INHERENT IMPURITIES IN GRAPHENE-LIKE MATERIALS

G. Hristea[1], O. Culicov[1,2], V. Marinescu[1], M. Lungulescu[1], C. Obreja[1], I.Zinicovscaia[2, 3]

[1]*National Institute for R&D in Electrical Engineering, INCDIE ICPE CA, Splaiul Unirii 313, Bucharest 030138, Romania*

[2]*Joint Institute for Nuclear Research, Dubna, Joliot Curie 6, Moscow Region, Russian Federation*

[3]*Horia Hulubei National Institute for R&D in Physicsand Nuclear Engineering, 30 Reactorului Str., MG-6,Bucharest-Magurele, Romani*

E-mail: gabriela.hristea@icpe-ca.ro

The capabilities of graphene are well recognized (from flexible displays or ultra-lightweight devices to memory chips and high-capacity batteries. But even so, several issues must be addressed. The greatest difficulty is in producing large quantities of graphene in various formats and at a reasonable cost, while maintaining effective yields and purity levels that do not hinder graphene's requested chemistry. Since metallic impurities can directly affect many features of graphene materials, their implications are far-reaching, potentially affecting many suggested graphene applications. Because impurity-free materials are practically difficult to handle, understanding how defects and impurities influence the physical-chemical properties of these systems is crucial [1]. Some evidence suggests that different synthesis routes for graphene-like materials involving different oxidation and reduction processes may imply different types and amounts of metallic components [2].
Alternative synthesis routes for graphene-like materials that include different oxidation and reduction processes may indicate various kinds of metallic components, according to some data.
These elements may originate from impurities in the synthesis of raw materials/precursors. Metallic impurities, in particular, can significantly alter the chemical properties of graphene materials. Extensive measurements of the metallic impurities inherent in chemically reduced graphene oxides are important to ensure that the level of contamination does not affect the intended purpose of the graphene-like material.
In this work, few synthetic routes for graphene-like materials synthesis are developed, by applying different oxidation and reduction strategies and tracking the concentrations of metallic impurities at each stage of synthesis. Morphological and structural characterizations of synthetized graphene-like materials implying Energy-dispersive X-ray spectroscopy analysis (EDX), scanning electronic microscopy (SEM), and neutron activation analysis (NAA) have been done.

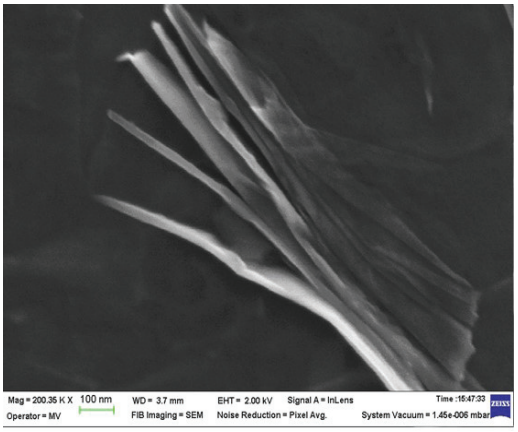

Fig.1. Scanning electron microscopy of a stack of few graphene sheets

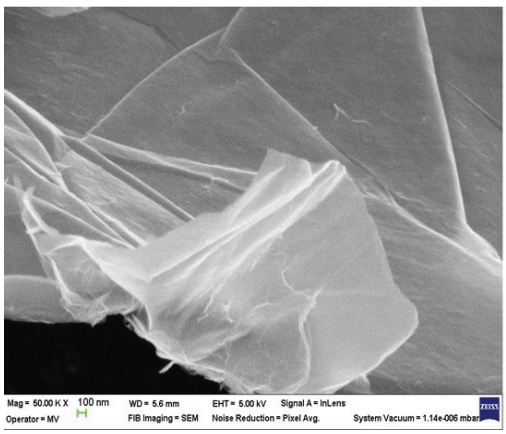

Fig. 2. Scanning electron microscopy of a plain sheet of graphene

Neutron activation analysis (NAA) was used as the primary method to determine the levels of impurities present in processed materials because of its accuracy and robustness. Additionally, because the materials being studied can be irradiated directly, true bulk analysis of the material can be performed as well as the elimination of the possibility of contamination during sample preparation for analysis.

[1] P.T. Araujo, M. Terrones, M. S. Dresselhaus (2012), Defects and impurities in graphene-like materials, Materials Today, 15 (3), 98-109.
[2]. HJ Shin, et al. (2009), Efficient reduction of graphite oxide by sodium borohydride and its effect on electrical conductance, Adv Funct Mater, 19(12):1987–1992.