**Scientific relation on research results obtained by Dr. Iskandar kholmanov at the University of Texas at Austin in the framework of CNR- Short Term Mobility Program during the period of 12/05/2010 - 08/06/2010.**

[Relazione scientifica sui risultati dell'attività di ricerca svolta presso al "the University of Texas at Austin"]

The research investigations carried out in the framework of CNR- Short Term Mobility Program – 2010 by Dr. Iskandar Kholmanov have been performed at the Nanoscience and Technology Laboratory headed by Prof. Rodney Ruoff, at the Department of Mechanical Engineering, The University of Texas at Austin during the period of 12/05/2010 - 08/06/2010.

Today, graphene plays a central role in nanomaterials science and nanotechnology mainly due to its unusual electronic characteristics. Properties of graphene have direct relevance to its peculiar electron band structure, described by the interaction of the $\pi$-electrons with the hexagonal lattice maintained by $\sigma$-bonds between carbon atoms. In spite of significant achievements in investigation of basic electronic properties of graphene, synthesis of graphene materials with controlled structural, mechanical, electronic and chemical characteristics is remaining a challenging task.

At present among the developed methods of graphene synthesis, chemical vapor deposition (CVD) growth and wet-chemistry exfoliation of graphite methods are considered as a promising approaches for low-cost, large-scale production of graphene films. However several drawbacks in the properties of graphene films, obtained by these methods, seriously limit their potential in application for electronic devices. One of these characteristics is the poor electrical conductivity of graphene films that is caused by the presence of different structural defects (for CVD grown graphene) and residual chemical compounds remaining attached to the graphene flakes even after reduction process of graphene oxide films (by wet-chemistry method). In addition, structural defects in graphene flakes are considered as an important factor in worsening of transport properties of graphene films.

During the stay at the University of Texas at Austin the research activity were focused on synthesis of graphene nanostructures by CVD and wet-chemistry methods, and on interaction of metal/metal oxide nanoparticles with graphenic materials. Concerning the CVD growth of graphene nanostructures, as a continue of the research studies carried out prior to the short-term mobility fellowship, main aspects and importance of the research on this topic have been discussed and the obtained results have been elaborated. Particularly, research results dealing with the incorporation of metal/metal oxide nanoparticles with graphenic structures, and the role of metal/metal oxide nanoparticles in synthesis and processing of graphene structures have been considered in details. It is expecting that on the basis of these results a manuscript will be prepared for publication in an international journal.

In research on the wet-chemistry methods of synthesis the production of colloidal graphene oxide solution by wet-chemistry oxidation and exfoliation of graphite particles has been studied. The obtained colloidal graphene oxide suspension has been deposited on silicon and quartz substrates using different coating methods, such as drop coating, spin coating and dip coating methods. The obtained films have been reduced in hydrazine atmosphere and their structural and morphological properties have been characterized using SEM and AFM techniques.

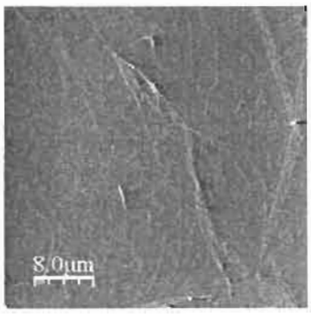


Figure. Typical AFM image of reduced graphene film on quartz substrate.

In addition, we carried out experiments on development of wet-chemistry method in order to produce graphene with improved structural characteristics. In these research investigations we studied the role of metal/metal oxide nanoparticles in chemical characteristics of the colloidal graphene/graphene oxide nanostructures. Particularly, the role of gold and copper (copper oxide) nanoparticles incorporated to graphene oxide flakes in solubility of graphene oxide composites in aqueous solutions has been investigated.

Summarising the research activity carried out in consistent with the research proposal submitted for CNR Short Term Mobility Program Fellowship, we note that obtained results, including the research experience and skills on synthesis, characterization and processing of graphene materials is very interesting and useful for future research activity on graphene-based materials, particularly on graphene-based photovoltaic and sensor devices, and to set international collaborations in this field.

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15/07/2010

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