

Graphene-Based Polymer Nanocomposites: Synthesis and Characterization of Novel Multi-Functional Materials

Hannes C. Schniepp

Department of Applied Science, The College of William and Mary, Williamsburg, VA

Graphene-based polymer nanocomposites are very promising candidates for new high-performance materials that offer improved mechanical, barrier, thermal and electrical properties. In our laboratory, we synthesize different kinds of single-layer, functionalized graphene sheets in gram quantities. The surface functionality of these sheets can be adjusted easily, which allows us to make stable dispersions in a large range of solvents. Employing the good solvent compatibility of these sheets, we make nanocomposites with different polymers via solution processing. Due to the outstanding characteristics of graphene, some of these nanocomposites exhibit significantly enhanced properties at small nanofiller concentrations, including increased stiffness, strength, electrical conductivity, as well as improved thermal and barrier properties. We believe that the mechanical performance of these materials can be even further improved once the underlying mechanisms are better understood. Therefore, we use scanning probe techniques to investigate and manipulate these materials at the level of individual filler nanoparticles. We are able to probe the mechanical properties of individual graphene sheets, and based on a new technique we can directly measure their interactions with the different polymer host materials. Moreover, we are developing new methods that will allow us to “look inside” nanocomposites. Our ultimate goal is a systematic design of new nanomaterials with tailored properties.