CNM-4
2015

International Meeting

CLUSTERS AND NANOSTRUCTURED MATERIALS (CNM'4)

PROGRAM and MATERIALS

Uzhgorod Ukraine
12 – 16 October, 2015

National Academy of Sciences of Ukraine
Institute of Physics
G.V.Kurdyumov Institute for Metal Physics
V.E. Lashkaryov Institute for Semiconductor Physics
Institute for Information Recording
Uzhgorod Scientific-Technological Center of the Institute for Information Recording
Uzhgorod National University

INTERNATIONAL MEETING

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The materials represent the contents of meeting's reports based on the results of fundamental and applied works on topical questions in the field of nanostructured systems, nanomaterials and nanotechnologies. Main attention is given to the consideration of problems of nanophysics and nanoelectronics, to atomic and electronic structure of cluster and nanostructured materials, amorphous alloys, nanostructured films and coatings, colloidal and biofunctioal materials, to study of their properties. The results of investigations in the field of supramolecular chemistry, synthesis of nanoparticles, nanostructores and multifunctional nanomaterials, physico-chemistry of superficial phenomena and diagnostics of nanosystems are presented.

The edition is designed for scientists, engineers, higher school lecturers, post-graduates and students of corresponding specialities.

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TUESDAY, 13TH OF OCTOBER, 2015

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Bilyovskii P.A., Poroshin V.N., ***Vinoslavskii M.N.***, Kochelap V.O., Baidus N.V., Zvonkov B.N.
Institute of Physics, National Academy of Sciences of Ukraine, Kyiv, Ukraine.
9^{55}– 10^{45} – MAGNETIC STATES OF METAL NANOLAYERS UNDER SPIN TRANSPORT
Sohatsky V.P.
*Taras Shevchenko Kiev National University, Ukraine***.**

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Popovic K., Six B., Postl M., Jäger M., Blümel A., Sax S., Nau S., Klug A., List-Kratochvil E.J.W.
NanoTecCenter Weiz Forschungsgesellschaft mbH, Weiz, Austria.
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Peleshchak R.M., Kuzyk O.V., Dan'kiv O.O., Kryvoruchko Y.
Drohobych Ivan Franko state pedagogical university, Drohobych, Ukraine.

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PLENARY
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Mitsa V., Marton A., Holomb R., Kuchak I., Ihnatolja P.
Uzhhgorod National University, Uzhgorod, Ukraine.
15^{55} – 16^{25} – LASER ASSISTED TRANSFORMATIONS OF CHALCOGENIDE NANOLAYERS SURFACE: SRPES, SERS AND DFT STUDY
Holomb R. M.
*Uzhgorod National University, Uzhgorod, Ukraine***.**
16^{30} – 17^{00} – NANOINHOMOGENEITIES IN CHALCOGENIDE GLASSES AND SPATIAL DISPERSION
Kozak M.I.
Uzhhorod National University, Uzhhorod , Ukraine.

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LASER ASSISTED TRANSFORMATIONS OF CHALCOGENIDE NANOLAYERS SURFACE: SRPES, SERS AND DFT STUDY

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Due to their infrared transparency amorphous chalcogenides are known as the materials of choice for infrared (IR) optics. Further research into physico-chemical properties and atomic structure of amorphous chalcogenides during last decades revealed their unique and remarkable structural, electronic, optical properties and large functionality and has attracted significant attention in condensed-matter physics. In addition to their intrinsic infrared properties, they offer a wide possibilities in domains such as information technologies (data storage and ultrafast optical information processing), renewable energy technologies (media for high efficiency solar cells and solid electrolytes), medicine, thermal imaging, sensing and biosensing *etc* because of useful combination of optical activity, structural photosensitivity and high third-order optical non-linearity. Resent progress in technology of nanomaterials, nanofabrication and photonics show that the amorphous chalcogenides becomes among the best candidates as a active optical media for future ultrafast *all-optical* processing systems. Therefore, the great efforts are now being focused on investigation of surface of ultrathin chalcogenide films and nanolayers in context of surface morphology, atomic structure, laser assisted transformations, induced mass transport, age degradation, surface contamination *etc*.

In this work the high resolution synchrotron radiation photoelectron spectroscopy (SRPES) and surface enhanced Raman spectroscopy (SERS) were used in order to investigate the local and molecular structure of top and sub surfaces of amorphous chalcogenide nanolayers. The density functional theory (DFT) electronic structure and vibration spectra calculation were also performed to assist interpretation of experimental results and to elucidate the interconnections between structure and properties of the materials at nano scale. The thermal annealing, near- and over-bandgap laser irradiation, exposure to oxygen and to ambient condition were used to study the structural modification of chalcogenide surfaces.

The results of *in-situ* and *ex-situ* investigation of surface composition, local and cluster/molecular structure of chalcogenides as well as their induced transformations are summarized. Detail analysis of the surface of chalcogenide nanolayers indicate:

1) The presence of relatively large (~20% and more) amount of carbon at the surface of materials. This concentration increase during laser illumination in air.

2) Oxidized species (As-O, Ge-O) are also present at the surface of chalcogenide nanolayers contacted with air. Laser exposure of chalcogenides in air lead to increase in concentration of this group(s).

3) *In-situ* investigation of laser induced processes in As_2S_3 chalcogenide nanolayers show the essential structural transformations at the surface. Thermal annealing slightly improves stoichiometry and decrease the number of homopolar As-As and S-S bonds (structural ordering). In contrast, the over bandgap laser irradiation of As_2S_3 nanolayers lead to As enrichment, increase the concentration of As-rich s.u. with As-As bonds and form gradient of the concentration. It can directly be related with the laser induced mass transport effect. Reversibility of these processes in "annealing-irradiation" cycles is also discovered.

4) The results of molecular modeling and DFT calculations indicate that the observed reversible changes at the surface is originated from realgar to pararelgar molecular transformations at the surface.

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