High Performance Nanocomposites Based on Colloidal Assembly of Carbon Nanotubes

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Despite the many potential applications of carbon nanotubes our inability to controllably assemble these nanostructures into macroscale systems with precise geometries remains a major bottleneck in efforts to applications. There is a real need to develop practical technologies for transforming the as-produced nanotubes into materials or integrated assemblies with properties that are both fundamentally interesting and useful.

A novel method for tailoring the properties of nanotube-based composites using colloidal crystal templating is described. This simple colloidal deposition process facilitates the formation of highly ordered multi-arrays of polymer particles, which act as a template for the assembly of carbon nanotubes into three-dimensional hexagonal patterns and thus creates the possibility to overcome problems with filler distribution. Nanotubes are assembled and positioned at interstitial sites between the polymer particles resulting in a honeycomb-like arrangement. The physical properties of these composites can be tuned by varying controllable parameters such as polymer glass transition temperature, particle size and crystal assembly method. A range of applications including tissue scaffolding, conductive transparent coatings and tough pressure sensitive adhesives is discussed.