Carbon and boron -based nanomaterials for biomedical, energy, and environmental significant applications

Experimental Nanochemistry
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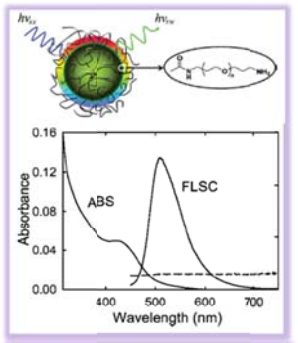
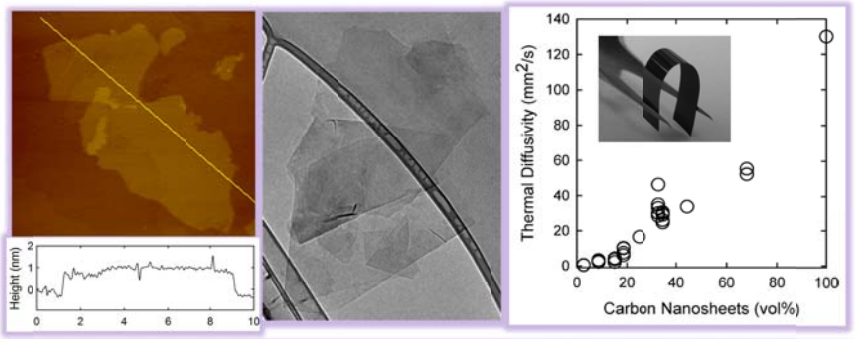
Description: Our current research activities are primarily in the following two areas:

1. Fluorescent Carbon-Based Nanomaterials. Currently, there is great interest in the development of benign (such as nontoxic or less toxic) quantum dots for a wide variety of applications. The recent finding that small carbon nanoparticles could be surface passivated by organic molecules to become strongly photoluminescent in the visible and near-infrared spectral regions is of particular interest and may serve as an ideal benign alternative to the widely pursued semiconductor quantum dots. Our specific aims in this area will be to (i) improve the properties of C-Dots in reference to those of traditional semiconductor QDs, and (ii) explore other architectures and configurations that could take advantage of the high brightness and energy transfer characteristics of these C-Dots.



Carbon dot structure and its typical absorption (ABS) and luminescence emission (FLSC) spectra

2. Carbon and Boron -based Nanomaterials as Multifunctional Modifiers for Polymers. Much excitement has been generated in recent years with the new research focus on the synthesis of carbon and boron -based nanomaterials (e.g. CNTs, boron nitride nanotubes (BNNTs) and graphene sheets) and their processing as nanoscale additives and reinforcements for polymers. The known mechanical, electrical, and thermal properties of these nanomaterials have prompted many predictions on their extraordinary potentials for ultimately performing polymeric nanocomposites. The major technical challenges encountered today are to significantly exfoliate and achieving high degree of dispersion of nano-scale fillers in a host polymer matrix. In this area, we are interested in employing several organic chemical functionalization strategies for complete exfoliation and high degree of dispersion of these nanofillers.



Atomic force microscopy (AFM) and Transmission electron microscopy (TEM) images of isolated graphene sheets and the observed thermal diffusivity on the graphene sheet loading in the polymeric-nanocomposite thin films.

These works are being done in collaboration with researchers at Clemson University.

- **Student Researcher:**
  - Aldwin Foster-Rettig (Spring 2011)