Soft Materials Approaches to Carbon Nanotubes: from Gels to Composites

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Carbon nanotubes combine low density with exceptional mechanical, electrical and optical properties. Unfortunately, these nanoscale properties have not been retained in bulk structures. I will describe surface modification assisted self-assembly of single wall carbon nanotube into macroscopic nanotube networks - hydrogels and aerogels.[1-3] The nanotube networks are ultra-lightweight, electrically conducting and thermally insulating.[4,5] The shapes and sizes of these nanotube networks are readily tunable and is a tremendous strength of our fabrication method. The interesting properties and structure of these nanotube networks make them suitable for diverse applications.[6] For example, we have used these networks as scaffolds to enhance elastic modulus of polymers by 36,000%. The porous nanotube networks also show high capacitance, and can be impregnated with catalysts nanoparticles at high loading, which can then be simultaneously used as electrodes and catalysts supports in electrochemical cells. A weakness of the nanotube networks is their fragility – but we have recently developed a method to transform these inelastic networks into superelastic materials by coating them with between one and five layers of graphene nanoplates.[7] This work has been supported by the NSF (DMR-0645596, DMR-0619424 and CBET-0933510), Sloan Foundation, ACS-PRF, the Korea Institute of Energy Research, DARPA, and Bayer Materials.

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