Electrical properties of Graphene Oxide (GO) at high pressure and low temperatures

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GO is a water-soluble nanomaterial prepared through extensive chemical attack of graphite crystals to introduce oxygen-containing defects in the graphite stack. In GO, a large fraction (0.5–0.6) of carbon is sp^3 hybridized and covalently bonded with oxygen in form of epoxy and hydroxyl groups. The remaining carbon is sp^2 hybridized and bonded either with neighboring carbon atoms or with oxygen in the form of carboxyl and carbonyl groups, which predominantly decorate the edges of the graphene sheets. GO is therefore a 2D network of sp^2 and sp^3-bonded atoms, in contrast to an ideal graphene, which consists of 100% sp^2-hybridized carbon atoms. This unique atomic and electronic structure of GO, consisting of variable sp^2/sp^3 fractions, opens up channels for new functionalities. The most notable difference between GO and mechanically exfoliated graphene is the optoelectronic properties arising from the presence of a finite band gap. Graphene oxide can be a semiconductor or insulator, depending on the degree of oxidation, and their electronic and optical properties can be tuned in large scope.

The samples are characterized by high resolution transmission electronic microscopy, FTIR and Raman spectroscopy (Figure 1). In the Raman spectrum of graphene oxide the G band is broadened and shifted to 1594 cm^{-1} whereas the D band at 1363 cm^{-1} becomes the prominent feature in the spectrum indicating the creation of sp3 domains due to the extensive oxidation. The intensity ratio of the D and G bands is a measure of the disorder, as expressed by the sp2/sp3 carbon ratio.

A four-probe technique for electrical and photoelectrical measurements in a gasketed diamond anvil cell is presented [1]. The special anvil profile and the method for the gasket preparation used in these experiments are described. Insulation and continuity of the electrical leads are shown to be satisfactory at least up to 30 GPa. As an example we report magnetotransport measurements in narrow gap semiconducting multilayer Graphene Oxide (GO), using a QD- PPMS platform.

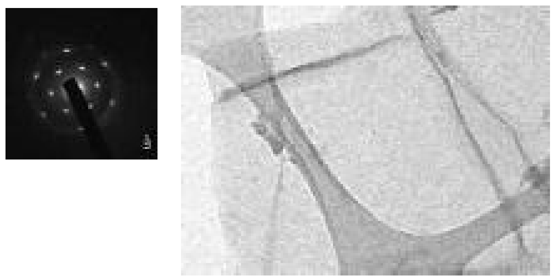

Figure 1. HRTEM and Electron Difrattion images of GO

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