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Structural, Morphological, and Chemical Characterization of Commercial Graphene Nanoplatelets (GNP's) with Different Specific Surface Area

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Introduction

There is a growing interest in the use of GNP's as a reinforcement element in polymeric nanocomposites. When incorporated into polymeric matrices, graphene (GN) generates materials with excellent optical, electrical, thermal and mechanical properties superior to those of conventional materials. For these reasons, the standardization of GN and reliable quality control for industrially produced graphene materials, has now become one of the most critical prerequisites for the growing GN industry, where the fight against "fake graphene" in the market is one of the top priorities.[1-3] In this context, this work presents the characterized three of commercial GNP's with specific surface area (GNP1: 300 m^2/g, GNP2: 500 m^2/g, and GNP3: 750 m^2/g).

Experimental

The characterization methods used in the quality control analysis of graphene powders, such as Raman spectroscopy, Brunauer-Emmett-Teller (BET) method, Field Emission Gun-Scanning Electron Microscopy (FEG-SEM), X-ray diffraction (XRD), Fourier transform infrared spectroscopy (FTIR) and thermogravimetrical analysis (TGA) were employed.

Results e Discussion

Fig. 1 indicates presence of defects in the crystalline structure of the GNP's. Furthermore, an I_{2D}/I_G ratio of 0.35, 0.31 and 0.32 is observed for GNP1, GNP2 and GNP3, respectively. These results suggest that the GNP's sample has a reduced number of graphene layers. The specific surface area of the GNP's used in this work and obtained by the BET multipoint method were 301, 457 and 687 m^2g^{-1}. The folds along the graphene sheets are indicative of the flexibility of these materials. Fig. 2 indicates pronounced wrinkling due to the incorporation of sp^3 carbon atoms, which produces the breakage of the sp^2 hybridized flat graphene nanosheets.

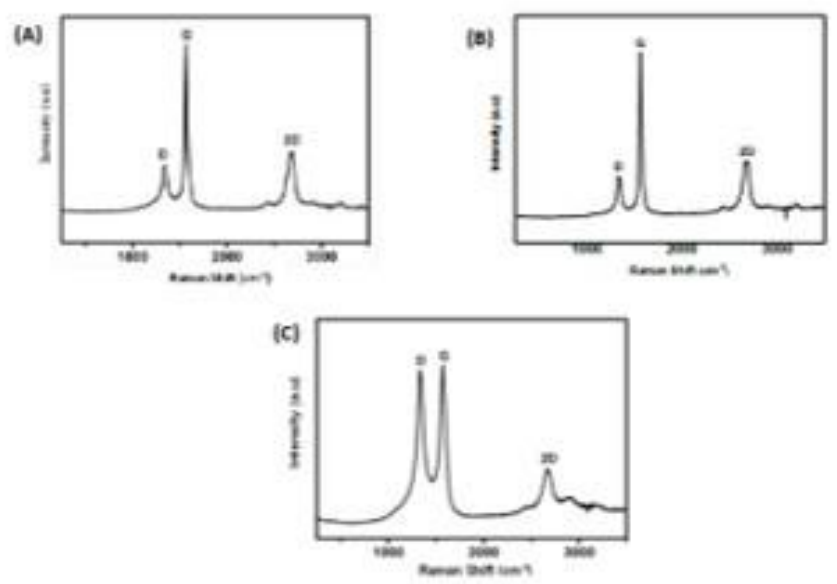


Figure 1. Raman spectrum of GNP's: (A) GNP1; (B) GNP2 and (C) GNP3.

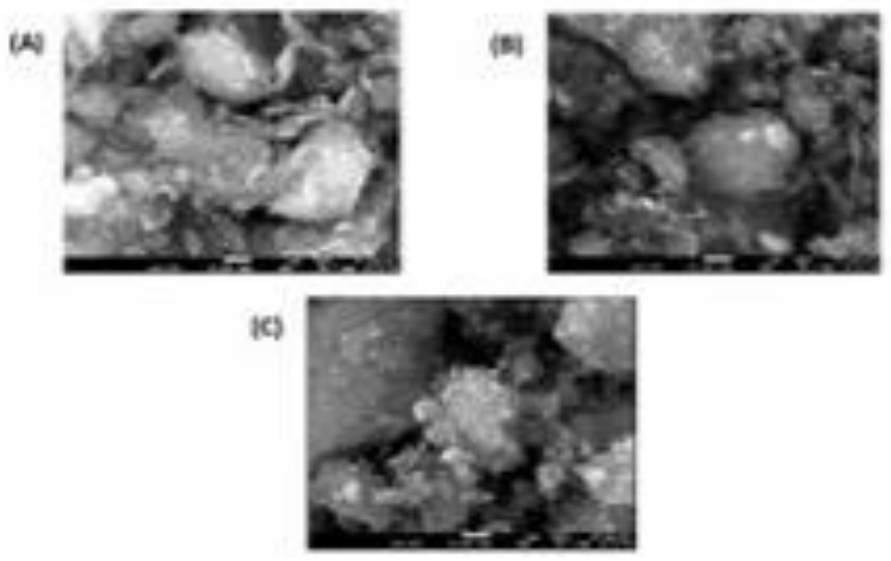


Figure 2. FEG-SEM of GNP's: (A) GNP1; (B) GNP2 and (C) GNP3.

The XRD spectrum was used to calculate the number of GN layers, indicating that the samples consist of GN with nine to ten layers, i.e., few-layer GN (FLG). The FTIR spectrum of GNP's was observed as absorption bands corresponding to the oxygenated groups derived from the graphite oxidation process. In the TGA curve of GNP's was observed that present thermal stability up to approximately 700 °C, where the begins combustion of the carbon structure of the sample.

Conclusions

The characterization results of GNP's suggest that the GN used has a low number of stacked layers and defects, which classifies it as a better-quality material. Thus, adequate characterization of GN is important and necessary for understanding its properties and, therefore, efficiently guiding its application in different systems and technologies.

References

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