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Characterization of solution processable graphene related materials

As graphene based materials move from the laboratory to production, there is increasing interest in a wide range of applications such as membrane filtration, batteries, printable electronics, and graphene-polymer composites, which require graphene related materials in solution. In this case the graphene is in the form of flakes dispersed in organic or aqueous solvents. Solution processable routes to graphene generally fall into two categories direct exfoliation of graphite or oxidation to graphene oxide (GO) followed by reduction to graphene. Properties of films made from these dispersions are dependent on both the quality of the individual flakes and how they are assembled into films. Here we will present results on evaluating the structure, morphology optical and electrical properties of GO and reduced GO samples derived from various protocols using starting materials from a variety of commercial sources. Different sizes of individual GO flakes were prepared by controlling the sonication energies in aqueous dispersion and implemented new approaches to characterize various GO properties as a function of the average flake size. New protocols were developed to determine and compare the flake size of GO dispersions by using dynamic light scattering and atomic force microscopy (AFM). AFM height measurements were also used to determine flake thickness and monitor the thermal reduction of GO. The atomic scale structure of the flakes was observed using scanning tunneling microscopy. Photoluminescence of GO was characterized as a function of sonication energy, excitation wavelength, and pH of dispersion. Strong dependence of photoluminescence intensity on pH control and variation of photoluminescence intensity with different flake sizes was observed. GO concentration dependent cytotoxicity was studied with various flake sizes for multiple cell lines.

References

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