris by using optical and scanning electron microscopies and Raman spectroscopy . Additionally, the measurement of the coatings hardness was taken into account. The results showed relatively clear correlation between the tribological properties and the coatings composition.

A9 1

add to my program

(close full abstract)

10:50 Silver and copper nanoclusters in a-C:H matrix as antimicrobial coating

Authors : F. Schwarz, B. Stritzker Universität Augsburg, Lehrstuhl für Experimentalphysik IV, Universitätsstraße 1, 86159 Augsburg, Germany

Resume : One of many applications of diamond like carbon (DLC) is the biocompatible coating of medical tools and implants. Also widely-used is the modification of DLC films by doping in order to enhance certain material properties like e.g. surface energy. A more recent field of interest concerns the generation of antimicrobial activity in combination with excellent wear resistance and biocompatibility of DLC. As has already been shown for polymers, nanoparticles of silver or copper within a carbonacious matrix have a bactericidal effect on eg. Escherichia Coli and Staphylococcus Aureus. In this work we describe a new technique to produce amorphous hydrogenated carbon films (a-C:H) which contain nanometer sized clusters of silver or copper. The hybrid deposition process is based on sol-gel synthesis of polymer films and subsequent ion-induced densification and crosslinking to form a-C:H. By thermal or UV-induced reduction of metal salts in polymer solution, colloidal metal particles are produced. In this way polymer films, already containing noble metal nanoclusters, can be deposited in a wet chemical step. Upon sol-gel deposition, the polymer is subjected to irradiation of different ion species, energies and fluences. The influence of these parameters on chemical and mechanical properties, as well as bonding structure is investigated. Special attention is dedicated to films containing copper, whereas ion induced diffusion and growth as well as oxidation effects will be discussed.

A9 2

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(close full abstract)

11:10 OPTICAL AND SURFACE CHARACTERISTISATION OF AMORPHOUS BORON NITRIDE THIN FILMS FOR BIOMEDICAL COATINGS

Authors : S. Lousinian, N. Kalfagiannis, S. Logothetidis, Aristotle University of Thessaloniki, Department of Physics, GR-54124 Thessaloniki, Greece

Resume : An important consideration, for the development of materials with extreme haemocompatibility, is the conception of the interactions between plasma proteins and surfaces. The aim of this work is the investigation of the thrombogenicity potential of homogeneous and amorphous BN thin films through the adsorption of two basic blood plasma proteins, human serum albumin (HSA) and fibrinogen (Fib). a-BN thin films, with mixed sp3 – sp2 bonded BN, were produced by radio frequency Magnetron Sputtering onto c-Si (100) substrates under various values of substrate bias voltage. For the consideration of the optical, compositional and structural properties of the films Spectroscopic Ellipsometry in the energy region of 1.5-6.5 eV was used, while for the study of the surface morphology, surface charge distribution and wetting properties of the thin films, Atomic Force Microscopy (in tapping mode), Electric Force Microscopy and Contact angle measurements were employed, respectively. The properties of the a-BN and of the overhead proteins were correlated with the a-BN thrombogenicity potential, through the use of the HSA/Fib surface concentration ratio as an indicator. The thrombogenicity potential does not exhibit a trend with sp3 bonding percentage and small variations in the surface roughness of the films. On the other hand, it seems that the more hydrophilic and the less negatively charged the surface of the a-BN film is, the less thrombogenic it becomes. A comparative study between a-BN films

A9 3

developed under different deposition conditions is presented and the results are discussed in view of tuning the a-BN optical and surface properties in order to minimize their thombogenicity potential.

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(close full abstract)

11:30 Development of Gelatin Hydrogel Film Containing Silver Nanoparticles and Their Antibacterial Activity

Authors : Nuanchan Choktaweesap, Nuttaporn Pimpha, and Pitt Supaphol

Resume : Gelatin hydrogel films were prepared from 10 wt.% gelatin solution containing 2.5 wt.% of silver nitrate (AgNO3) in an acidic condition by solvent-casting technique. The formation of silver (Ag) nanoparticles was evidenced by the presence of the surface plasmon absorption band around 420 nm. Morphology and size of the Ag nanoparticles were characterized by transmission electron microscopy (TEM). In order to improve their water-resistant ability, the gelatin hydrogel films were cross-linked with saturated glutaraldehyde solution (GTA). The obtained hydrogel films were tested for the antimicrobial activity against Gram-positive Staphylococcus aureus and Gram-negative Escherichia coli.

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(close full abstract)

Biomedical and biochemical applications II : Stergios Logothetidis, N.N.

14:00 Polymer microcantilever biochemical sensors with integrated polymer composites for electrical detection

Authors : 1. Seena.V, Research Scholar, Center for Nanoelectronics, Department of Electrical Engineering , Indian Institute of Technology Bombay, Mumbai, India. 2. Nageswararao.P, M Tech student, Center for Nanoelectronics, Department of Electrical Engineering, Indian Institute of Technology Bombay, Mumbai, India. 3. Soumyo Mukherji, Professor, School of Biosciences and Bioengineering, Indian Institute of Technology Bombay, Mumbai, India. 4. V.Ramgopal Rao, Professor, Center for Nanoelectronics, Department of Electrical Engineering, Indian Institute of Technology Bombay, Mumbai, India.

Resume : Micro fabricated sensors based on nanomechanical motion with piezoresistive electrical readout have become a promising biochemical sensing tool. The conventional microcantilever materials are Silicon based materials. The sensitivity of the sensor depends on the Young's modulus of the structural material, thickness of the cantilever as well as on the gauge factor of the piezoresistor. UV patternable polymer like SU-8 has a very low Young's modulus compared to Si based materials. So polymer cantilevers with a piezoresistive material having a large gauge factor as well as small Young's modulus would be very useful for sensing applications. A thin conductive film out of a mixture of Carbon black (CB) in SU-8 with proper dispersion characteristics can be embedded with the SU-8 cantilevers. In this paper we present the results on the percolation experiments using SU-8/CB material, fabrication of polymer microcantilever with SU-8/CB composite piezoresitor, characterization and application of the sensor in biochemical sensing. With our controlled dispersion experiments, we could get a uniform piezoresistive thin film of thickness less than 1.2 microns and resistivity of 0.3Ωcm out of 10 wt% of CB in SU-8. These sensors can be used for detection of protein markers during pathological conditions.

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(close full abstract)

14:20 Functional nanostructured composite films based on nanocarbon/biomolecule

Authors : O.Kysil, I.Sporysh, R.Shein, F.Frolov, H.Gogotsi, E.Buzaneva National Taras Shevchenko University of Kyiv, Volodymyrska 64, Kyiv 01033, Ukraine L.Weber, U.Ritter, P.Scharff, T.Erb, G.Gobsh TU Ilmenau, Institut für Physik, Postfach 100565, 98684 Ilmenau, Germany

Resume : The research is aimed to an evolution of concepts for nanocarbon composite film formation with controlled architecture, what determines film function. The illustration of different concepts for disorder and order nanostructured carbon /selected molecule composite are presented. We use for this composite type interface organizations: well established rationale of interface organization of biological macromolecules (nucleic acids, proteins), driven by non – covalent interactions (hydrogen bonding, hydrophobic effect and electrostatic interaction) in living cells (mimetic concept) and approaches of molecular interface interactions for organic polymers, pointing the role of electrostatic and hydrophobic interactions (polymer concept). Then, this composite for selected pair has photo- and electrofunction as donor – acceptor pair and the concept for an architecture and a function of the film from network of nanocarbon/molecule composite building blocks is determined. The first experimental investigation is aimed to choose potential properties of immobilized nanocarbons: multi-walled carbon nanotubes (MWCNT) and fullerenes (C60), and of selected biomolecules: – oligo, – mononucleotides, biotin, amino acids, for donor - acceptor building blocks in suspensions. Main optical and electronic characteristics of thin films from these suspensions, obtained on silicon by a spray – on evaporator and microwave irradiation for different nanorelief, were investigated and interpreted. The principal result, what confirms the concept for selected building blocks, is that nanocarbons in the building blocks, such as immobilized MWCNT and C60, having positive or negative charge, change optical absorbance and photoluminescence spectra of composite films in UV – vis range.

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(close full abstract)

14:40 Brightly Fluorescent Surface Functionalized Carbogenic Quantum Dots

Authors : A. Stassinopoulos, D. Anglos, Institute of Electronic Structure and Laser, Foundation for Research and Technology-Hellas (IESL-FORTH), Heraklion, Crete, Greece A. B. Bourlinos, Institute of Materials Science, NCSR "Demokritos", Athens, Greece R. Zboril, Department of Physical Chemistry, Palacky University, Olomouc, Czech Republic, E. P. Giannelis, Department of Materials Science and Technology, Cornell University, Ithaca, NY, USA

Resume : Surface functionalized carbon-based quantum dots (C-QDs) are formed in-situ in a single-step process via thermal carbonization of suitable molecular precursors based on ammonium citrate salts. The nanoparticles have near spherical morphology and size around 7 nm. Depending on the nature of the surface modifier it is possible to form hydrophobic or hydrophilic capped C-QDs, which are dispersible in organic or aqueous solvents, respectively. These C-QDs were found to exhibit strong blue-green fluorescence upon optical excitation; their emission quantum yield in solution was measured to be around 7%. It is noted that the observed fluorescence emission is tunable with excitation wavelength; emission maxima shift all the way from blue to red as the excitation is red-shifted. We believe that the fine size of the C-QDs,

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combined with their disorder structure, favor a high concentration of defect sites at the surface of the nanoparticles that upon stabilization by the attached organic groups give rise to the observed emissions. These types of materials are promising as fluorescent taggers for biological applications.

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Carbon-based nanostructured composite films

26 May 2008 | 27 May 2008 | 28 May 2008 | **29 May 2008** | 30 May 2008

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start at	Subject	Num.
	Electronic structure & electrical properties I : Stanislav Novak, Sigitas Tamulevicius	
08:45	STRUCTURAL AND ELECTRICAL CHARACTERIZATION OF BORON CONTAINING DIAMOND-LIKE CARBON FILMS DEPOSITED BY FEMTOSECOND PULSED LASER ABLATION Authors : A. Sikora1, A. Berkesse2, O. Bourgeois2, J-L Garden2, C. Guerret-Piécourt3, J-N Rouzaud4, A.S. Loir1, F. Garrelie1, C. Donnet1 1 Laboratoire Hubert Curien, UMR 5516 CNRS, Université Jean Monnet, 18 Rue Pr. B. Lauras, 42000 SAINT ETIENNE, France 2 Institut Néel, UPR 2940 CNRS, 25 Avenue des Martyrs, 38042 GRENOBLE CEDEX 9, France 3 Laboratoire de Tribologie et Dynamique des Systèmes, UMR 5513 CNRS, Ecole Centrale de Lyon , 36 Avenue Guy de Collongue, 69134 ECULLY Cedex, France 4 Laboratoire de Géologie de l\'Ens, UMR 8538 CNRS, 24 rue Lhomond 75231-Paris Cedex 5 **Resume :** The present study investigates the influence of the incorporation of boron in Diamond-Like Carbon (DLC) films on the structure and electrical properties of the coatings within the temperature range 70-300K. The a-C and a-C:B films have been deposited at room temperature by ablating graphite targets with an amplified Ti:sapphire laser of 800 nm wavelength and a pulsed duration of 150 femtosecond in high vacuum conditions. Doping with boron has been performed by ablating alternatively graphite and boron targets with the femtosecond laser. The film structure and composition have been highlighted by coupling Atomic Force Microscopy (AFM), Scanning Electron Microscopy equipped with a field emission gun (SEM-FEG), Raman spectroscopy and High Resolution Transmission Electron Microscopy. Boron dilution ranges between 2 and 8 % and appears as nanometer size clusters embedded in the DLC matrix. A regular electrical four probe technique was used to measure the electrical resistance versus temperature. Typical resistivity values are 100 ☐.cm for pure a-C fims, down to few ☐.cm for a-C:B films at room temperature. The resistance decreases exponentially when the temperature increases in the range 70 K to 300 K. The results are discussed considering the classical model of hopping conduction in thin films. Some coatings show temperature coefficients of resistance (TCR) as high as 3.85%. TCRs decrease when the doping increases. Such high values of TCR may have interests in the use of these films as thermometer elements in micro and nanodevices. add to my program (close full abstract)	A11 1
09:05	Optical properties study of diamond by VEELS Authors : L. Zhang*, R. Erni, G. Van Tendeloo EMAT, University of Antwerp, Groenenborgerlaan 171, B2020 Antwerp, Belgium **Resume :** Due to the fascinating electronic and optical properties, bulk diamond, diamond films and nanodiamond materials are promising candidates for a wide area of applications. These outstanding properties are fundamentally determined by the electronic structure of the material under consideration. Until now much of what is known about the electronic structure of nanomaterials, such as diamond films or nanodiamond materials, is based on theory and experimental methods lacking of spatial resolution measure integral electronic properties, and thus fails to locally measure the electronic structure information of the nanomaterial. Valence electron energy loss spectroscopy (VEELS) in (scanning) transmission electron microscopy ((S) TEM) could provide a means to obtain local electron structure information of nanomaterials. Aiming at determining the dielectric function of diamond, a detailed VEELS study is presented with a method which is derived to extract the dielectric function of diamond and also can be applied to nanodiamond materials. Owing to plural scattering effects, retardation and surface losses that all substantially contribute to the measured energy-loss signal of diamond, the VEELS raw-data need to be analyzed in a way of considering all these effects. We propose a procedure which consists of three basic steps. The first step is the acquisition of the VEELS data under well defined experimental conditions. Once the spectra have been collected, in the second step a series of data corrections are applied to eliminate the scattering contributions mentioned above and to extract the energy-loss function from the raw data. It is only after this procedure that in the third step a Kramers-Kronig analysis can be applied in order to derive the complex dielectric function. add to my program (close full abstract)	A11 2
09:25	Electronic structure of metal(Au,Ag,Cu,Mo)-doped nanocomposite carbon films Authors : J.L. Endrino (1,2), R. Gago (3,2), D. Horwat (4), J. Andersson (1), J.M. Albella (2), and A. Anders (1) (1) Lawrence Berkeley National Laboratory, Berkeley, CA 94720, USA; (2) Instituto de Ciencias de Materiales de Madrid, E-28049 Madrid, Spain; (3) Centro de Micro-Análisis de Materiales, Universidad Autónoma de Madrid, E-28049 Madrid, Spain; (4) LSGS, Ecole des Mines, F-54042, Nancy, France **Resume :** Incorporation of metals (Me) inside a carbon (C) host matrix is an interesting approach to tailor the electronic, tribological and biocompatible properties of the C-based materials. In this work, we address a systematic study of the influence of the incorporation of different Me (Au, Ag, Cu, Mo) on the electronic structure and conductivity of C:Me films. The films were grown at room temperature using a novel plasma ion immersion implantation and deposition (PIIID) technique, where the Me content (< 20 at. %) was tuned by the relative number of voltage pulses applied to	A11 3

a Me arc cathode with respect to the biased substrate. Compositional analysis was performed with secondary neutral mass spectroscopy (SNMS) and Rutherford backscattering spectrometry (RBS). X-ray diffraction (XRD) shows the segregation of Me nanoclusters above a solubility limit of ~10 at. %. The electronic structure as a function of the Me content has been monitored by x-ray absorption near edge structure (XANES) at the C(1s) edge. XANES shows that the sp2-C content is not affected significantly by the incorporation of Me atoms, independently of the Me nature. However, for the largest incorporation of noble-Me atoms, a slight modification in the local bonding environments of C atoms has been observed, as evidenced by changes in the spectral lineshape of the sigma* adsorption edge. The nature of the Me element incorporated in the nanocomposite film appears to have an impact on the conductivity behavior.

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Applications of CBNC films : Panos Patsalas, Michael Stüber

10:30 On the importance of morphology in donor-acceptor composite organic solar cells
Authors : G. Dennler and C. J. Brabec Konarka Autria GmbH
Resume : The intensive research performed in the field of conjugated polymers during the last four decades gave rise to a new class of materials, in which the electrical conductivity can be adjusted to cover the entire range from pure insulator to metallic. Their ease of processability, low weight, mechanical flexibility and potential low production cost triggered the use of these "plastic semiconductors" for electronic device applications. The discovery of ultrafast (45 fs) photoinduced electron transfer from a conjugated polymers to C60 allowed one to contemplate building photodiodes and solar cells. Indeed, the absorption of a photon in conjugated polymers usually induces the creation of an exciton that relaxes in the nanosecond range. If this exciton can diffuse to the interface between a donor and an acceptor material, for example a conjugated polymer and a C60 molecule, the electron-hole pair is separated by the electron transfer to the acceptor. This reaction generates charge carriers which are can be harvested after they diffused and/or drifted to their respective collective electrode. One of the most critical issues to ensure efficient charge separation is the optimization of the interface between donor and acceptor phases, that is, the nanostructure of the composite film. By mixing the two components, an interpenetrating network of donor and acceptor materials is created inducing a 3 dimensional "bulk" interface photovoltaic cells. Morphologic studies of this active blends revealed that the solvent used to prepare plays a critical role for the quality of the "bulk heterojunction" . But several other approaches have recently been employed to enhance the structure of the composite and control its nanoscopic arrangement. Although the absorption of the conjugated polymers available now do not perfectly fit the solar emission spectrum, efficiencies higher than 5 % have been reported, paving the way to the production of low-cost, flexible, light-weight solar cells. A11 1

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11:00 Investigation on the properties of nanoporous carbon composite films used in supercapacitor cell electrodes
Authors : Vasile V.N. Obreja National R&D Institute for Microtechnology (IMT-Bucuresti). Bucharest, Romania
Resume : Supercapacitor electrodes consist of a mixture of nano-porous carbon particles with a size of the order of tens of micrometer and nano-sized carbon particles. The particles are bound by means of a suitable polymer (binder). Typical supercapacitor cells available at this time as commercial products have been investigated. Microscope images of their electrode samples have revealed distribution of nanoporous microsized and nanosized particles and of the binder material. The binder material can cover pores located at the grain peripheral surface with impact on the specific capacitance and energy, because in the final supercapacitor cell the electrolyte may not penetrate part of the pores. Analysis of the film samples has shown that the nanoporous carbon particles are not entirely surrounded by polymer binder. Better contact between the adjacent particles enables higher electrical conductance and specific power. By means of slurry containing mixture of nanoporous and nanosized carbon particles and polymer binder, experimental carbon electrode films have been prepared with a thickness of about 75 micrometers. With a test supercapacitor cell, the specific capacitance and electric conductance has been measured and compared with those values corresponding to films from the investigated commercial products. Further advance in the preparation of carbon based nanostructured composite films can enable tailoring of their structure and properties so that to improve supercapacitor performance. A11 2

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11:20 Patterning polymeric structures with 2 nm resolution at 3 nm half-pitch in ambient conditions
Authors : R.V. Martínez, N. S. Losilla, J. Martinez, and R. Garcia* Instituto de Microelectrónica de Madrid, CSIC Isaac Newton 8, 28760 Tres Cantos, Madrid, Spain. *Correspondence and requests for materials: rgarcia@imm.cnm.csic.es
Resume : The miniaturization limits of electronic and mechanical devices depend on the minimum pattern periodicity that is stable in ambient conditions[1,2]. Here we demonstrate an atomic force microscopy lithography that enables the patterning of 2 nm organic structures with 6 nm periodicities in air[3]. We also demonstrate that the lithography can be up-scaled for parallel patterning. The method is based on the formation of a nanoscale octane meniscus between a sharp conductive protrusion and a silicon (100) surface. The application of a high electrical field (10V/nm) produces the polymerisation and cross-linking of the octane molecules within the meniscus followed by their deposition. The resulting pattern periodicities are very close to the ultimate theoretical limits achievable in air (3 nm). [1] Martinez, R.V.; Garcia, R. Nano Letters. 2005, 5, 1161. [2] Garcia, R.; Martinez, R. V.; Martinez, J. Chemical Society Reviews 2006, 35, 29. [3] Martinez, R. V.; Losilla, N. S.; Martinez, J.; Huttel, Y.; Garcia, R. Nano Letters 2007, 7, 1846. A11 3

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11:40 Conjugated polymers and carbon nanotubes composites for devices applications
Authors : Lucimara S. Roman1, Carla Canestraro1, Carlos Cava1, Mariane C. Schnitzler2, Marcela M. Oliveira 2, Marlus Koehler1, Marcos Gomes Eleutério da Luz1, Aldo J. G. Zarbin2, 1) Departamento de Física – Universidade Federal do Paraná 81531 – Curitiba PR/Brazil 2) Departamento de Química – Universidade Federal do Paraná 81531 – Curitiba PR/Brazil
Resume : The research on carbon nanotubes and composites with this material has grown

sharply, opening opportunity for novelties. Several applications for these materials were proposed and demonstrated, mainly the nanoscale electronic devices, transistors, sensors and memory devices based on field effect transistors. Conjugated polymers have also increasingly having being used in opto-eletronic devices with success, light emitting diodes, photodiodes, solar cells and transistors. The idea of combining such materials in devices is quite attractive; the nanostructures formed in the films can predict the properties of the devices. In this work we report our investigations on the electrical and morphological properties of conjugated polymers, mainly poly 3 hexyl-thiophene and iron filled carbon nanotubes composites in sandwich and planar geometries. Photovoltaic, memories, and, sensors devices based on this combination were obtained and experimentally characterized. Modeling the electrical properties of P3HT/Iron filled carbon nanotubes by varying the nanotubes concentration, we develop a model based on drift-diffusion with space-charge effects to understand the electrical results. We found different behaviors associated to different microscopic mechanisms: a drastic increase for the injection current due to drain channels provided by the nanotubes, a percolation transition at a critical concentration, and a fractal-like structure for transport after the percolation threshold.

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(close full abstract)

14:00 CONFINEMENT EFFECT ON MELTING OF MIXTURES IN ACITVATED CARBON FIBRES AND SILICA GLASSES; EXPERIMENT AND MOLECULAR SIMULATION:

Authors : a)Joanna Czwartos,a)Małgorzata Śliwińska-Bartkowiak b)Benoit Coasne, c)Keith E. Gubbins, a Faculty of Physics, Adam Mickiewicz University, Umultowska 85, 61-614 Poznań, Poland, (msb@amu.edu.pl) b Laboratoire de Physicochimie de la Matiere Condensee,CNRS (UMR 5617) & Universite de Montpellier II, Place Eugene Bataillon, 34095 Montpellier Cedex 05, France c Department of Chemical Engineering, North Carolina State University, Raleigh, NC 27695-7905, USA

Resume : We report experiments and molecular simulations of the freezing and melting of azeotropic and eutectic mixtures confined in nanoporous media. Dielectric relaxation spectroscopy was used to determine the experimental solid/liquid phase diagram of CCl4/C6H12 mixture bulk and confined in activated carbon fibres (ACF), with a pore size H = 1.2 nm. The temperatures of solidus and liquidus transitions were determined as the temperatures of the changes in the permittivity of the system, related with the change in the density of mixtures. Grand Canonical Monte Carlo simulations combined with the parallel tempering technique were used to model the freezing of the azeotropic Lennard-Jones mixture Ar/CH4 in a graphite slit pore. The structure of crystal phase in the simulations is investigated by means of positional and bond-orientational pair correlation functions and appropriate bond-order parameters. Experiments and simulations are in qualitative agreement. Both series of results show that the phase diagram of the confined mixture is of the same type as that for the bulk. The solid/liquid coexistence lines for the confined system are located at higher temperatures than those for the bulk. GCMC simulations show that the azeotrope is shifted, upon confinement, towards the component having smaller ratio of the wall/fluid to fluid/fluid interactions [1, 2]. Our measurements performed for eutectic C6H12 / C6 H5 Br systems placed on CPG with the pore diameter 7,5 nm, have shown a pronounce decreasing of the solid/liquid coexistence line relative to the bulk in the silica pores, but the phase diagram of the confined mixture is also of the same type as that for the bulk system. [1] B.Coasne, J.Czwartos, K.E.Gubbins, F.R.Hung, M.Sliwińska-Bartkowiak, Mol.Phys., 16, 2149-2163 (2004). [2] B.Coasne, K.E.Gubbins, J.Czwartos, M.Śliwińska-Bartkowiak , Apply Phys. Lett., (submitted)

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(close full abstract)

14:00 Modeling and TEM characterization of carbon based nanostructures

Authors : G. Prodan1, V. Ciupina1, M. Prodan1, I. Morjan2, I. Voicu2, F. Dumitrache2, E. Vasile3 1. Ovidius University of Constanta, Mamaia Avenue No. 124 2. National Institute for Laser, Plasma and Radiation Physics, Bucharest, Atomistilor 409 3. Metav Research-Development SRL, Bucharest, CA Rosetti 31

Resume : The basic structural unit (BSU) found in carbon base nanostructures could be a new modeling starts for build a new type of nanostructure. In case of transmission electron microscopy, modeling a real response for particularly sample is very difficult due to large number of factor that can influence the electron motion in sample space. We find that BSU theory can be successfully applied to onion like carbon and carbon nanotubes. Also, electron diffraction data for both nanostructures are compared with data acquired from graphite. Size of BSU are determined for HRTEM images and from diffraction data, using Debye Scherrer relation, applied to XRD and electron diffraction data. The minimum value was 1 nm, and maxima tend to 5 nm. To identify more easily the BSU, we apply a filter to HRTEM images that convert 8 bit image in black and white image. The application software builds a new structure, using the graphite structure and user parameters that control nanostructure size and properties. Keywords: carbon, BSU, TEM, diffraction

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(close full abstract)

Poster Session CBNC-2 : Martin Balden

14:00 Dielectric properties of onion-like carbon based polymer films: experiment and modeling

Authors : J. Macutkevic, D. Seliuta, G. Valusis, Semiconductor Physics Institute, Lithuania; J.Banys, University of Vilnius, Lithuania; S. Maksimenko, P. Kuzhir, Institute for Nuclear Problem, Belarus; V. Kuznetsov, S. Moseenkov, Boreskov Institute of Catalysis SB RAS, Russia; O. Shenderova, International Technology Center, USA; Ph. Lambin FUNDP – University of Namur, Belgium

Resume : The first measurements of the complex permittivity of polymethyl methacrylate (PMMA) films with embedded onion-like carbon (OLC) have been carried out within the wide frequency range from 20 Hz to 1MHz to investigate structural relaxations by varying the temperature between 240 and 520K. Dielectric analysis demonstrates that frequency dependence of permittivity could at a given temperature be non-monotonous function of the OLC concentration. The beta transition in OLC-PMMA films has been observed practically independent of OLC concentration. It indicates that the included OLC do not introduce any significant frustration of the rotation degree of freedom of the ester groups along the polymer chains. It in turn points out the weak interactions between the OLC fillers and the polymer molecules. At the same time increasing the OLC concentration has strong effect on the glass and melting temperatures. Accordingly, the inclusion of OLC particles in the polymer matrix may result in a less ordered alignment of the

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polymer chains, with the concomitant effect that the chains translation and side group relaxation processes are affected. The research was supported by NATO SfP grants CBP.NR.SFPP-981051 and CBP.EAP.CLG 982007, Lithuanian State Science and Studies Foundation V-07018, INTAS 06-1000013-9225, the Belarus FFR F06R-091, the Russian FBR 06-03-81038 and the Ministry of Science and Education of Russian Federation RPN 2.1.1.1604.

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14:00 Electrical characterization of carbon nanotubes

Authors : F. Gégot(1), S. Kouassi(1-2), E. Rouvière(3), C. Boulmer-Leborgne(1), M. Roy(2), P. Bouillon(2) and P. Pantigny(3) (1) GREMI, Orleans University, France (2) ST Microelectronbics, Tours, France (3) CEA/DRT/LITEN, Grenoble, France

Resume : Due to their extraordinary properties, Carbon NanoTubes (CNTs) have potential applications in many industrial fields such as microelectronics. In particular, CNTs are strong candidates for future through wafer interconnects. First, the aim of our study is to work out long CNTs process on Si substrates, where an isolating barrier of SiO2 and Ni or Co catalyst particles are deposited. Then, it deals with the integration questions and feasibility for the final structure. To achieve this, electrical and thermal tests must be realised on the produced devices. This paper focuses especially on electrical tests. After depositing Au or Ti-Al electrodes by shadow masking onto the top of CNTs, the measurements are made with a Source Measure Unit (SMU) connected to a probe station. This station consists in two probe holders with needles, which motion is controllable with a precision less than 5 µm. We applied voltage ranges with the SMU via the two needles which measure simultaneously the induced current. Obtained results will be presented and discussed. Finally, another technique for measuring electrical properties of a single CNT will also be presented. Few CNTs are put in a solution of ethanol, and after ultra-sonic bath, are collected on a wafer, where metallic electrodes were deposited. After heating, with a FIB-SEM we search a CNT between two electrodes and contact them to measure electrical properties of this CNT. This work is sponsored by the French National Research Agency.

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(close full abstract)

14:00 Dielectric spectroscopy and electrical properties of PVC/MWCNT polymer nanocomposites.

Authors : Mamunya Ye. - Institute of Macromolecular Chemistry of National Academy of Sciences of Ukraine Levchenko V. - Institute of Macromolecular Chemistry of National Academy of Sciences of Ukraine Rybak A. - Laboratoire des Matériaux Polymères et Biomatériaux, UMR CNRS 5627, Université Claude Bernard Lyon 1 Boiteux G. - Laboratoire des Matériaux Polymères et Biomatériaux, UMR CNRS 5627, Université Claude Bernard Lyon 1 Lebedev E. - Institute of Macromolecular Chemistry of National Academy of Sciences of Ukraine Seytre G. - Laboratoire des Matériaux Polymères et Biomatériaux, UMR CNRS 5627, Université Claude Bernard Lyon 1

Resume : Dielectric study of nanocomposites poly (vinyl chloride)/multiwalled carbon nanotubes (PVC/MWCNT) has showed that the conductive structure in the MWCNT phase is forming at very low content of filler (φ). The appearance of conductivity leads to increasing of ε` and tanδ values. Increasing of the MWCNT content leads to disappearance of the AC conductivity dependence on frequency (σAC~f) starting from φ=0.00054, and at φ=0.0067 the value of σAC is constant in the whole diapason of frequency (10E-1÷10E6 Hz) that indicates the electron type of the charge transport. The maximums of tanδ are shifted to higher frequency on the dependence tanδ~f. Measurement of DC conductivity (σDC) demonstrates the percolation dependence of σDC with low value of percolation threshold φc equal to 0.0005. The curves σAC~f and ε` ~$f$ have percolation character as well with the same value of φc. The temperature dependence of σAC demonstrates the presence of three regions: lower φc, in the vicinity of φc and essentially higher of φc which are distinguished by character of dependence σDC~T whereas the dependence ε` ~T has identical character for all composites.

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(close full abstract)

14:00 Electrical properties of nanocomposites near percolation threshold

Authors : Stanislav Novak1, Rudolf Hrach1,2, Martin Svec1, Vera Hrachova1,2, 1Department of Physics, Faculty of Science, J. E. Purkinje University, Ceske mladeze 8, 400 96 Usti nad Labem, Czech Republic, 2Department of Surface and Plasma Science, Faculty of Mathematics and Physics, Charles University, V Holesovickach 2, 180 00 Prague 8, Czech Republic

Resume : Composite and nanocomposite films containing metal particles distributed in dielectric (oxide or polymer) matrix are very interesting and promising materials. Their mechanical, electrical, as well as optical properties could be very uncommon. Moreover, there can be found remarkable correlations between morphological and the other properties of such structures. In our paper, we will focus on electrical conductivity of the composite and/or nanocomposite films and their strong dependence on the morphology of the films. A novel analytical self-made tool – computer modelling software – was developed and the electrical properties of these types of materials were studied in association with their structural (morphological) properties. The morphological analysis allows one to characterize the forms and spatial distribution of metal inclusions in the matrix of the film. The structures exhibit encouraging properties and behaviour in the range below and near the percolation threshold. In that case one meet the types of infinite and/or so called fuzzy clusters. They well describe the morphology of the structures. Transport properties are very strong dependent on the morphology of the films near the percolation threshold. Charge transfer is possible by tunnel effect below and near the percolation threshold but when the percolation threshold is really reached the ohmic contact between individual metal inclusions becomes the main mechanism. Monte Carlo simulations of charge transport through these structures give us a detailed insight into the transport processes. In the contribution, the correlations between morphology and electrical properties of simulated composite and/or nanocomposite structures are studied, described, and discussed. A soft-sphere model with Lennard-Jones potential combined with simulated annealing is used to generate our structures. The results show how the morphology of the composite and/or nanocomposite films influences the electrical properties near the percolation threshold.

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(close full abstract)

14:00 Synthesis and characterization of electrical conducting porous carbon structures based on resorcinol-formaldehyde

Authors : I. Najeh(1), N. Ben Mansour(1), M. Mbarki(1), A. Houas(2), J. Ph. Nogier(3), L. El Mir

(1),* 1Laboratoire de Physique des Matériaux et des Nanomatériaux Appliquée à l'Environnement, Faculté des Sciences de Gabès, Cité Erriadh Manara Zrig 6072 Gabès, Tunisie. 2Unité de Recherche Environnement, Catalyse et Analyse des Procédés URECAP (UR/99/11-20), Ecole Nationale d'Ingénieurs de Gabès, Route de Médenine 6029 Gabès, Tunisie. 3Systèmes Interfaciaux à l'Echelle Nanométrique, SIEN, Université P et M Curie, CNRS UMR 7146, Case courrier 196, Tour 55, 3ème étage, 4 place Jussieu 75252 Paris, Cedex 05, France.
Resume : Electrical conducting carbon (ECC) porous structures were explored by changing the pyrolysis temperature of organic xerogel compounds prepared by sol-gel method from Resorcinol-formaldehyde (RF) mixtures in acetone using picric acid as catalyst. The effect of this preparation parameter on the structural and electrical properties of the obtained ECCs was studied. The analysis of the obtained results revealed that, the polymeric insulating xerogel phase was transformed progressively with pyrolysis temperature into carbon conducting phase; this means the formation of long continuous conducting path for charge carriers to move inside the structure with thermal treatment and the samples exhibited tangible percolation behaviour where the percolation threshold can be determined by pyrolysis temperature. The temperature-dependent conductivity of the obtained ECC structures show a semi-conducting behaviour and the I(V) characteristics present a negative differential resistance. The results obtained from STM micrographs revealed that the obtained ECC structures consist of porous electrical conducting carbon materials.

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14:00 Piezoresistive properties of SiOx containing diamond-like carbon films

Authors : Š. Meškinis1,2, R. Gudaitis1, K. Šlapikas1, S. Tamulevičius1 1 Institute of Physical Electronics of Kaunas University of Technology, Savanorių 271, LT-50131 Kaunas, Lithuania 2 International Studies Center, Kaunas University of Technology, A. Mickevičiaus 37, LT-44244 Kaunas, Lithuania
Resume : Diamond-like carbon (DLC) films are at the top of the considerable interest due to their outstanding mechanical, chemical, optical and electrical properties and possibility of the room temperature synthesis. Introduction of the SiOx clusters into the diamond like carbon matrix results in improved functionality of the diamond like carbon films such as reduction of the internal stress, better adhesion with different metallic substrates, higher wear resistance, higher optical transmittance, higher thermal stability and increased hydrophobicity. Recently the piezoresistive properties of diamond like carbon have been discovered. In present study SiOx containing diamond-like carbon films were deposited by ion beam synthesis from the hexamethyldisiloxane vapour. Effects of the ion beam energy on piezoresistive properties of the SiOx containing DLC films were studied using four points bending test. Optical bandgap of the synthesized films was investigated by UV-VIS spectrophotometry. Electrical properties of the SiOx containing diamond like carbon films were evaluated to reveal main charge transfer mechanisms.

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14:00 METAL CONTAINING DIAMOND LIKE CARBON THIN FILMS

Authors : Guenter Schultes, Ralf Koppert, Dirk Goettel University of Applied Sciences, 66117 Saarbruecken, Germany Departement of Mechatronics and Sensortechnology
Resume : Diamond like carbon coatings are well established for multiple applications. The electrical conductivity of amorphous carbon can be influenced by several orders of magnitude via doping with different metals. Depending on the deposition process hydrogen may be incorporated as well, thereby decreasing the conductivity. Recent investigations of DLC disclose nice piezoresistive properties. Our work was focused on Ni:a-C:H thin films on different substrates by reactive sputtering from a nickel target. Several carbon precursors were added to the sputtering gas to create an amorphous carbon hydrogen network with embedded nickel clusters. In order to optimize the piezoresistive properties we varied various process parameters. The piezoresistive response was monitored by measuring the resistance change during bending. Our Ni:a-C:H films develop gauge factors of approx. 12 in a wide range of process parameters. For sensor applications the temperature coefficient of resistance (TCR) is important as well. It depends on the metal concentration in the thin film and can be adjusted by the concentration of the incorporated nickel. It can be set to approximately zero in a wide temperature range of 80 K to 400 K. XRD measurements reveal nickel clusters with diameters of approx. 8-30 nm depending on the metal concentration. The clusters crystallize in the unusual hexagonal hcp structure which could be transformed into the cubic fcc structure by thermal annealing in a vacuum.

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14:00 The influence of tunneling on dissociation electron - hole pairs in polymers.

Authors : E.S. Kobus, M.A. Zabolotnyy, O.P. Dmytrenko, N.P. Kulish, Yu.I. Prylutskyy, Y.M.Barabash(*), V.M.Kharkyanen(*), D.A. Gryn'ko(**). Kyiv National Shevchenko University, Departments of Physics, Volodymyrska Str., 64, 01033 Kyiv, Ukraine (*)Inst. of Physics, N.A.S. of Ukraine, 03650, Kyiv-39, Prospekt Nauky 46, Ukraine; (**)Institute of Semiconductor Physics of NAS of Ukraine, pr. Nauky 45, 03028 Kyiv, Ukraine
Resume : Laws of division of electric charges determine features of some photochemical and photophysical processes. That is why, a study of inter-and intramolecular charge separation mechanism, as well an influence of the molecular structure and its physical surrounding upon this mechanism excites great interest. It is known that for polymers the photogeneration process consists of several steps from which two main stages are can be to extract. The first one takes about 10-11□10-12 s; during this stage, after the quantum of light is absorbed, the neutral exciton state is built that due to autoionizations transforms into an ion-\"hot\" charge carrier pair. Dissociation of the electron-hole pair occurs at thermal equilibrium with surrounding. For the description of this stage of process the model which is generalization of Onzager model is offered. Carried out computational analysis of model indicated that probability of separation of electron-hole pair can increasing accordingly to Law of Poole – Frenkel or decreasing with increasing of external electric field strength. The character of decreasing determined of tunneling processes intensity. This behaviour of separation probability is experimental confirmed [1] and it is inexplicably in terms of Onzager model. 1. Nam-Jun Kim, Hyunaee Chun, In Kyu Moon, Won-Jae Joo, Nakjoong Kim, Bull. Korean Chem. Soc. 2002, Vol. 23, №. 4, 571 – 576.

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14:00 Electrical properties of conductive polyisoprene/high structured carbon black composites in the temperature range 90 – 335 K
Authors : Sanita Zīke, Raimonds Orlovs, Māris Knite, Juris Zavickis, Valdis Teteris Riga Technical University, Institute of Technical Physics
Resume : This presentation deals with electrical properties study of high structured carbon black/polyisoprene (HSCB/PI) composites of various HSCB concentrations (8, 9, 10 and 11 mass parts) in the temperature range 90K – 335K. The DC electrical resistance of the sample was measured as a function of temperature. Composites exhibit negative temperature coefficient of resistivity (TCR) below the room temperature. The resistivity varies exponentially with temperature similar to a semiconducting behavior. Similar to doped semiconducting materials, composites have two different activation energies. The activation energies decrease with increasing HSCB concentration. Hysteresis of R(T) is not observed. Above the room temperature composites show positive TCR. Coefficient decreases with increasing HSCB concentration. There is observed small hysteresis of R(T). The resistance change with temperature in both cases is reversible. We have found that the investigated composite has wide multifunctional sensor properties. It shows temperature, strain and organic solvent vapor sensing behavior.
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14:00 Polyisoprene-nanostructured carbon thick films as a sensitive non-selective gas indicator material.
Authors : Gita Šakale, Juris Zavickis, Māris Knite, Valdis Teteris all from Riga Technical University, Institute of Technical Physics
Resume : Monitoring of environmental working conditions is very important for many industrial sectors, especially, when poisonous or toxic organic solvents are used in production. In this work we present filled elastomer-nanostructured carbon based film as a promising material for nonselective gas indicator. The material is made by dispersing nanostructured carbon into the natural polyisoprene raw rubber matrix and vulcanizing afterwards. When the concentration of conductive filler is close to the percolation threshold such composite exhibits sharp changes of its electrical resistance when exposed to certain organic solvent vapor. The absorbed vapor causes the matrix to swell and increases the tunneling gaps between conductive filler particles, thus increasing the electrical resistance of the composite. Similar changes on electrical resistivity are observed due to mechanical interaction on composite, such as strain or external pressure. Thick film samples by thickness of 1 mm and 200 microns with embedded brass foil electrodes were made to compare their sensitivity to toluone vapor. All samples were weared-in by multi cyclic pre-straining using universal material testing machine. It was found out that decreasing the sample thickness leads to up to 5 times increased vapor sensitivity. This means although, that effective exposure time can be shortened up to 5 times for similar exposure conditions. The sensing intensity is compared and conclusions are made.
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14:00 Effect of Electrode Materials and their Configuration on the Response of Oxide / Polymer Gas Sensor
Authors : Ibrahim Gaidan, University of Limerick (UL) and Electronic and Computer Engineering (ECE), Ireland
Resume : The response of the different ZnO/Fe2O3, NiO/Fe2O3 and MnO2/Fe2O3 sensors was tested. The sensors were deposited on alumina substrate with copper thin film electrodes. 2 % wt. of carbon black was added to the pastes to improve the baseline resistances of the sensors. The response and response / recovery times of the sensors were improved compared to those fabricated from the same materials on glass substrates and reported in our work [1-6]. For example, the response of Fe2O3/NiO devices to propanol for a concentration range of 2500–5000ppm increasing with a step size of 500 ppm at room temperature was examined. It was found that no significant differences were observed between the responses of the sensors based on compositions 75/25, 50/50 and 25/75 mol. % Fe2O3/NiO. The sensors show the same response to propanol, which was increased as the propanol concentration increased. The response of the three sensors to 4000 ppm propanol was 14.2 % compared to the response of the sensors that were deposited on glass substrate, 8.6, 6.52 and 6.2 % [2]. This change in the devices behaviour may be due to the effect of may factors such as the change in, the microstructure, the film morphology, and the adhesion properties and materials electrodes. All these factors were fully discussed in this study. 1. K. Arshak and I.Gaidan, International Microelectronics and Packaging Society - JMEP,. Vol. 2, pp. 1551-4897,2005. 2. K. Arshak and I. Gaidan, Thin Solid Films, 495(1-2): p. 286-291, 2006. 3. K. Arshak and I. Gaidan, Thin Solid Films,. 495(1-2): p. 292-298, 2006. 4. K. Arshak and I. Gaidan, Sensors and Actuators B: Chemical,. 111-112: p. 58-62, 2005. 5. Materials Science and Engineering B, 2005. 118 (1-3): p. 44-49. 6. K. Arshak, and I. Gaidan,. Sensors and Actuators B: Chemical,. 118(1-2): p. 386-392, 2006.
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(close full abstract)

14:00 Carbon-based nanostructured hybrid composite layers for hydrogen peroxide chemical sensing
Authors : Jerzy Superata1, Izabela Janowska2, Cuong Pham-Huu2, Piotr Warszyński1 1. Polish Academy of Sciences, Institute of Catalysis and Surface Chemistry, Niezapominajek 8, Kraków 30-239, Poland 2. Laboratoire des Matériaux, Surfaces et Procédés pour la Catalyse, Louis Pasteur University, CNRS (LMSPC-ULP), 25 rue Becquerel, Strasbourg 67087, France
Resume : Hybrid carbonaceous nanostructured composite films were produced by combined bottom-up techniques. Metallic microwires were used as substrates either untreated or pretreated by electro- or chemical deposition including monolayer self-assembly of thiolated compounds. Purified carbon nanotube (CNT) samples were dispersed and functionalized in various ways with cationic small molecules or polyelectrolytes. Subsequently, they were combined with the Prussian Blue (PB) nanoparticles and deposited onto metallic substrates by physical, chemical or electrochemical methods being dispersed within polymer network or deposited as dense layer followed by its covering with protective/selective barrier. Alternative attempts were made using both the cationically functionalized CNT and PB nanoparticles to modify the substrate surfaces by Layer-by-Layer assembly technique thus forming electroactive multilayers. Both electric and sonic field energy was applied to facilitate synthesis, dispersion and/or deposition of the components. Electrocatalytic properties of the obtained films on the resulting microelectrodes were assessed by comparison of the cyclic voltammetry (CV) scans. Based on the present and past experimental results the general conclusion can be drawn that the better the electrochemical sensing
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performance the more efficient electron transport within the film structure is. Several best performing microelectrodes were selected for more detailed structural and functional characterization.

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14:00 Influence of nickel and cobalt catalyst layer properties on the growth of carbon nanotubes using DC plasma enhanced CVD

Authors : Sanjay K. Ram, Paramananda Biswas, Suman Banerjee, Anukul P. Parhi, Surajit Sarkar, Vandana Singh and Satyendra Kumar Department of Physics and Samtel Centre for Display Technologies, Indian Institute of Technology Kanpur, Kanpur-208016, India

Resume : The novel and remarkable electrical, mechanical and thermal properties of carbon nanotubes (CNTs) have made this a promising emergent technology with numerous potential applications. One such recent application of CNT is the deposition of MgO on multiwalled CNTs resulting in a high secondary electron emission (SEE) yield from the CNT-MgO system compared to pure MgO films. Our study involves the optimization of CNT morphology for such MgO-CNT multi-layers deposited in DC-PECVD, for application in dielectric-emissive layers of high definition plasma display panels. The nature of the catalyst layer used in the deposition of CNT plays a great role in controlling the shape, unidirectional alignment and separation of the nanotubes, which in turn determine the properties of the MgO-CNT layer. We have fabricated CNTs using DC-PECVD techniques on silicon and quartz substrates with a buffer layer of titanium film, and a catalyst layer of either nickel or cobalt. The MgO-CNT layers were characterized by scanning electron microscopy, Raman spectroscopy, atomic force microscopy and scanning tunneling microscopy. We were able to control the CNT layer properties by altering the size or density of the catalyst nanoparticles created by annealing of very thin films at high temperature. We accomplished controlled growth of aligned CNTs using different types and dimensions of catalyst nanoparticles of nickel and cobalt.

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14:00 OBTAINING BAMBOO – STRUCTURED, MULTIWALLED CARBON NANOTUBES USING THE SPRAY PYROLYSIS METHOD

Authors : O. Ţiprigan, A.A. Koósb, P. Nemes–Inczea, Z.E. Horváthb, Al. Darabont, L.P. Birób a Babeş–Bolyai University, Fac. of Physics, 400084 M. Kogălniceanu str., nr. 1, Cluj–Napoca, Romania b Research Institute for Technical Physics and Advanced Materials Science, Konkoly Thege str. 29-33, Budapest, H-1121 Hungary

Resume : In this paper we have investigated the synthesis of multiwalled carbon nanotubes by spray pyrolysis, which is a type of catalyzed chemical vapour deposition method*. As carbon sources we have used pyridine (C5H5N) and benzene (C6H6) and a mixture of these. As catalyst ferrocene Fe(C5H5)2 was added to the liquid carbon source. The thermal decomposition of ferrocene/benzene/pyridine solution was realized in an argon or nitrogen atmosphere. The obtained nanotubes were investigated by TEM. The TEM images indicate that the carbon nanotubes in most of case are \"bamboo-like\". * The experiments were carried out using a home-made experimental set-up.

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14:00 Effective purification of Double-Walled carbon nanotubes

Authors : H. N. Kang1, S. C. Lyu2 , I. H. Maeng3, J. H. Son3, W. S. Hong 1,2, K.W. Park 1,2, J. H. Sok 1,2 1. Department of Nano science & technology, University of Seoul, Seoul 130-743 .KOREA 2. Department of Nanotechnology, University of Seoul, Seoul 130-743 . KOREA 3. Department of Physics , University of Seoul, Seoul 130-743 . KOREA

Resume : High-quality double-walled carbon nanotubes (DWNTs) were synthesized without defects and amorphous carbonaceous particles by catalytic decomposition method at 800 in high yield. As-synthesized carbon materials almost consist of DWNT bundles with a diameter 14 – 25 nm. The diameter of DWNT is in the range 1.8 – 2.8 nm. The DWNTs rope have uniform diameter about 1 – 4 um and length up to several tens micrometer. We also investigate the crystallinity of DWNTs by TEM analysis and Raman spectroscopy. Our results also indicate that Tetra Hydro Furan (THF) is a very ideal carbon source for the synthesis of DWNTs. Simple purification process which removed amorphous carbonaceous particles and metal catalysts must be necessary for many applications of DWNTs. So we removed Mgo, Fe, and Mo which had been used to CNTs synthesis with an efficient method that did not give any damage to CNTs. The purification process comprises oxidation and acid treatment with CH3COOH, HCl. At the first step of purification process, we suggest that vertical type oxidation method more effective remove the amorphous carbonaceous particles than general horizontal type furnace at 420 . In the next step, we removed MgO with CH3COOH for 30~120 minutes, Fe and Mo metal particles with HCl for 10~30 minutes by magnetic stirring and ultra sonicataion method. After purification, purity of DWNTs was achieved about 96% with less than 1% of metal catalyst particles.

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14:00 CHARACTERLIZATION OF CNT BASED GAS SENSOR BY USING ORGAN-METAL CATALITIC SOURCE METHOD

Authors : Shin-ichi Aoqui, Ikuya Muramoto, Tamiko Ohshima (1), Tsuyoshi Ueda (2), Takamasa Sakai (3) Department of Electrical System & Computer Engineering, Sojo University, 4-22-1, Ikeda, Kumamoto 860-0082, Japan (1) Department of Electrical Engineering, Sasebo National College of Tech., (2) Graduate School of Science and Technology, Kumamoto University, 2-39-1 Kurokami, Kumamoto, 860-8555, Japan (3) Kumamoto Tech. & Industry Foundation, Tabaru 2081-10, Mashiki-machi, Kamimashiki-gun, Kumamoto, 861-2202

Resume : Ever since the discovery of carbon nanotubes (CNTs), a lot of efforts have been given to utilizing their unique electric, structural and chemical properties. That is to say, CNTs have been focus of considerable attention because of many possible applications in nanostructure, super strong materials, low friction materials, semiconductor, electron emitting device, hydrogen storage, gas sensor and gas occlusion materials. And also when an electric device is used for environmental application, many conditions must be satisfied such as low preparation cost, simple and safe preparation system and so on. Regarding to CNTs, several process methods such as arc discharge, chemical vapor deposition (CVD) and pulsed laser ablation (PLA) have been used to produce it. However, as for which methods as well, it isn\'t easy to apply the catalyst metal, which

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is necessary for the CNTs growth. In order to prepare CNTs based gas sensor, the way that we applied a catalysis organ-metal solution to a substrate and then it was burned out was used. This method is very unique, especially it has almost never used as the catalyst for the nanotubes. Nano size dots of catalytic metal such as Platinum (Pt), and Nickel (Ni), Palladium (Pd), Titanium (Ti) and Iridium (Ir) on several substrate preparation technique by burning of catalysis organ-metal solution had already been developed by pervious our work. In this study in order to prepare CNT based gas sensor we used 2 methods. One was conventional thermal CVD system and another one was pulsed laser ablation (PLA) assisted CVD system. In this method, pure graphite rod was irradiated by Nd:YAG laser within the heated furnace, and then carbon soot deposited in front of the sensor substrate. CNT based NOx gas sensors, which can operate at room temperature, were fabricated. Both CVD and PLA assisted CVD CNT thin films were grown on a substrate with interdigital Pt-electrode, which was also prepared by our unique method of Organ-metal solution source to develop gas sensor. Gas sensing property to NO and NO2 gases were measured. Resistance of the prepared CNT-based gas sensor decreased with increase of NO and NO2 gas concentration.

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14:00 Radiation modification of C60 fullerites doped with metals

Authors : Popenko V.I., Dmytrenko O.P., Kulish M.P.,Bulavin L.A.,Staschuk V.S., P.Sharf, Shpilevsky E.M., Pogorelov A.E., Shlapatskaya V.V.

Resume : The fullerite films doping can lead to molecules polymerization and changes of crystal structure. The polymerization can vary during radiative influence, particular with hight-energetic electrons bombardment. Obviously the transformation of electron structure takes place. But the character of the transformation considerably depends on type of doping atoms and radiation dose. In this work we present investigations of fullerite C60 films with penetrated Ag, Ti, Cu by the methods of simultaneous components deposition and deposition of near-surface metal layer and further it annealing. The complicated transformations of optical conductivity, photoluminescence, Raman scattering spectrums, X-ray`s diffraction were observed. The changes depend not only on doped atoms sort, their concentration and radiation damages but also on additional interaction appearing between fullerenes and metals. The interaction type is determined mainly by doped atoms type.

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14:00 Radiation-stimulated polymerization and destruction of thin C60 films

Authors : O.L. Pavlenko, O.P. Dmytrenko, M.P. Kulish, Yu. I. Prylutskyi, M.M. Bilyi, Yu. E. Grabovskyi, T. V. Rodionova, *V.V. Shlapatska, **O.E. Pogorelov, ***P.Scharff Department of Physics, Kyiv National Shevchenko University, Volodymyrska Str., 64, 01033 Kyiv, Ukraine *Institute of Physical Chemistry of NAS of Ukraine, pr. Nauky, 31, 03028 Kyiv, Ukraine **Institute for metal physics of NAS of Ukraine, pr. Venadskogo, 36, Kyiv, Ukraine ***Technical University of Ilmenau, Institute of Physics, D-98684 Ilmenau, Germany

Resume : The fullerites polymerization due to pressure and UV irradiation changes their properties because of electron, vibration and crystal structures transformations. During polymerization mainly the formation of dimmers takes place but interaction between molecules is different depending on applied conditions and parameters. Similar clustering can appear under low-energetic influence of bombardment particles. More complicated is high energetic electron and ion irradiation on C60 films due to destruction and polymerization of molecules simultaneously. The effects are also accompanied changes of electron and vibration spectra. In the work the ellipsometric, raman scattering, photoluminescence spectrums and X-ray`s diffraction for C60 films irradiated with high energetic electrons (Ee=1.8 MeV) and Fe+ ions are investigated. It is shoved that transformation of investigated spectrums takes place and that proves about changes in polymerization mechanisms and proportion of dimerized and destructed molecules.

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(close full abstract)

14:00 Radiation modification of durability properties of nanocomposites of isotactic polypropylene with nanotube films.

Authors : (1) T.M. Pinchuk, (1) T.P. Didenko,(1) O.P. Dmytrenko, (1) M.P.Kulish, (1) Yu.E. Grabovskyy,(1) Yu.I. Prylutskyy,(1) M.A. Zabolotnyy,(2) Yu.I. Sementsov,(3) P. Scharff, (4) V.V. Shlapatska (1) Kiev National Shevchenko University, Vladimirskaya Str, 64, 01033 Kiev, Ukraine (2) Institute of Surface Chemistry of NUAS, General Naumov Str.,17, 03164 Kiev, Ukraine (4) L.V. Pisarghevsky Institute for Physical Chemistry of NUAS, 40 Nauka Boulevard, 03650 ?iev, Ukraine

Resume : Nanotubes are one of the important components at producing of composites with polymers at a necessity the noticeable increase of their durability properties. For growth of composites durability often the weak junction of macromolecules with nanotubes is the most substantial barrier. In the case of application of multi-walled nanotubes by substantial appearance to promote durability of composites appears impossible because the weak interlayer Van-der-Vaals interaction. One of the effective methods of increase of durability of polymeric composites with nanotubes is their radiation modification by the high-energetic irradiation. Such irradiation can to improve the interface of components due to creation of free radicals as well to increase durability of nanotrubes at sewing together of their layers also. Nanocomposites of polypropylene with the multi-walled nanotubes were synthesized by the method of the chemical besieging at high temperature extrusion. Then the samples were exposed to the rays by electrons with the energy E =1,8 MeV and absorption dose from 0,2 to 1,0 MGy. Concentration of nanotubes in composites changed from 0,1 to 5%. There are complex concentration and dose dependences of maintenance of crystalline phase, parameters of lattice, microhardness and the positions of D, G and also two-phonon band G? of the Raman dispersion, which testify about of the changes of mechanisms of interaction both between macromolecules and nanotubes and between the layers of nanotubes.

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14:00 Transformation of nanotube vibrational spectra with radiation damages.

Authors : S.V. Lizunova(1), O.P. Dmitrenko(1), M.P. Kulish(1), Yu.I. Prylutskyy(1), M.M. Belyi(1), E.V. Prylutskyy(2), V.V. Shlapatskaya(3) (1) Kyiv National Shevchenko University,Departments of Physicsa and Biophysicsb, Volodymyrska Str. 64, 01033 Kyiv, Ukraine (2) Frantsevich Institute for Problems of Material Science NAS of Ukraine, 03680, Ukraine, Kyiv-142 Krzhizhanovsky str., 3 (3) Pisarghevskiy Institute of Physical Chemistry of NAS of Ukraine, pr. Nauky, 31, 03028 Kyiv,

Ukraine
Resume : The appearance of Raman D-band the intensity of which is comparable with that of G-band of tangential vibrations is typical to multiwalled carbon nanotubes as well to disordered graphite. The appearance of this band indicates on considerable defects of this nanotubes, appearing with their synthesis. However, it is note that the G-band and especially two-phonon G\'-band correlates with nanotube defect structure also. It is clear that destruction of nanotubes as well as intralayer lacing, which can essentially influence on nanotube crystalline structure and their vibrational spectra, can progress depending on type and energy of irradiating particles as well their dose. In this work the Raman spectra and crystalline structure of multiwalled carbon nanotubes synthesized by chemical precipitation with various absorption doses of high-energy electron irradiation are investigated. It indicates on noticeable changes of G-band fine structure, sizes of coherent scattering blocks and microdistortion with increasing of electron flux, in which the particle energy is 1,8 MeV. This indicates about of reconstruction of nanotube radiation defects, which is determined of their damages and intralayer lacing.

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14:00 Ionized Physical Vapour Deposition, IPVD, combined with PECVD, for synthesis of carbon-metal nanocomposite thin films
Authors : P.Y. Tessier1, E. Luais2, M. Boujtita2, A. Granier1, B. Angleraud1 1Université de Nantes, CNRS, Institut des Matériaux Jean Rouxel, IMN, UMR 6502, France 2Université de Nantes, CNRS, Laboratoire d'Analyse isotopique et Electrochimique de Métabolismes, LAIEM, UMR 6006, FRANCE
Resume : An original process has been developed for the deposition of metal/carbon nanocomposites thin films. The process combines ionized physical vapour deposition IPVD by magnetron sputtering with plasma enhanced chemical vapour deposition, PECVD. For IPVD, the sputtered atoms are ionized in an additional plasma generated by a RF coil. This RF plasma is also used for the dissociation of the gaseous precursor. The plasma is a mixture of methane and argon. The synthesis of the a-C:H carbon matrix is governed by the PECVD parameters. The amount of metal in the a-C:H film is controlled by the IPVD parameters. The main interest of this hybrid process is that the PECVD discharge is independent from the magnetron discharge leading to a wide range of deposition conditions. Moreover, one can take advantage of the unique performance of the IPVD process: ionization of a high fraction of the sputtered metal atoms in the plasma and control of their energy and directionality towards the substrate. Ti/a-C:H and Cu/a-C:H nanocomposite films are deposited on silicon substrates. Deposition rate, composition and microstructure are studied as a function of the main parameters of the process: target power, RF coil power, pressure and composition of the discharge gas. SEM, XPS, FTIR and Raman spectroscopies are used for this study. OES is performed in order to make the link between the plasma properties and the film microstructure.

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14:00 Si-DOPED CARBON NANOFILMS BY PULSED LASER DEPOSITION
Authors : T. Csako Department of Optics and Quantum Electronics, University of Szeged, P.O. Box 406, 6701 Szeged, Hungary, O. Berkesi Department of Physical Chemistry, University of Szeged, P.O. Box 105, 6701 Szeged, Hungary, I. Kovacs Department of Surface Chemistry and Catalysis, Institute of Isotope, CRC HAS, P. O. Box 77, 1525 Budapest, Hungary G. Radnoczi Research Institute for Technical Physics, Department of Materials Science and Thin Films, P.O. Box 49, 1525 Budapest, Hungary T. Szorenyi Department of Natural Sciences and Environmental Protection College of Dunaujvaros, 2401 Dunaujvaros, PO Box 152, Hungary, and LaserSkill Ltd., Kalvaria sgt. 24., H-6722 Szeged, Hungary
Resume : A novel approach to fabrication of a-C:Si films: ablation of a commercially available silicone oil, Dow Corning's DC-705 with femtosecond pulses is reported. Films are grown by gently focusing extremely clean 700 fs pulses of ~15 mJ@248 nm of a hybrid dye/excimer laser system onto the target surface in high vacuum. The evolution of the chemical structure of film material is followed by comparing the FTIR spectra of films deposited onto KCl substrates at temperatures between RT and 250 ºC. Despite minimum target heating in the spectrum of films deposited at RT the fingerprint of the silicone oil can clearly be identified. With increasing substrate temperature the contribution of the oil features gradually diminishes, but does not completely disappear even at 250 ºC. This result is intriguing since the chance of oil droplets to survive in their original liquid form at this temperature at 10-3 Pa should be minimal. Reflection mode optical microscopy and low magnification scanning electron microscopy reveal that the films are inhomogeneous: areas of lateral dimensions ranging from tens to hundreds of micrometers, possessing different contrasts can be identified. On the other hand, surface mapping by FESEM and AFM unambiguously proves that all films possess a solid surface built of nanoparticles of <100 nm dimension, without the presence of any drop of oil. The most probable explanation of the results is that the films are oil - solid a-C:Si nanoparticle composites.

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(close full abstract)

14:00 Carbon-Polymer Nanocomposites by Jet-Cooled Cluster Beam Deposition
Authors : Luisa D'Urso,Giuseppe Compagnini, Orazio Puglisi and Antonino Scandurra.
Resume : Composite thin films have been deposited by low-energy cluster beam deposition starting from a PTFE target. Photoinduced dehydrohalogenation, with wavelength below 300 nm, of halogenated polymers is a known technique for the production of carbon chains. Here we show that a pulsed visible (532 nm) laser vaporization source can be successfully used to deposit, in one step, carbon cluster with a high-density sp-hybridized carbon atoms into a fluorinated polymer matrix with composition and structure depending on the experimental conditions. Composite thin films with F/C ratio ranging from 0.6 to 1.6 have been obtained. Photoelectron (XPS) and vibrational (Raman and FT-IR) studies conducted in a vacuum before and after the degradation have been of fundamental importance for the understanding of the conversion mechanism of polycumulene and polyyne to graphene-like species. Kinetic data show that the sp carbon chains tend to cross-link to sp2 hybridizations by a second-order kinetic law, suggesting the necessity of a reaction between sp linear chains. The obtained cross-linking rate is 2 times faster for the polycumulene structure than for polyyne, confirming the higher stability of the polyynic configurations. More detailed experiments are underway in our laboratory to clarify the role of fluorine atoms and matrix in the polyyne and polycumulene formation and reactivity.

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14:00 Carbon based polyimide nanostructured composite films.
Authors : A.Valozhyn, A.Sontsau, L.Yakimtsova, L.Krul, M.Zenker, J.Subocz
Resume : It is known that polyimides are superingeneering plastics with exellent heat resistance,electrical insulation and mechanical strength properties. They are widely applied in many advanced technologies for fabrication of adhesives, coatings and varioys composites. The polyimides used were usual poly(diphenylether)pyromellitimides which were synthesized by usual method. Mulitiwallrd carbon nanotubes (MWCNT) were synthesized in gas-phase nonequilibrium plasma process (high voltage atmospheric pressure discharge plasma) and contained up to 10% of carbon nanofibers. Polyimide composites were obtained by incorporation of MWCNT suspension in o-xylene to polyamic acid solution in dimethylformamide followed by stirring of obtained mixture. Strong black coloured composite films were obtained after polyamic acid-MWCNT mixtureas casting on glass supports and thermal dehydration. Thermal, mechanical and some electrical properties of of polyimede composite films with 0.05-0.15% of MWCNT have been investigated. A13 26
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Electronic structure & electrical properties II : Anne Sophie Loir, N.N.

16:30 Onion-like carbon based polymer composite films in microwaves
Authors : P.P. Kuzhir, S.A. Maksimenko, D.S. Bychanok, Institute for Nuclear Problem of Belarus State University, Belarus; A.V. Gusinski, O.V.Ruhavets, Belarusian State University of Informatics & Radioelectronics, Belarus; V.L. Kuznetsov, S.I. Moseenkov, Boreskov Institute of Catalysis SB RAS, Russia; O. Shenderova International Technology Center, USA; Ph. Lambin FUNDP – University of Namur, Belgium
Resume : The electromagnetic (EM) properties of a novel technological material - onion-like carbon (OLC) [1] – reported in [2], demonstrate their possible high potentiality for the design of wide-band microwave absorbers in the form of OLC-based composites. A consistent analysis of the dielectric response of polymethyl methacrylate (PMMA) and polydimethyl siloxane (PDMS) with 1-3 wt.% of OLC fillers has been carried out in the frequency range 26-37 GHz. The spectral dependences of the complex permittivity and permeability of OLC-PMMA and OLC-PDMS composites have been studied in relation with the synthesis conditions and the nanocarbon physical-chemical properties (different types of sp2-sp3 hybridization, geometry of nanoclusters, etc). To reach the overall goal of the study - proposition of new EM shielding materials with controlled properties – the OLC agglomeration processes and its influence on the nanocomposites EM response have been analyzed along with the role of different host media. The research has been supported by NATO CBP.NR.SFPP-981051, INTAS 06-1000013-9225, the Belarus FFR F06R-091, the Russian FBR (grants 05-03-32995 and 06-03-81038) and the Ministry of Science and Education of Russian Federation (grant RPN 2.1.1.1604). [1] V.L. Kuznetsov et al, Chem. Phys. Lett. 222 (1994) 343 [2] S.A. Maksimenko et al, Diam. Rel. Mat. 16 (2007) 1231 A14 1
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16:50 C-cage based ultra low-k materials for on-chip interconnect structures
Authors : Chumakov1 , K. Zagorodniy2, D., C. Täschner2, A. Lukowiak3, H. Stegmann 4, D. Schmeisser5, H. Geisler1, H.J. Engelmann1, H. Hermann2 and E. Zschech1 1 AMD Saxony LLC & Co. KG, Wilschdorfer Landstraße 101, D-01109 Dresden, Germany 2 IFW Dresden, Helmholtzstraße 20, D-01069 Dresden, Germany 3 Wroclaw University of Technology, Smoluchowskiego 25, PL-50-370 Wroclaw, Poland 4 Zeiss NTS, Manfred-von-Ardenne Ring 20E, D-01099 Dresden 5 BTU Cottbus, Konrad Wachsmann Allee 17, D-03046 Cottbus, Germany
Resume : On-chip interconnect structures of high performance microprocessors are integrated using the low-k materials. Currently Organo- Silicate Glasses (OSG) with OH- methyl groups are used. The reduction of the dielectric constant is due to the reduced molecular polarizability and reduced density. Next step on the industry's roadmap is to introduce porosity into these materials. All these steps inevitably lead to a reduction of mechanical reliability of the dielectric films, and increase of their susceptibility towards damages and modifications during manufacturing process flow. C-cage based materials possess potential to become an alternative to the SiO2- based ones. The new class of insulators based on a three-dimensional network of C60– one of the most stable modifications of carbon – is proposed. It will be shown that modeling of the proposed 3D network structure forecasts a material with excellent dielectrical and mechanical properties satisfying the demands of the ITRS. First test films were deposited by a sol gel method and characterized by XAS, AFM and TEM. A14 2
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17:10 Wave packet dynamical simulation of electron transport through graphene nanodevices
Authors : G. I. Márk1, L. P. Biró1, Ph. Lambin2, and L. A. Chernozatonskii3 1 Research Institute for Technical Physics and Materials Science, H-1525 Budapest, P.O.B. 49, Hungary 2 Département de Physique, Facultés Universitaires Notre-Dame de la Paix, 61 Rue de Bruxelles, B-5000 Namur, Belgium 3 Institute of Biochemical Physics, Russian Academy of Sciences, 119991, Moscow, Russia
Resume : Devices made from graphene stripes [1] are potential building blocks for future nanotechnology based on their electronic structure. Formerly we calculated the propagation of electronic wave packets of different kinetic energies in graphene electronic waveguides [2]. In this paper we extend our simulations to several more complicated geometrical configurations, including Y- junctions cut from graphene sheets. The wave packet dynamical simulation makes it possible to study the details of electron transport through graphene nanodevices. [1] L. Tapasztó et al: Tailoring the atomic structure of graphene nano-ribbons by STM lithography (submitted) [2] G. I. Márk et al: Wave packet dynamical simulation of electron transport through a line defect on the graphene surface; Physica E (2007), doi:10.1016/j.physe.2007.09.016 A14 3
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17:30 Onion-like carbon based composite films: theoretical modeling of electromagnetic response
Authors : R. Langlet, Franche-Comté University, Besançon, France; Ph. Lambin, A. Mayer, FUNDP – University of Namur, Belgium; P.P. Kuzhir, D.S. Bychanok and S.A. Maksimenko Institute for Nuclear Problem of Belarus State University, Belarus
Resume : Onion-like carbons (OLC) [1] obtained by thermal transformation of detonation nanodiamonds are studied theoretically as a basic absorbing component of nanocomposite films aimed at providing wide band EM absorbing coatings. The present work is devoted to an analysis of the permittivity of thin films of polymer containing OLC clusters. Atomistic calculations [2]

demonstrates that the static polarizability of spherically-shaped assemblies of arrays of fullerenes, modeling real agglomerated OLC materials, is weakly dependent of the actual geometry of its constituent molecules and is proportional to the volume of the whole cluster. The OLC-based composite has been simulated by using two different fullerenes (C60 and C80) embedded in a parallelepiped unit cell filled with a dielectric medium. Periodic boundary conditions were applied in two directions to represent a thin film. Electromagnetic modeling of static polarizability of isolated fullerenes and OLC structures is used to evaluate the effective parameters relevant for OLC-based composites. The theoretical estimates are in good agreement with the Maxwell-Garnet theory as well as recent experimental results on the microwave characterization of OLC-based composite films. This work was supported by NATO SFP-981051, INTAS 06-1000013-9225, Belarus FFR F06R-091. [1] Kuznetsov V L et al, Chem. Phys. Lett. 222 (1994) 343 [2] Mayer A et al, Appl. Phys. Lett. 89 (2006) 063117 A14 4

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