Electrical properties of Different Graphene based Epoxy composites

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Conductive polymer composites have been extensively used in resistors, over-current and over-temperature circuit protection devices, supercapacitors, organic solar cells, biosensors, flexible transparent displays, antistatic materials and materials for electromagnetic interference (EMI) shielding [1]. A flexible, light and strength Electromagnetic shielding coating is desirable for many applications: Medical devices, Aeronautics and Automotive industries, civil engineering…etc. A wide range of Polymer Matrices with nano carbon inclusions, have been studied in these last years to achieve high quality coating as EMI shielding [2-4].
The idea is simple, to combine the own huge properties of these nano materials with the important properties of polymeric matrix. In these years we have been working on electromagnetic properties of Cabon Nanotubes – Epoxy matrix composites and nowdays Graphene. Graphene based composites are the novel kind of composites with multi-properties that will can give better material for several applications.

Exfoliated graphite (EG) is an interesting raw material, which could be a low- cost, green and efficiency solution for the production of graphene. The preparation of EG was usually done by rapid heating of intercalation compounds of graphite (CIG), but also conducted by different heating systems.

Asbury bought Commercial Graphene Nanoplates® are platelets with primary particle sizes below 100nm. Depending on the specific grade these platelets can be as little as 2.5nm thick in the through plane direction. The entire line of Asbury Carbons' nanographite powders are manufactured from fully graphitized parent carbon materials.

In our Lab, Graphene NanoPlates (GNPs) were obtained by microwave assistance irradiation of CIG, from Asbury®, used as carbon source. The graphite was put in home microwave oven, with a power of 800W, inside a ceramic melting pot. About ten seconds of irradiation are enough to produce expansion of EG and formation of worm-like particles: the process of expansion was carried out by thermal shock due to microwave irradiation that warms EG and vaporize molecules present inside EG planes. Furthermore sparks that occur during the process also caused thermal shock: vaporized molecules change dielectric constant of atmosphere and electric arc occurs. GNPs particles were obtained with mild sonication in ultrasonic bath for ten minutes. Particles were characterized by a large area (from 2 to 10μm), and a thickness ranging from 4 to 9nm (i.e., 4-11 layers). The fabricated samples are shown in the scanning electron microscope (SEM) and scanning transmission electron microscope (STEM) images, reported in Figs.1 and 2, respectively.

Both Graphene nanoplates are mixed with the Epoxy matrices and eight samples were made, using our procedure [5].
All sample were measured using a Precision LCR Meter homemade, at Vilnius University, from 20Hz to 1MHz. In the Figure 3a) and b) are showed the results of analysis.
The results show the conductivity of GNPs - Frascati are better than Commercial GNPs, and the GNPs - Frascati's percolation threshold is minor than Commercial GNPs. That can suggest to use GNPs – Frascati as filler for Electromagnetic Shielding coating.

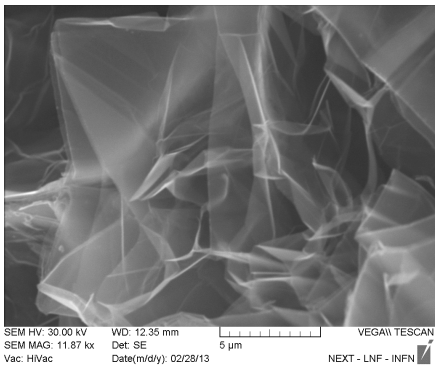


Figure 1 SEM images of GNPs –Frascati

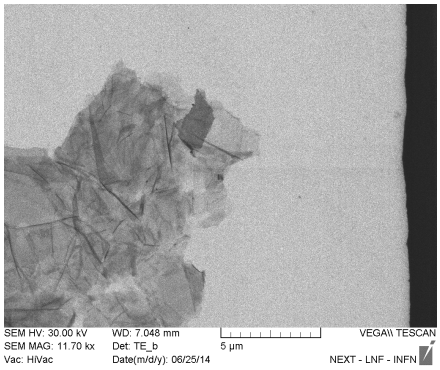
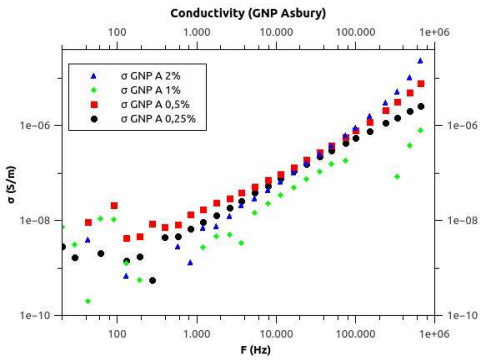
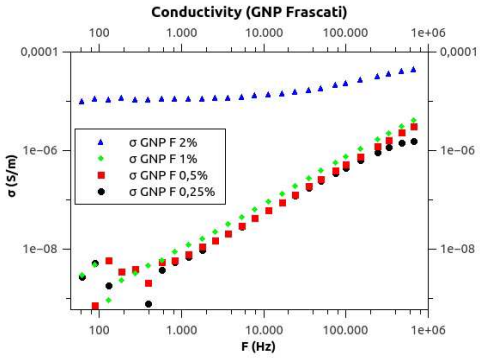


Figure 2 STEM images of GNPs - Frascati



3a)



3b)

Figure 3a) Conductivity Commercial GNPs; 3b) Conductivity GNPs- Frascati

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