Electrical and electrochemical applications of liquid exfoliated nanosheets

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Abstract

Liquid phase exfoliation (LPE), is a simple and versatile method to exfoliate layered crystals like graphite, BN and MoS2 to give 2-dimensional nanosheets such as graphene in large quantities. These dispersions can be straightforwardly processed, allowing the production of composites or the printing of nanosheet networks. In this talk, I will discuss our latest results on exfoliation of new layered materials, for example SnP3, which displays superlative lithium storage. I will also describe the printing of size-selected nanosheet networks using aerosol jet printing as well as their electrical properties. By combining networks of different nanosheet types, it is possible to form heterostructures for device applications. For example, when mixed with a polymer conductive nanosheets can yield extremely sensitive strain sensors. Alternatively, using graphene electrodes and high permittivity BiOCl nanosheets as dielectric, it is possible to print capacitors with dielectric constants >50. However, for many applications, graphene networks are too resistive to be useful. I will demonstrate metallic nano-platelets (Figure 1) which yield networks with conductivities approaching 10^7 S/m, display state of the art EMI shielding performance and show unusual electrical properties. Finally, I will demonstrate that a number of non-layered materials can be converted to nanosheets using LPE (Figure 2). Such quasi-2D materials demonstrate outstanding performance in a number of applications, for example Li ion battery electrodes.

FIGURES

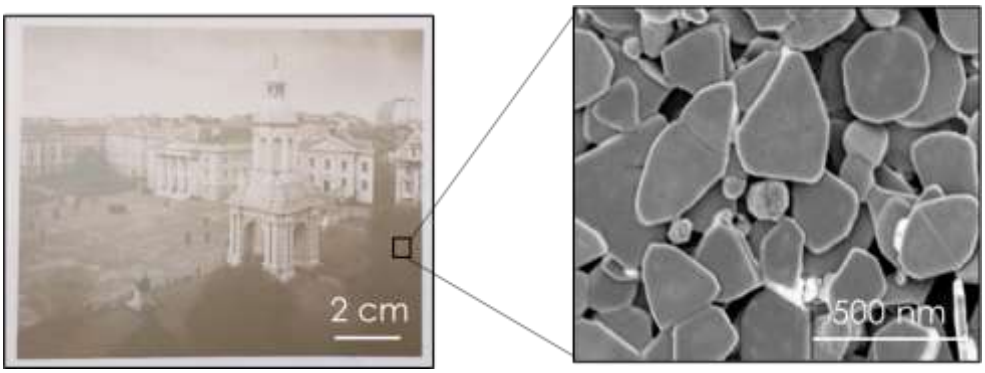

Figure 1: Printed network of metallic nano-platelets.

Figure 2: Liquid phase exfoliation of the mineral, fool's gold (pyrite).