Fabrication of graphene flakes via oxidation-reduction method

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Chemical methods are proved to be an efficient way for mass production of graphene dedicated to broad set of applications, for example for various type of composites. There are many strategies to achieve efficient wet exfoliation of graphite to very thin flakes. Among them the oxidation-reduction way is the closest for scaling up. Importantly, the intermediate product-graphene oxide GO is also very promising material with high application potential.

In this work, we have succeeded in preparing single layer graphene oxide flakes by mild oxidation of expanded graphite. The GO sheets were investigated by Raman spectroscopy. The thickness was measured by atomic force microscopy (AFM). The size and surface morphology of flakes were probed by scanning electron microscopy (SEM) and transmission scanning electron microscopy (STEM) presented in Figures 1 and 2.

Obtained graphene oxide was used to prepare polysiloxane composite. We showed that addition of only 0.5 % GO significantly enhances the thermal conductivity of the composite. The next step was the reduction of graphene oxide in order to improve electrical conductivity of the composite. We used several chemical reducing agents: sodium borohydride, ascorbic acid, sodium citrate, formic acid, benzylamine. Products of reactions - reduced graphene oxide (rGO) samples were characterized by infrared spectroscopy (FTIR) and X-ray photoelectron spectroscopy (XPS). Finally electrical measurements were performed by testing conductivity between dense spaced planar electrodes covered by rGO flakes. The principles and details will be presented on the poster. It turned out that conductivity of rGO strongly depends on used reducing agents and reaction conditions. The best results were obtained by two step reduction and synergistic reduction by two agents.

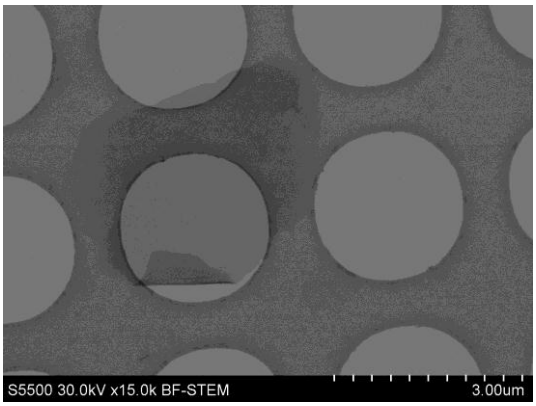

Figure 1. SEM image of GO flake

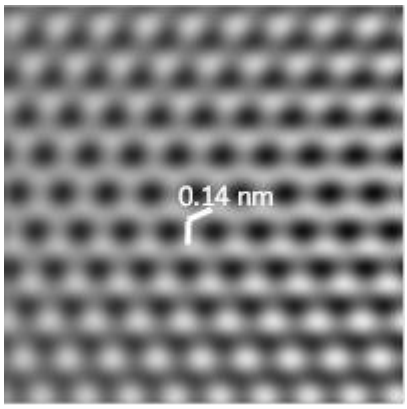

Figure 2. STEM picture of part of GO flake