

Production of nanosheets by liquid exfoliation: The route to applications

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In this talk, I will review liquid phase exfoliation as a method for producing 2D nanosheets, both of graphene and a range of other 2D materials including BN, transition metal dichalcogenides, metal oxides and hydroxides, III-VIs and black phosphorous. I will describe the use of spectroscopic metrics to measure mean nanosheet size, thickness and monolayer population in dispersion and show how this facilitates the production of dispersions with predetermined parameters such as high monolayer content. In order to produce large quantities of nanosheets, we have developed shear exfoliation methods. I will describe the scaleup of this process as well as using it to size select nanosheets. Once controlled nanosheet dispersions can be produced, they can be mixed with conducting additives such as nanotubes to produce functional composites with enhanced conductivity. We will demonstrate that such systems are extremely useful in electrochemical applications such as supercapacitor and battery electrodes as well as hydrogen and oxygen evolution electrocatalysts. Finally, we will demonstrate that liquid exfoliated nanosheets can be inkjet printed to form functional heterostructures. We will demonstrate printed photodetectors and supercapacitors.