Synthesis and Characterization of a Well-Dispersed Nanostructured Polymer System

Arianna Lubomyra Watters
Advised by Giuseppe R. Palmese, PhD

Epoxy resins are an important class of thermosetting polymers widely used in structural composite applications such as adhesives, coatings, and encapsulants for a wide variety of industries, however, these high performance matrices are limited by their brittle nature. The focus of this work was to contribute to the development of epoxy reinforcement by incorporating carbon nanotubes to enhance electrical and mechanical properties of these multifunctional materials. Nanocomposites were synthesized using a novel ionic liquid dispersant/initiator in conjunction with three roll milling, resulting in well-dispersed nanotube-epoxy composites with an ultralow critical percolation. The quality of the dispersion is comparable with the best published results for nanotube-epoxy composites, created using simplified and streamlined methods. Young's modulus of the resultant composites exhibit enhancements up to a nanotube content of 1.0 wt%, at which point no further increases are observed due to the material surpassing its rheological percolation. Nanotube-epoxy fracture toughness is moderately improved over the unmodified network and enhancements are exhibited at nanotube contents as low as 0.01 wt%. Development of well-dispersed nanotube-reinforced epoxy resins have led to a better understanding of processing-structure-property relationships in nanotube-epoxy composites that can be applied to the design of improved systems.