GRAFENIKA [GRAPHENICS] RUSSIAN GUBIN'S SEMINAR (MOSCOW)

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Russian Seminar "GRAPHENE: MOLECULE AND CRYSTAL (material, physics, chemistry, electronics, photonics, biomedical applications)" under the direction of prof. SP Gubin operates from November 2011. Seminar sessions are held once a month, mainly in the boardroom VNIIAlmaz in Gilyarovskogo str., 65 (metro station "Rizhskaya"). The seminar is supported by LLC "AkKoLab" and the VNIIAlmaz. Programms of seminars are available at http://www.akkolab.ru. The seminar organizers see it as a discussion platform to discuss new ideas and concepts, review the results and the exchange of experience of researchers in the booming grafenika - an interdisciplinary field of modern science. Anticipated publication of an annual compendium of seminar materials, creating Programs of research in this area with possible access to financing. The seminar was attended by officials from various scientific institutions of Moscow - Kurnakov Institute of General and Inorganic Chemistry RAS, Nesmeyanov Institute of Organoelement Compounds of RAS, Semenov Institute of Chemical Physics RAS, Kotel'nikov Institute of Radio Engineering and Electronics RAS, National Research Centre "Kurchatov Institute", Moscow State University Department of Chemistry, Moscow Institute of Physics and Technology, National Research Nuclear University "MEPhI", People's Friendship University of Russia, LLC "AkKoLab", Open Joint Stock Company (JSC) "VNII ALMAZ", LLC "Karbonlayt", JSC NIIgrafit and others, as well as invited members of scientific institutions in Russia, Commonwealth of Independent States (CIS) and foreign countries. The audience for each session - about fifty participants. In the four- hour meeting with a break heard and discussed the 3-4 reports, news review and submitted poster presentations.
The journal RENSIT is published semi-annual reports of this seminar: list of reports indicating affiliated authors and submitted abstracts.

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25th SEMINAR, 13.10.2016

1. **Svintsov DA (PhD Phys&Math), V'yurkov VV, Ryzhii VI, T. Otsuji. (**MIPT, FTI RAN, Tohoku Univ., Sendai, Japan**). PROMISING DEVICES FOR NANO - AND OPTOELECTRONICS BASED ON GRAPHENE HETEROSTRUCTURES.**

The unique electronic properties of graphene and optical properties of layered semiconductors can be successfully combined into a new composite materials called van der Waals heterostructures. The report will provide an overview of the devices, nano - and optoelectronics on the basis of heterostructures: as a functioning and planned for implementation. Special attention will be paid to devices based on resonant tunneling: tunneling transistors, cascade - infrared photo-detectors and sources of terahertz radiation. The report will show how "relativistic" spectrum of charge carriers in graphene can dramatically improve the performance of devices based on graphene structures are compared with counterparts based on compounds III-V semiconductors.

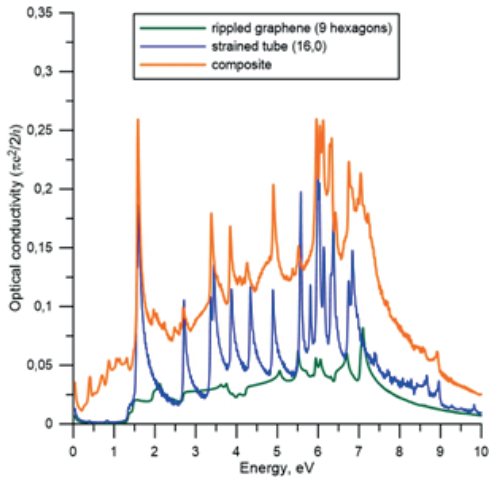
2. **Amirov RKh, Isakaev EKh, Shavelkina MB (PhD Tech) (**JIHT RAS**). DIRECT SYNTHESIS OF HYDROGENATED GRAPHENE IN THERMAL PLASMA.**

Shown the possibility of direct synthesis of hydrogenated graphene materials in plazmotrona reactor. The materials obtained in the free state by decomposition of hydrocarbons with the plasma torch constant current at a pressure close to atmospheric. Elemental analysis, scanning electron microscopy, spectroscopy Raman scattering and

x-ray photoelectron spectroscopy showed that the synthesized samples present maloletnyh hydrogen relative to carbon of 1:4. When heated samples is the release of hydrogen, as illustrated by thermogravimetry in an inert gas atmosphere.

3. **Glukhova OE (**Dr Sci Phys&Math, Saratov Univ.**) HYBRID 2D/3D NANOCOMPOSITES BASED ON GRAPHENE WITH A POSITION OF APPLICATION IN OPTO - AND EMISSION ELECTRONICS.**

The optical and electronic properties of 2D graphene hybrid nanocomposite-nanotrubok material and a new topological form 3D porous glass-like carbon material formed by graphene flakes and fullerenelike fragments. Methods modeling was performed by the molecular mechanical method and the quantum method AIREBO SCC DFTB2. Static study conducted using the software package DFTB+ (http://www.dftb-plus.info), dynamic - with the domestic open source KVAZAR (http://nanokvazar.ru). Installed the thermodynamically stable form of 2D graphene-nanotrubok composite structural components which are the nanotubes of type (n,0) located between the two monolayers of graphene and related covalent (n=10, 12, 14,16, 18, 20). The calculated band structure showed that the composite has a conductivity characteristic of metals (like graphene). The exception is the topological model of composite with tubes (10,0), the conductivity of which is of a semiconductor character with a gap in conditioning the structure of 0.08-0.1 eV, depending on the step of distancing tubes. Calculated the complex optical conductivity, dielectric permittivity showed that the 2D graphene-nanotrubki the composite is a very high quality filter and a polarizer, in comparison with graphene and separate the individual nanotubes (see figure). It was also found that in the UV and optical range of the composite is almost not reflected (reflection is less than 0.2 % for H-waves), and the absorption reaches 8-9 %, which makes the composite promising in the development of optical nanoantenna and solar cells.



For other graphene nanocomposite - porous glass-like carbon 3D material identified ways to control the emission properties. Established ways of filling the pores with atoms of alkali metals, the maximum concentration of these atoms reduces the work function by 1 eV or more. Identified as critical oxygen concentration, increasing the work function by more than 0.5 eV. All studies were performed on atomistic material models, built as a result of heating and compressing a porous mixture of graphene flakes and deformed fullerene fragments.

26th SEMINAR, 15.12.2016

1.Kuznetsova IE (Dr Sci Phys&Math, prof RAS, IRE RAS**). HIGHLY SENSITIVE ACOUSTOELECTRIC SENSOR OF HUMIDITY WITH A LAYER OF GRAPHENE OXIDE.**

2. Chervonoborodov SP (PhD Phys&Math) **THE MESSAGE ABOUT THE ROUND TABLE AT THE INTERNATIONAL CONGRESS "RENEWABLE ENERGY XXI CENTURY: ENERGY AND ECONOMIC EFFICIENCY."** SKOLKOVO, 13 -14 OCT 2016. "CAN CARBON MATERIALS (GRAPHENE-BASED) IS FUNDAMENTALLY CHANGING THE ENERGY OF ANY ELECTROCHEMICAL DEVICES?

3. D'yachkova TP (PhD Chem, Tambov GTU). **PHYSICO-CHEMICAL ASPECTS OF FUNCTIONALIZATION AND MODIFICATION OF CARBON NANOMATERIALS.**

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