Formulation of low dimension carbon particles for composites and supercapacitor applications

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The superlative properties of isolated graphene sheets and nanotubes are often quoted, however the properties achieved when these nanomaterials is incorporated into bulk materials are typically a fraction of these values [1,2,3]. This issue, of course, is a symptom of most nanomaterials and arises from the challenges in formulating materials with high surface areas, making them highly prone to aggregation. This challenge is increased when one aims for multifunctionality, where different functionalities require conflicting microstructural requirements; e.g. electric percolation in polymer composites requires a percolated network of nanotubes, whereas mechanical reinforcement needs the nanotubes highly aligned in the direction of the load.

We have developed a range of functional approaches to control dispersion of carbon nanoparticles, including electrostatic [4] and steric approaches [5]. Alternatively hybrid materials are produced to reduce their impact of processing [6]. We then have measured their rheological properties [7,8] and looked at routes to control their microstructure during processing towards composite and supercapacitor applications.

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