Structural and Electronic Properties of Graphene Oxide and Reduced Graphene Oxide Papers

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High performance planar supercapacitors, and anodes for new generation lithium ion batteries may both relay on development of new materials based on graphene and graphene oxide nanomaterials. Graphene oxide was prepared by Marcano method. Both, standard vacuum assisted filtration method and recently developed proprietary method were used to obtain series of graphene oxide and reduced graphene oxide papers.

SEM and X-ray diffraction methods were employed for structural studies of the samples. Stacking sequence and number of layers of nanosheets of graphene present in the paper samples play important role [1, 2] in the electronic and electrochemical properties of the material studied. Our X-ray measurements revealed that the nanosheets of reduced graphene oxide have turbostratic stacking arrangement and interplanar spacing well above standard graphite value. In the case of graphene oxide the spacing is at least two times larger.

The reduced graphene oxide samples show the Raman spectra similar to these obtained for multilayer graphene. The optical measurements in the infrared and terahertz region for the same samples showed typical plasma behavior. The “plasma frequency” depends on the number of layers in the nanosheets.

A typical graphene oxide Raman spectrum is observed for “graphene oxide” paper. In the terahertz region no plasma behavior for these samples was observed. The paper becomes transparent for wavelengths above 30 micrometers. What is probably due to the intense scattering for higher energies.

Electrical parameters were characterized by four-point probe and microwave contactless technique to obtain a sheet resistance. Also a Hall effect in van der Pauw configuration was measured to establish concentration and mobility of charge carriers in the samples studied.

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