International Conference on Advanced Optical Materials and Technologies ICAOMT – 2018

27-29 April 2018, Borovetz Bulgaria

Supported by the National Science Fund, Project ДФНИ Т-02 /26

Preface

Dear Participants and Guests,

The organizing Committee of ICAOMT – 2018 warmly welcomes you to join the International Conference on Advanced Optical Materials and Technologies (ICAOMT-2018, http://www.iomt.bas.bg and http://physics.uctm.edu/icaomt_2018/), held on April 27-29, 2018 in Borovetz, Bulgaria.

The aim of ICAOMT – 2018 is to provide a platform for researchers from different fields to present their research results and development activities in optical materials and technologies, energy technology, nanotechnologies, and functional materials.
It provides opportunities for the participants to exchange new ideas and application experiences, to establish research relations and to find partners for future collaborations.

The conference is organized by the Institute of Optical materials and Technologies (IOMT), Institute of Solid State Physics (ISSP), University of Chemical Technology and Metallurgy (UCTM) and financially supported by *National Science Fund, Project* ДФНИ Т-02/26.

With our warmest regards,
Vera Marinova

Conference Organizing Chair - IOMT
Sofia, Bulgaria

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Financial support by the National Science Fund, Project ДФНИ Т-02/26

Program Schedule ICAOMT (27-29.04.2018)

1st day Friday (27.04.2018)

Arrival and registration

12:00 Registration
13:00 Lunch

Chair P. Rafailov

16:00 Welcome and introduction to the ICOMAT *V. Marinova, N.Malinowski*

Section I

16:10 Porous materials and structures for optical sensing applications *T. Babeva*

16:35 Next generation magnetic materials (multiferroics) for application in electronics *S .Kolev*

17:00 Flexoelectric studies of nematic materials for electro-optical devices *Y.Marinov*

17:25 Application of XPS for understanding Graphene and its properties *I.Avramova*

17:50 Direct Raman spectroscopy identification of alkali halides nanowires encapsulated in single wall carbon nanotubes *V. Ivanov*

19:00 Dinner

2nd day Saturday (28.04.2018)
Section II

Chair S.Kolev

09:00 Modification of Carbon Nanostructures for Energy Storage and Environmental Applications *C.Trapalis*

09:30 Growth and characterization of graphene layers *P.Rafailov*

09:55 Two-dimensional superconductor materials *D.Dimitrov*
10:20 Atomic Layer Deposition on Flexible Substrates *B. Blagoev*

10:45 Coffee break

Chair I. Avramova

11:00 Graphene-based organic/inorganic hybrid devices *V.Marinova*

11:25 Tin and Indium Oxide Films for Use as Large Area Position Sensitive Photodetector *V.Zhelev*

11:50 Advanced Oxide and Non-Oxide Materials for Multifunctional Applications *T.Petkova*

12:15 Anodic behavior and composition of films obtained on zinc in water solutions of oxalic acid *E. Lilov*

13:30 Lunch

Section III

Chair D. Dimitrov

16:00 Incorporation of PE6800-templated mesoporous thin film within Bragg reflector for optical sensing application *R. Georgiev*

16:15 Nanocrystalline ZnO thin films formed by electrospray and electrochemical deposition *G. Marinov*

16:30 Coffee refreshment

16:45 Preparation and microstructural characterization of dielectric oxide glass-ceramics for electronic and optoelectronic applications *R.Harizanova*

17:10 On adsorption fluctuations during deposition of monolayer thin films *Olga Jakšić*

17:30 Closing remarks and conclusions

19:30 Farewell Diner

3rd day Sunday (29.04.2018)
Departure -11 a.m

Invited Lectures

1. Prof. Dr. Christos Trapalis, NCSR Demokritos, Athens Greece
2. Prof. Olga Jakšić, Institute of Chemistry, Technology and Metallurgy, University of Belgrade, Serbia
3. Prof. Dimitre Dimitrov, ISSP, Bulgarian Academy of Sciences
4. Prof. Tamara Petkova, IEES, Bulgarian Academy of Sciences
5. Prof. Dr. Ruzha Harizanova, Department of Physics, UCTM, Bulgaria
6. Prof. Ivalina Avramova, IGIC, Bulgarian Academy of Sciences
7. Prof. Svetoslav Kolev, IE, Bulgarian Academy of Sciences
8. Prof. Tzvetana Babeva, IOMT, Bulgarian Academy of Sciences
9. Prof. Victor Ivanov, Sofia University, Sofia
10. Dr. Veselin Zhelev, Department of Physics, UCTM, Bulgaria
11. Prof. Peter Rafailov, ISSP, Bulgarian Academy of Sciences
12. Prof. Vera Marinova, IOMT, Bulgarian Academy of Sciences

Seminar Speakers

1. Prof. Yordan Marinov ISSP, Bulgarian Academy of Sciences
2. Prof. Blagoy Blagoev, ISSP, Bulgarian Academy of Sciences
3. Dr. Emil Lilov, Department of Physics, UCTM, Bulgaria
4. Rosen Georgiev, PhD candidate, IOMT, Bulgarian Academy of Sciences
5. Georgi Marinov, PhD candidate, IOMT, Bulgarian Academy of Sciences

Abstracts booklet

Modification of Carbon Nanostructures for Energy Storage and Environmental Applications

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During the last few years a great research effort has been devoted on the design and development of novel nanostructured materials with high technological importance. Large part of this effort is focused on carbon nanostructures and their derivatives like fullerenes, carbon nanotubes (CNTs) and graphene nanosheets. These nanostructures have interesting mechanical, optical and electrical properties and can be used in a wide range of technological applications, such as nanoelectronics, flexible displays, batteries, photovoltaics, electromagnetic interference shielding, supercapacitors, polymers, ceramics or other nanocomposite materials. The quality of the nanostructured composite material is dependent on the characteristics of the carbon nanostructures (purity, size and size distribution, number of defects) and on the degree of dispersion in the certain inorganic or organic matrix.

Important factors affecting the homogenous incorporation of carbon nanostructures in to the selected matrix are their dispersion in a common solvent and their surface modification with functional groups that increase the chemical interactions between carbon nanostructures and surrounding matrix.

In this presentation the modification/functionalization of CNT and Graphene nanosheets and nanostructured composites suitable for energy storage devices, as well as for air pollutants oxidation is described.

Initially, the role of modifiers in exfoliation and reduction of GO at different pH conditions and different weight ratios of GO/modifier for application in supercapacitors, is presented. The specific capacitance of the materials estimated performing cyclic voltammetry (CV) and electro-chemical impedance spectrometry (EIS) measurements using KCl aqueous solution as an electrolyte and three-electrode configuration is determined. The real operating conditions simulated by fabrication of EDLC cells based on organic electrolyte such as TEABF4 and employing the electrochemical testing via CV and EIS in two-electrode configuration is demonstrated.

In addition, the coupling of TiO_2 semiconductor with surfactant stabilized graphene (ssG) and reduced graphene oxide (rGO) is also discussed. TiO_2/graphene composites with different graphene content synthesized and comparatively investigated with emphasis on their efficiency in photocatalytic removal of NOx pollutants from ambient air. It was revealed that the photocatalytic performance of the composites in NOx removal was enhanced. The enhancement was attributed to the interaction between TiO_2 nanoparticles and graphene nanosheets. The graphene is acting as electron traps in the case of ssG and photosensitizer in the case of rGO. The enhancement was more prominent under visible light where the rGO is activated. Second, the composite photocatalysts exhibited low NO_2 release with the addition of ssG and rGO, which was related to affinity of NO_2 molecules to graphene nanosheets. The De-NOx efficiency of TiO_2/rGO photocatalysts was significantly increased which renders such materials promising photocatalysts for NOx removal from ambient air.

On adsorption fluctuations during deposition of monolayer thin films

Olga Jakšić[1] and Vera Marinova[2]

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The interest in Graphene, a 2-dimensional (2D) material formed of carbon monolayers, is still high because of its preeminent mechanical, electrical and optical properties favorable in nano- and optoelectronic device applications and successful methods for obtaining good quality graphene films have already been achieved. Apart from obtaining graphene films, chemical vapour deposition (CVD) and atomic layer deposition (ALD) are utilized for growing additional layers on graphene for device implementation. Adsorption and desorption processes that take place in repeated pulses of atomic layer deposition of thin films, are basically stochastic in nature. Here we focus on ozone adsorption on graphene because it is illustrative: it binds through different mechanisms (physisorption, chemisorption) modeled with different desorption energy, or with different orientations modeled with different molecular surface projection areas [1-2]. So far, various tools have been developed for analytical and numerical investigations of fluctuation kinetics of adsorption in time domain and fluctuation dynamics of adsorption in frequency domain. We present review of these tools for the example of ozone adsorption on Graphene. A software package, designed in MathWorks MATLAB environment, based on these theoretical models and simulation algorithms has been developed in ICTM Centre of Microelectronic Technologies and used for investigations of fluctuations in adsorption phenomena.

Acknowledgements
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References

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Porous materials and structures for optical sensing applications

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Abstract

Optical sensing is an approach of detecting chemical substances by measuring different optical signals, for example, absorption, reflection, luminescence, fluorescence, etc. The sensitive element (receptor) identifies the analyte and changes some of its parameters. It is connected to transducing element that transforms the receptor's change into measurable signal suitable for further processing by the detector. Immunity to electromagnetic disturbances, safety when working with easily inflammable and explosive substances, low cost and simple operational principle are some advantages of optical sensing that justify the increasing scientific interest in this way of sensing.

The presentation will outline the idea behind the optical sensing and its corresponding advantages and limitations. The development and utilization of sensitive materials as receptors will be described. This includes deposition of thin films from nanosized zeolites, polymers, oxide-zeolite nanocomposites and mesoporous oxides using sol-gel, spin coating and electrospray ionization methods and characterization of their structural, morphological, optical and sensing properties. Optical sensing will be illustrated by examples from our studies: sensing of VOC's and humidity by visual detection of color using smart photonic structures and sensing with optical fiber coupler covered with hydrophobic zeolite films through monitoring of resonance wavelength shift.

Acknowledgement

The support of Bulgarian Science Fund under the project FNI T-02/26 is acknowledged. T. Babeva gratefully appreciates the collaborative work with Prof. Mintova's group from LCS-Caen, France and Prof. Andreev's group from ISSP-BAS.

Next generation magnetic materials (multiferroics) for application in electronics

Svetoslav Kolev and Tatyana Koutzarova
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Abstract

The magneto-electrics (ME), by virtue of possessing simultaneously ferroelectric and ferromagnetic properties, have recently stimulated rapidly growing scientific research on the fundamental relations between spin, charge and lattice degrees of freedom, and on the possibilities for applications in innovative multifunctional devices such as spintronic devices, sensors of electric and magnetic fields, electrically controllable microwave elements etc.
The **multiferroics** are multifunctional materials where two or more of the primary ferroic properties (ferromagnetism, ferroelectricity, ferroelasticity, ferrotoroidicity) coexist. The interest in **magnetoelectric multiferroic** materials in which ferroelectricity and ferromagnetism are both present is due to the **magneto-electric effect** (fig.1). The magneto-electric effect allows one to manipulate the magnetic phase by an external electrical field and/or manipulate the electric phase by an external magnetic field.

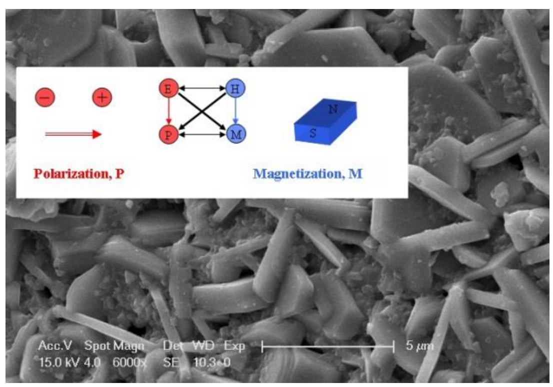

Fig.1 Magneto-electric effect.

In particular, new knowledge will be acquired related to the preparation and the characterization of the structural, magnetic, magneto-electric and microwave properties of **novel structures** based on single-domain magneto-electrics of the class of **hexaferrites** ($(Ba(Sr)_2Me_2Fe_{12}O_{22}$ and $Sr_3Me_2Fe_{24}O_{41}$, where Me = Mg, Zn, Ti, Al, Cu, Co).

Studies are also envisaged of **phase transitions** by following temperature or pressure driven changes in the short and long-range order in order to elucidate the interplay between local structural distortions and global magnetoelectric properties. Special emphasis will be placed on explaining the influence of the presence of magneto-electrics in these structures on the fundamental causes of their magnetic and microwave properties.

The improved fundamental understanding of the contradictions between magnetism and ferroelectricity lead to the identification of new routes of combining them, while the availability of modern synthesis techniques allow a precise control over the crystalline perfection and chemical stoichiometry in samples large enough to allow for accurate characterization.

Direct Raman spectroscopy identification of alkali halides nanowires encapsulated in single wall carbon nanotubes

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Abstract

Identification and characterization of materials encapsulated in carbon nanotubes is a subject of long standing research. Another important issue concerns the experimental assessment of degree of functionalization of the filler material to the walls of the nanotube. We address the two questions in the case of potassium iodide (KI) 1D crystals (nanowires) of 2×2 and 3×3 cross section grown inside single wall carbon nanotubes (SWCNT), by means of DFT lattice dynamics calculations, HRTEM and Raman spectroscopy. The DFT calculations show stable ground state structures for the freely standing KI nanowires with positive phonon frequencies over the whole 1D Brillouin zone. The calculated interatomic distances correspond to a high precision to the values obtained from HRTEM images. Raman spectra of KI@SWCNT composites reveal several additional lines in the spectral range below the radial breathing mode (RBM) of the surrounding nanotube. Their frequencies match well with the calculated Γ-point modes of the freely standing 2×2 and 3×3 KI nanocrystals with exception of the two radial KI vibrations, which are observed experimentally at higher frequencies. The frequency upshift of the radial nanowire vibrations evidence for a significant van der Waals pressure exerted on the KI crystal from the surrounding SWCNT.

Application of X-ray photoelectron spectroscopy for understanding Graphene and its properties

Ivalina Avramova

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Abstract

Graphene is a two dimensional allotrope of carbon. It is a potential candidate in various applications due to its extraordinary properties such as: photovltaics, catalysts, fuel cells, batteries, sensors, OLED, filters and so on. The area of applications can be expanded through interfacing graphene with other materials. Most methods of synthesis of graphene are complicated and expensive, so there is need for cheaper, simpler and more efficient way of producing it. The detailed understanding of graphene needs accurate surface characterization. Because the surface is the point of interaction with the external environment, the X-ray Photoelectron Spectroscopy (XPS) is a perfect technique for characterizing graphene. The basic principle of XPS will be presented in brief. The XPS results obtained for the graphene or graphene related phases on (001)Si substrates will be discussed in details as an example.

Preparation and microstructural characterization of dielectric oxide glass-ceramics for electronic and opto-electronic applications

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Abstract

The synthesis of inexpensive materials with advanced electrical and electro-optical properties is an important task nowadays. Thus, the main goal of the present investigation was the synthesis of glasses in the system $Na_2O/Al_2O_3/BaO/TiO_2/B_2O_3/SiO_2$ with additions of SrO from which, after appropriate thermal treatment, barium titanate or Sr-substituted barium titanate will be crystallized. The prepared glass-ceramics show different crystallization behaviour, volume fractions of the crystal phase as well as different particle sizes, depending on the ratio of the Na/Al-oxides. The phase composition analyses by X-ray diffraction reveal precipitation of cubic barium titanate, $BaTiO_3$ or strontium-barium titanate, $Ba_{1-x}Sr_xTiO_3$ and for thermal treatments at higher temperatures and for longer annealing times - of additional crystalline phase, i.e. fresnoite, $Ba_2TiSi_2O_8$. Scanning electron microscopy proves the occurrence of blackberry-like barium titanate or barium-strontium titanate crystals with dense-branching morphology in the prepared glass-ceramics. Additionally, polygon-shaped bright crystals are observed. The energy dispersive X-ray spectroscopy, EDXS analyses performed on the crystals show that the polygons correspond most likely to fresnoite while the blackberry structures are with elemental composition matching the barium or barium-strontium titanate phase.

Position sensitive photodetectors on the base of silicon and thin SnO2 and In2O3 films

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Abstract

The aim of the present work is to prepare a position sensitive structure acting on the base of lateral photoeffect. A few studies have been reported on large area photodetectors with structure “metal-oxide –semiconductor” in which the metal is changed with a high conductive and transparent “metal oxide” layer. Such devices are able to determine precisely the location of an incident light spot over the oxide surface and act as position sensitive sensor. In our work two type of such structures were obtained using high conductive and transparent In_2O_3 and SnO_2 thin films, deposited over heated silicon substrates with native SiO_2 surfaces, by the method of spray pyrolysis. To achieve a low sheet resistance the films were doped with proper additives in optimal concentration. Arsenic was used as a dopant for SnO_2 films, and for films of In_2O_3 dopping was realized with tin from $SnCl_4$ solution. Characterization of the films was provided with XRD, SEM, AFM and UV-VIS spectroscopy. For lateral photovoltage (LPV) measurements samples with structure Si-SiO_2-SnO_2:As and Si-SiO_2-In2O_3:Sn were cut into rectangles. The resulting lateral photovoltage was measured using standard lock-in technique. The position sensitive characteristics are symmetric to the zero and linear in all of the active area.

Growth and characterization of graphene layers

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Abstract

Films of monolayer and few-layer graphene were grown on copper foil substrates by chemical vapor deposition (CVD) using methane. The obtained samples were characterized by resonant Raman spectroscopy analysis using the unique phenomenon of double-resonant scattering; SEM and AFM analysis. The flux geometry of the reactant gases is found to have influence on the number of layers of the deposited graphene films. Effects of the substrate roughness and its composition on the quality and the Raman response of the grown layers are discussed.

Acknowledgements

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Two-dimensional superconductor materials

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Abstract

Currently there are theoretical suggestions and experimental evidences that superconductivity can be remarkably enhanced in the two-dimensional (2D) limit. Superconducting ordering temperatures and critical current densities, in particular 2D materials, may even exceed those in the corresponding bulk by a significant margin. In this presentation the recent progress in two-dimensional superconductors with atomic-scale thickness is reviewed. The superconducting systems of interest involve graphene and atomic sheets of transition metal dichalcogenides ($NbSe_2$), $TiSe_2$ and post-transition metal dichalcogenides ($SnSe_2$). Thin films or layered materials deposited on substrates lead to systems with modified band structure and sometimes considerably improved superconducting parameters. By shifting the chemical potential over a wide range, correlated states can be controlled to a large extent, leading to new symmetry breaking fields, such as charge order, structural transitions, broken spin-degeneracy due to spin-orbit interaction and new unconventional superconducting properties. The growth and optimization of novel two-dimensional materials, down to a single atomic layer, via chemical vapour deposition (CVD), molecular beam epitaxy (MBE) or atomic layer deposition (ALD) are reviewed.

Graphene-based organic/inorganic hybrid devices

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Abstract

Recently, graphene shows enormous potential to extend the landscape of photonic and optoelectronics technology owing to its exceptional optical and electrical properties [1]. Moreover, it is regarded as an excellent candidate to replace conventional indium tin oxide (ITO) electrodes due to its outstanding features as very high conductivity, excellent transparency in a broad spectral range, low sheet resistance, etc. [2]. Various applications of graphene as conductive electrode in field-effect transistors (FETs), sensors, integrated electronic circuits, solar cells, light emitting diodes and other optoelectronic devices have been reported [3].

We demonstrate varieties of graphene-based organic-inorganic hybrid devices assembled by highly photoconductive materials and strongly birefringent liquid crystals (LC), supported by excellent transmittance and conductivity of graphene. Measured modulation characteristics and response time of the proposed devices show phase modulation ability and very high contrast ratio competitive to the same devices, using ITO electrodes. By projecting video images fast response of modulated pump light intensity is demonstrated, revealing applications in optical image processing and display technology.

Acknowledgements

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Flexoelectric studies of nematic materials for electro-optical devices

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The soft matter nanostructured materials like liquid crystal systems, gels, etc. exhibit a remarkably rich phase behavior leading to a wide range of viscoelastic and electro-optical properties. The development and understanding of those advanced materials require a detailed knowledge of their functional responses as flexoelectric, dielectric and optical ones.

In this presentation, we will report details of flexoelectric and electro-optical measurements of nanostructured nematics. Nanoconfined nematic system of 4-*n*-heptyl cyanobiphenyl liquid crystal (7CB) containing hydrophilic silica nanoparticles (Aerosil 300) was investigated.

Acknowledgements
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Atomic Layer Deposition on Flexible Substrates

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Abstract

Flexible microelectronics is a fast-growing modern technology with a variety of attractive applications: energy harvesting, micro-/nano- electromechanical systems (sensors and actuators), organic light-emitting displays (OLEDs), flexible smartphones, electronic paper, wearable microelectronics and biological applications. Recently, mechanical energy scavenging from human motions has attracted great attention due to its potential application in the bioelectronics and medicine. When used for self-sufficient power supply of biosensors, these elements must be small-sized, ultrathin, lightweight and possibly flexible. To obtain such flexible device, low-temperature deposition processes are needed. Atomic Layer Deposition (ALD), especially in plasma enhanced mode (PEALD) is low-temperature deposition method for high quality films. The advantages of ALD over other deposition techniques are: large area thickness uniformity, atomically flat and smooth coatings, perfect 3D conformability, uniform covering on high aspect ratio features and possibility to control the thickness at the nanometer scale. [1]

References

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Nanocrystalline ZnO thin films formed by electrospray and electrochemical deposition

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Abstract

Poly and mono crystalline ZnO thin films were prepared both methods of electrospray and electrochemical deposition. The electrospray deposition system is with vertical set-up and for the spraying solution water and ethanol were used as solvents for zinc acetate dehydrate. The influence of substrate temperature in the range 150 – 250 ^{o}C on surface morphology and roughness was studied by Scanning Electron Microscopy (SEM) and Atomic Force Microscopy (AFM). An improvement of surface quality and smoothing of the films with temperature were obtained. X-ray diffraction measurements revealed that at all investigated substrate temperatures the films were polycrystalline with crystallites sizes decreasing with temperature. The photoluminescence spectra at room temperature revealed that the types and number of defects are influenced by the substrate temperature.

The electrochemical deposition was performed using three-electrode system with a saturated calomel electrode as reference electrode and graphite as an anode. An aqueous solution containing $ZnCl_2$ and KCl was used as an electrolyte. ITO and SnO_2 covered glasses were used as cathode substrates on which ZnO thin layers were formed. The surface morphology was studied by Scanning Electron Microscopy (SEM) and optical profilometry. The X-ray Diffraction patterns reveal polycrystalline structure on the SnO_2 while on the ITO-covered substrate a ZnO film with monocrystalline structure is obtained. The influence of methods and conditions of preparation on the properties of ZnO thin films is demonstrated and discussed.

Acknowledgements

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Incorporation of PE6800-templated mesoporous Nb_2O_5 thin film within Bragg reflector for optical sensing application

Rosen Georgiev and Tsvetanka Babeva

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Bragg reflectors are photonic structures composed of alternating layers of low and high refractive index materials with a quarter-wavelength optical thickness having band gap where the propagation of waves with certain frequencies (i.e wavelengths) is forbidden. Niobium oxide (Nb_2O_5) is a material that has exceptional chemical resistance, high refractive index and transparency in the visible range, making it suitable for photonic applications. The high refractive index allows its strong modulation when dense material is converted into mesoporous one. Thus, Bragg reflectors of dense and mesoporous thin films of the same material could be prepared enabling the preservation of the advantages of the material, but also keeping high optical contrast.

This study presents Bragg reflectors built of 2, 3, 5 and 7 layers. Each layer is a dense or porous thin Nb_2O_5 film with certain thickness, prepared by the sol-gel and spin-coating methods. Low refractive index material is mesoporous Nb_2O_5 film produced by the method of evaporation induced self-assembly of triblock copolymer Pluronic PE 6800 added to niobium sol and removed by subsequent annealing of films at 320 ^{o}C. Sensing properties of single films and multilayers structures are studied through samples exposure to different VOC's (Volatile Organic Vapors) followed by detection of transmittance and reflectance changes due to the condensation of vapors in the pores. The application of mesoporous Bragg reflectors as optical indicators for volatile organic compounds has been demonstrated and discussed.

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Thermal properties and microhardness of azopolymer thin films for optical applications

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Abstract

Azopolymers prepared as thin films are a promising material as a medium for optical recording due to their photoanisotropic optical properties. The applicability of these materials for optical recording depends on their mechanical properties, as well as on the quality of the prepared films, i.e. roughness of the surface, uniformity of the thickness and smoothness of the layers formed. In the present study azopolymer thin films are prepared by spin-coating on glass substrates. The glass transition temperatures are determined for different types of azopolymers and micromechanical characteristics are investigated by studying of the dependency of load-penetration depth at constant loading speed (depth sensing indentation, DSI).

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MICROSTRUCTURE AND PROPERTIES OF MAGNETIC NANOCOMPOSITES

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Abstract

The aim of the present study is to obtain new magnetic nanocomposite materials with a high content of ferrospinel nanoparticles and to study their structure and magnetic properties.

Glass-crystalline composite materials based on borate glassy matrix and iron spinel particles are prepared by incorporation technique. The glass composition is selected to be located on the phase separation boundary in the system B_2O_3-TeO_2-Fe_2O_3. The Fe_3O_4 nanoparticles are previously obtained by co-precipitation method in alkaline medium. The phase composition is determined by X-ray diffraction analysis. The microstructure is observed by scanning electron microscopy. Energy dispersive X-ray microanalysis is applied in order to identify the elemental distribution in the samples. The results confirm the presence of microcrystals Fe_2O_3 in the vitreous matrix.

The magnetic hysteresis and differential AC magnetization of samples are performed by Physical Property Measurement System (PPMS) on Quantum Design. The results obtained show the presence of two magnetic phases - paramagnetic and ferrimagnetic.

Process parameters optimization for preparation of high quality thin film materials containing azo polymers

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Abstract

Azo dyes containing polymers are a well studied class of materilas due to their significant application potential for fabrication of a large variety of photonic elements, such as diffraction gratings, microlens arrays, photonic crystals, plasmonic nanostructures and so on. Another attractive area of application for these materials represents the photoimprint-based immobilization of viruses, DNAs or antibodies due to deformation of the azopolymer surfaces along the contours of the biomolecules during irradiation with light. Since the azo dyes containing polymers are studied for optical application and for development of biosensors most in the form of thin layers the growing scientific interest over the last years in optimisation of the process conditions for the fabrication of high quality thin film azomaterials is understandable.

In this work we report the fabrication process of thin film materials containing novel azo polymers using two different techniques, namely spin coating and vacuum deposition. The influence of different process parameters such as the spin coating rate on the thickness and the surface modification of the prepared thin films is presented and discussed.

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Anodic behavior and composition of films obtained on zinc in water solutions of oxalic acid

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Abstract

Kinetics of galvanostatic anodization of Zn in water solutions of oxalic acid is studied. Induction periods appear during the process. The dependence of the length of these periods on the concentration of the forming electrolyte and current density are investigated. The anodic films are studied by X-ray diffraction (XRD), attenuated total reflection fourier-transform infrared spectroscopy (ATR-FTIR) and X-ray photoelectron spectroscopy (XPS) in order to resolve their chemical composition. Scanning Electron Microscopy (SEM) is used to determine the morphology of the obtained films.

The results show that the layer consists of highly crystalline ZnC_2O_4.The chemical composition of the film is independent of the concentration of the forming electrolyte and remains unchanged after the breakdowns. The forming voltage can reach values above 100V. A valve effect is observed for the formed layer. The length of the induction periods decreases with the increasing of the concentration of the forming electrolyte. That is opposite to the dependence of the induction period for the valve metals on the concentration of the forming electrolyte. The duration of the induction periods decreases with the increasing of the current density. That is typical for the valve metals.