Characterization of Few-layer Graphene (FLG) starting with Pristine Graphite via Wet Chemical Functionalization

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Few-layer graphene (less than 10 stacked layers) possess outstanding electronic and mechanical properties. However, graphene has a gapless band-structure and is not solution processable. Chemical functionalization has been used to address these problems by covalent modification of graphene's π-electron system in association with wet chemical exfoliation. Here we show new synthesis methods which also achieves this goal. Starting with pristine graphite we have obtained few-layer functionalized graphene. These materials were characterized by Raman spectroscopy, x-ray diffraction and TEM.

In a recent article [1] Hirsch *et. al.* reported the first wet chemical bulk functionalization of graphene starting with pristine graphite. Dried flake of natural graphite were reduced with solvated electrons using a liquid alloy of sodium and potassaium and an inert solvent, 1,2-dimethoxyethane (DME). After the reductive addition the functionalization was performed by adding diazonium salts to the DME dispersion. This resulted in the reoxidation and functionalization of the charged graphene accompanied by the rapid evolution of nitrogen and heating of the reaction mixture. This covalent modification of the graphene π-electron system through the introduction of variable chemical decoration leads to the opening of a band-gap in graphene's gapless band-structure together with it being a more easily processable material. However, this is the only wet chemical derivatization sequence of graphene found so far.

Geim and Novoselov [2] stated in their article "The rise of graphene" that graphene with sheets consisting of fewer than 10 stacked layers of sp^2-hybridized carbon lattice have the combination of outstanding electronic and mechanical properties. Strano et. al [3] add a proviso "However, these promising materials require the development of new synthesis methods to effectively control the number of AB-stacked layers by means of graphite exfoliation and processing."

In this talk, we show that, we can apply analagous methods to those we reported to functionalize carbon nanotubes [4, 5] for the preparation of large quantities of graphene sheets. Figure 1 shows a detail HRTEM view of a graphene and FLG flake.

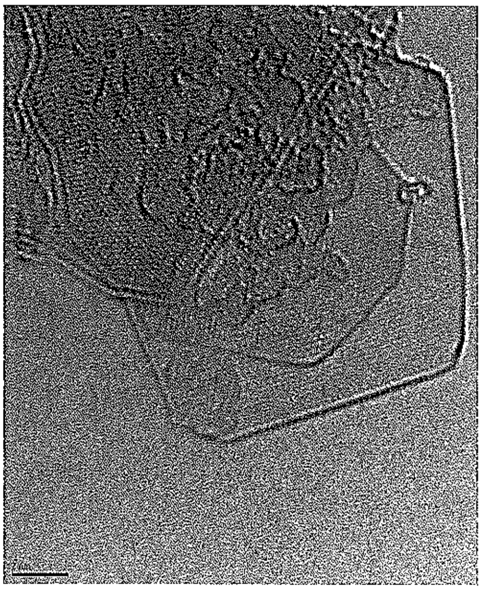

Figure 1. Detail HRTEM view of a graphene and FLG flake.

References

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