NANO HIGHLIGHT
Size-Controlled Synthesis of Nano Graphene Oxide (GO) Sheets Using Graphite Nanofibers

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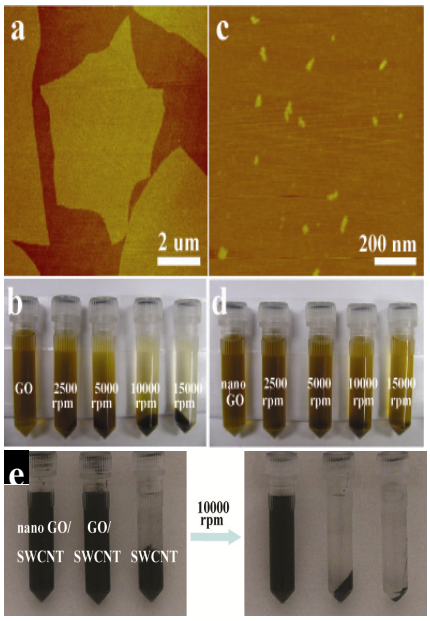
Graphene oxide (GO) is typically made by chemical exfoliation of graphite powders using strong oxidants. During reaction and processing, the graphene sheets are torn up into smaller pieces. As a result, the lateral sizes of the as-synthesized GO sheets are usually very polydispersed, ranging from a few nanometers to tens of micrometers. Recently GO sheets were revealed to act as surfactant with size-dependent amphiphilicity. Smaller GO sheets should be more hydrophilic due to higher density of charges originated from the ionized –COOH groups on their edges, which suggests that the colloidal stability of GO should also be size dependent. Now a group at Northwestern University has invented a size-controlled synthesis of nano GO sheets using graphite nanofibers as the precursor.



Nano GO (c, d) dispersions are much more stable than those of regular micron sized GO (a, b) as shown in the centrifugation tests for 30 minutes. (e) Both GO and nano GO can disperse SWCNTs in water after sonication, but nano GO creates more stable colloidal dispersion.
Credit: Jiaxing Huang, Northwestern University

These NU-NSEC researchers have developed a method to achieve size-controlled synthesis of nano GO sheets using coin-stacked graphite nanofibers as the precursor. Since the upper size limit of the graphene domain is predetermined by the diameter of the nanofiber precursor, the size distribution of the GO nanosheets is much more uniform than that of common GO synthesized from graphite powders. The size can be further tuned by the oxidation time. Compared to the micrometer-sized, regular GO sheets, nano GO has very similar spectroscopic characteristics and chemical properties. However, size is very important for the solution behaviors of GO. For example, regular micron-sized GO colloids tend to migrate to water surface over time. This eventually leads to a GO thin film covering the surface of an evaporating droplet, which eventually leaves a continuous film after drying. In contrast, the GO nano sheets preferably stay in water and tend to leave a "coffee ring stain" type of drying marks. In addition, the nano GO sheets can act as surfactant to disperse single-walled carbon nanotubes in water, generating a stable colloidal dispersion that can sustain high-speed centrifugation. This knowledge of size-dependent solution behaviors should be useful for the fabrication of GO-based thin films and coatings; it could also lead to new water-processable carbon nanotube-based materials.

[1] J. Luo, L.J. Cote, V.C. Tung, A.T. L. Tan, P.E. Goins, J. Wu, J. Huang. *J. Am. Chem. Soc.*, **132** (50), 2010.