11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25
ICAM2009

Raman characterization of bulk ferromagnetic nanostructured graphite

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Abstract – Raman spectroscopy was used to characterize bulk ferromagnetic graphite samples prepared by controlled oxidation of commercial pristine graphite powder. Intensity relation among peaks of the D and G bands, the position of the 2D band and the presence of a band at 2944 cm^{-1} allows to conclude that the modified material has a high degree of disorder with a significant presence of exposed edges of graphitic planes as well as a large number of sp^3 links.

Ferromagnetic carbon nanomaterials could potentially be used in magnetic imaging in medicine, communications, electronics, sensors, catalysis, etc. Despite the fact that in the last 20 years reports have regularly appeared with experimental verification of the presence of ferromagnetism in pure carbon materials, skepticism still exists about this phenomenon being intrinsic. This work looks forward to contribute to the discussion mentioned above by presenting a method for modifying pristine graphite in order to obtain room temperature, stable ferromagnetic graphite. The preparation method schematically consists of a controlled oxidation of pristine graphite powder. It is a method relatively easy to implement and economically affordable, which makes it particularly interesting for technological applications. Previous studies on samples prepared using the same method have shown that the presence of the magnetic impurities is insufficient to explain the total magnetic signal coming from the material. Further magnetization measurements as a function of applied field obtained from pristine and modified graphite at a temperature of 5 ° K confirmed these conclusions are also shown in this work. SEM micrographs show nanometric size defects introduced in the graphene layers that are associated with the magnetic signal. Comparative Raman spectroscopy studies between pristine and modified ferromagnetic graphite using wavelengths of 633 and 513.5 nm at room temperature, allow us to conclude that the modified material has a high degree of disorder with a significant presence of exposed edges of graphitic planes as well as a large number of sp^3 links, however, the material is not amorphous. The presence of vibrational peaks, associated to carbonyl, group gives a hint of the modification mechanism. This observation is in agreement with reports which show that the theoretical onset of magnetism in graphene may be due to the presence of such defects and the possibility of coexistence of Csp^2 and Csp^3 links.

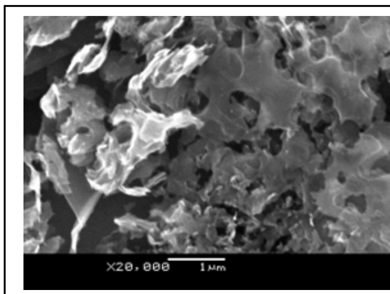

Figure 1: SEM micrography of MG.

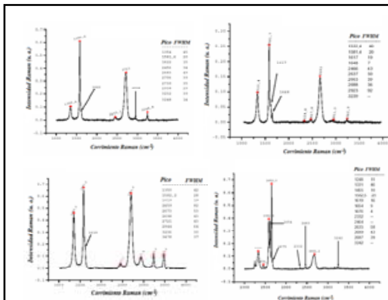

Figure 2: Raman spectroscopy resaults.

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