THE Alan G. MacDiarmid Nanotech Institute

PRESENTS

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Alexander Soldatov is currently a Professor of Physics at Lulea University of Technology in Lulea, Sweden. His current research interests include: Synthesis of nanostructured materials, composites, using high pressure and study of their physical properties; research on molecular electronics devices, single molecule spectroscopy; research on materials properties at ultra-high pressure or visiting scholars.

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Fullerenes and carbon nanotubes at high pressure: Towards new functional materials

The application of pressure in the range of 10-12 GPa to fullerenes at temperatures of about 1000 ºC is used to synthesize materials with outstanding properties including hardness exceeding that of diamond [1]. However, the "hard" p, T synthesis conditions hinder the practical use of these materials. Therefore characterization of structural and physical properties of C_{60} and C_{70} in the polymeric state and phase transitions between different polymeric structures of fullerenes is important to understanding the formation of these ultra-hard carbon-based materials. This presentation will review the results of our recent studies of the spectroscopic and thermal properties of polymeric phases of C_{70}, including dimers (C_{140}) and one-dimensional (zig-zag) chain polymers [2]. We describe a special effort [3] which was dedicated to testing the predicted transformation of 2D C_{60} polymer into a 3D *metallic phase*.at high pressure [4].Polymeric forms of fullerenes have potential for use in molecular electronic devices. We have measured electron tunnelling in single-electron transistors made from C_{140} and observed its strong coupling to the stretching (inter-cage) vibrational mode [5]. The results are discussed in terms of the Franck-Condon model.

We will report on our high-p studies of another molecular form of carbon - carbon nanotubes (CNTs) – which have enormous potential for materials synthesis due to their outstanding physical properties. We will discuss a possibility of CNTs polymerization and demonstrate an example of double-walled (DW) CNTs that high pressure is a very suitable tool for probing structural stability and tuning vibrational and electronic properties of CNTs. Finally, we present our recent data on synthesis and characterization of CNT- and fullerene-based composite materials.

References:

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[4] Y. Yamagami and S. Saito, Phys. Rev. B, **79**, 045425 (2009)..
[5] Pasupathy A.N. et al. *Nano Lett.*, **5,** 203-307 (2005).