Graphene nanoplatelets (GNPs): new preparation methods and their structural characterization

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Graphene is one of the allotropes of elemental carbon with a planar monolayer of carbon atoms arranged into a two-dimensional honey-comb lattice [1]. It has demonstrated a variety of intriguing properties as new material for future applications and composite industry [2-3]. In particular the interesting electrical properties candidate the graphene to be an excellent successor to silicon in electronic applications.

Since its preparation is rather difficult and complex, graphene nanoplatelets (GNPs) are also intensively studied. GNPs are more easily to obtain, have similar properties and can be used in the same applications [4].

The aim of the current research is the development of new preparation techniques to obtain GNPs in industrially usable quantities and with a good yield.

Different types of Graphite Intercalation Compounds (GICs), together with natural graphite (NG), were used. The exfoliation process was carried out trough different techniques, such as thermal treatment at different temperatures and microwaves irradiation (MWs). The exfoliation occurs because the water between the layers of the graphite, at high temperature or interacting with the MWs, passes in gaseous phase producing a pressure that separates the layers. GNPs preparation was also carried out in water-ionic liquid ([BMIM]Cl) mixture to minimize the re-aggregation of GNPs.

The obtained GNPs were studied by Transmission Electron Microscopy (TEM), together with Electron Energy Loss Spectroscopy (EELS) and Selected Area Electron Diffraction (SAED), Dynamic Light Scattering (DLS) and Small Angle X-ray Scattering (SAXS). From TEM micrographs and DLS curves it was observed that GNP's dimension varies with the exfoliation procedure. The thickness was evaluated by TEM micrographs (Figure 1) and calculated trough EELS technique. The effectiveness of the exfoliation process was evaluated by SAXS curves and SAED patterns, where ordered spots of the samples before treatment (NG or GICs) are replaced by diffraction rings in the samples after the treatment (Figure 2 and 3).

It can be concluded that GNPs of good quality, with variable size and few layers of thickness were obtained using different exfoliation techniques. Moreover the ionic liquid has helped to disperse and to stabilize the GNPs in suspension [5].

References

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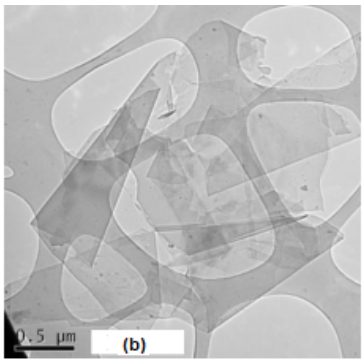

Figure 1. *TEM micrograph of GNPs (after thermal treatment)*

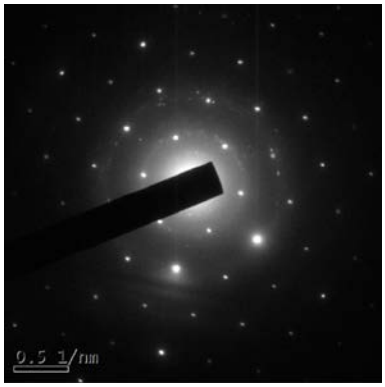

Figure 2. *SAED pattern of GICs (before thermal treatment)*

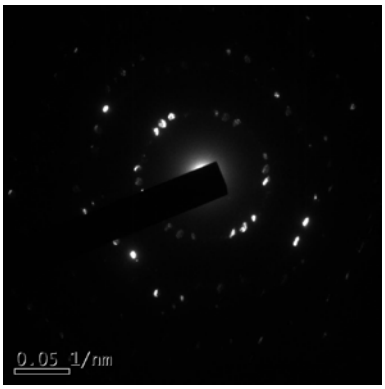

Figure 3. *SAED pattern of GNPs (after thermal treatment)*