

NanoCarbon Metrology: Solution Processed Graphene Films

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Abstract

The NRC Measurement Science and Standards Project in Nano Carbon Metrology aims to develop quantitative metrological assessment protocols for nano carbon materials such as nanotubes and graphene. There is a need to develop and evaluate reliable and low cost methods to obtain uniform, conductive films of graphene via solution processes. A variety of routes have been developed which can be grouped into two approaches. Oxidation of graphite yields monolayer flakes of graphene oxide (GO) which are readily dispersed in water. However, formation of conductive films requires reduction of GO by thermal or chemical routes. Direct exfoliation without oxidation typically yields few layer flakes with poor dispersion stability in organic solvents. Here we evaluate the structure, morphology and electronic properties of reduced GO and graphene films derived from various protocols using starting materials from a number of commercial sources. Structure, morphology and uniformity of the films have been characterized by a combination of scanned probe and Raman microscopies. These observations are correlated with measurements of the conductivity and work function of these films. The structure and electronic properties of the films derived from thermal and/or chemical reduction of GO are compared with those based on dispersions of directly exfoliated graphene flakes.

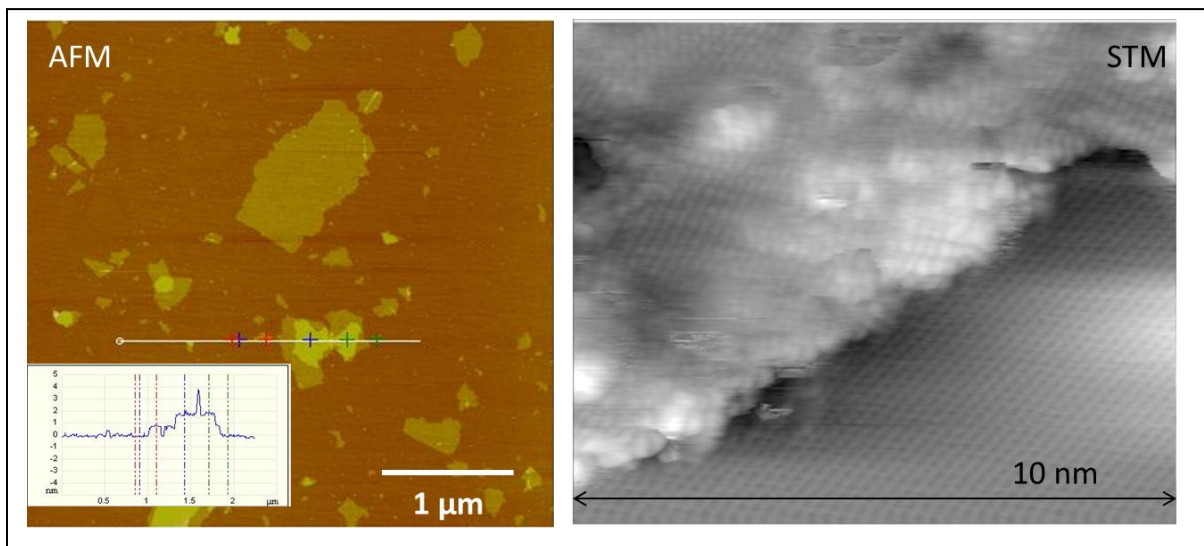


Figure 1. AFM and STM characterization of reduced GO.