Facile synthesis of reduced graphene oxide nanosheets free of paramagnetic impurities

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Classical presentation on graphene preparation routes distinguishes in one hand, graphene for physicists that is defect free mainly for electronics and spintronics applications and in the other hand, scalable graphene production for chemical applications such as composites and active electrode compounds for electrochemical storage (Li-ion batteries and supercapacitors). Defect free are prepared by mechanical exfoliation, or at a lower level of quality by epitaxial grow by CVD on metals or from SiC, while widely available graphene is prepared by solution-processing techniques [1], mainly by chemical exfoliation following the Hummers and Offeman method of oxidation of graphite in graphite oxide (GO). As such, GO is exfoliated by ultrasonication means forming graphene oxide layers that can be successfully suspended in aqueous media. After that GO that is in turn reduced. A wide range of reduction techniques have been described in the literature. The laboratory uses mainly chemical reducing agent (hydrazine, Fe [2] and $SnCl_2$).

A facile and cost-effective, one-pot and environmentally benign process for reducing graphene oxide based on stannous chloride reduction of GO in a strongly acidic medium is reported [3]. High quality metal free and spectroscopically pure graphene nanosheets Sn-rGO were obtained via metal induced reduction of expandable graphene oxide. Simultaneous exfoliation and reduction is achieved wherein, the reduction process is complete in this room temperature process. EPR studies (figure 1a) and magnetic measurements (figure 1b) show that the prepared graphene is spectroscopically pure and no paramagnetic metallic impurities are detected. Compared to the chemical reduction of GO using hydrazine or iron, Sn-rGO is several orders of magnitude less magnetic. Due to its high purity, this graphene is particularly well suited to study the effect of magnetic or electronic doping and as a support for catalyst.

References:

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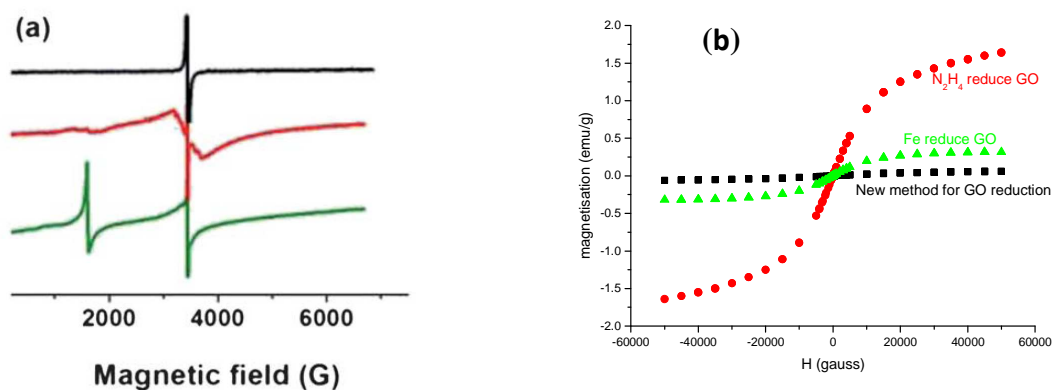
Figure 1: a), X-band EPR spectra of Sn–rGO (black), Hz–rGO (red) and Fe–rGO (green) registered at 10 K.; b), Magnetic moment as a function of the magnetic field at 1.8K