Oral Presentation

Title: Template-free fabrication of carbon nanotube-polymer ultra porous nanostructures

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Abstract

Low density assemblies of nanomaterials are unstable. In most real-world applications, nanomaterials can be released from the assembly and contaminate the environment and/or user. To prevent this, many have looked at hybridizing nanomaterials with polymers to increase the stability of the overall structure. Carbon nanotubes (CNTs) have been used as conductive nano-fillers within different polymer matrixes in a range of low-density materials. Typically, CNTs are first dispersed in solution using ultrasonication or emulsification using surfactants to increase the CNT loading and prevent agglomeration of CNTs within the polymer matrix. These approaches require multiple steps and the overall CNT fraction tends to be low. In our research, we address this problem, for the first time, with an inverse approach of fabrication. We first prepare free standing, stable 3D conductive foam like materials produced by stacking layers of CNT sheets. The CNT sheets are stabilized by a pyrolytic carbon coating to produce stable junctions at CNT interconnections resulting an ultra-porous (porosity ~99.9%) foam structure (~ 6.0 mg/cm^3). In a final single step, the hybrids are produced by infiltration of polymer solutions into the CNT structures with subsequent removal of the solvent. The multifunctional properties of our CNT-polymer nano-hybrids can be tuned over a wide range by changing the polymer solution concentration, providing resulting densities from ~8.8 mg/cm^3 to ~107.3 mg/cm^3. Multifunctionality of the CNT-polymer hybrids are demonstrated in piezoresistive sensing, liquid sensing and electromagnetic shielding interference applications.