Liquid exfoliated nanosheets: applications in energy, sensing and electronics

Jonathan N Coleman

School of Physics, CRANN and AMBER Research Centers, Trinity College Dublin, Dublin 2, Ireland

colemaj@tcd.ie

Abstract

Liquid phase exfoliation (LPE) is a simple method to exfoliate layered crystals like graphite to give 2-dimensional nanosheets such as graphene. LPE can be achieved either by sonicating or shearing layered crystals in appropriate liquids and has been used to produce nanosheets of graphene, MoS2, BN, MoO3, Ni(OH)2, phosphorene and many other materials. The nanosheets produced by this method tend to be ~100-1000 nm wide, a few monolayers thick and relatively defect free. Using centrifugation, the dispersions can be easily size selected, solvent exchanged and concentrated to ~10 mg/ml, and are ideal for producing nanosheet networks. Here we show that, especially when combined with carbon nanotubes, such networks are of use in electrochemical devices such as supercapacitors, battery electrodes or electrocatalysts. In particular, composite films fabricated from combinations of Co(OH)2 nanosheet and carbon nanotube networks perform as state of the art oxygen evolution catalysts. When graphene nanosheet networks are combined with soft polymers, the resultant composite becomes an extremely sensitive electromechanical sensor. When mounted next to the skin, such sensors can detect pulse and even measure blood pressure. Alternatively graphene networks can be printed to act as electrodes. When combined in the correct architecture with networks of semiconducting (eg MoS2) and insulating (eg BN) nanosheets it is possible to produce all-printed, all-nanosheet field effect transistors.

Figures

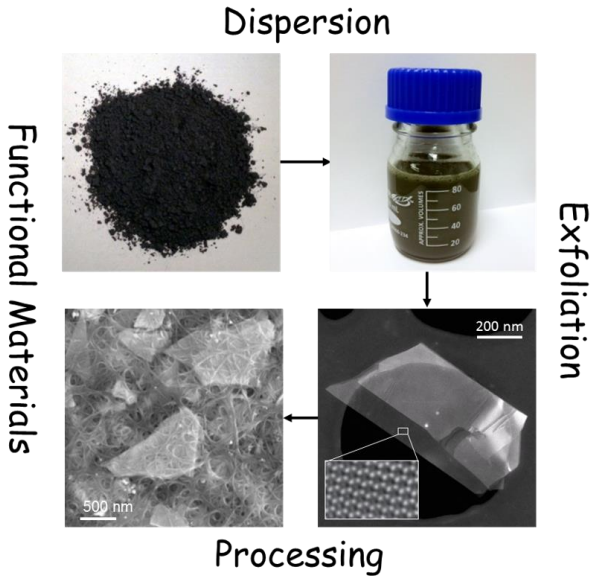

Figure 1: Liquid phase exfoliation allows the production of dispersions of exfoliated nanosheets which can eb fabricated into functional forms.