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Materials Research Science and Engineering Center

MRSEC SEMINAR SERIES

Chemically Refined Carbon Nanomaterials

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Date: Thursday, January 26, 2012

Time: 3:00 PM

Location: Microelectronics Research Center, Room 102

Abstract:

Carbon nanomaterials have attracted significant attention due to their potential to improve applications such as transistors, transparent conductors, solar cells, batteries, and biosensors. This talk will highlight our latest efforts to develop strategies for purifying, functionalizing, and assembling carbon nanomaterials into functional devices. For example, we have recently developed and commercialized a scalable technique for sorting surfactant-encapsulated single-walled carbon nanotubes (SWCNTs) by their physical and electronic structure using density gradient ultracentrifugation (DGU). The resulting monodisperse SWCNTs enhance the performance of thin film transistors, infrared optoelectronic devices, photovoltaics, catalysts, and transparent conductors. The DGU technique also enables multi-walled carbon nanotubes to be sorted by the number of walls and solution phase graphene to be sorted by thickness, thus expanding the suite of monodisperse carbon nanomaterials. By extending our DGU efforts to carbon nanotubes and graphene dispersed in biocompatible polymers (e.g., DNA, Pluronics, Tetronics, etc.), new opportunities have emerged for monodisperse carbon nanomaterials in biomedical applications.

In addition to these solution-phase approaches, this talk will also discuss vacuum compatible methods for functionalizing the surfaces of carbon nanomaterials. For example, a suite of perylene-based molecules form highly ordered self-assembled monolayers (SAMs) on graphene via gas-phase deposition in ultra-high vacuum. Due to their noncovalent bonding, these SAMs preserve the superlative electronic properties of the underlying graphene while providing uniform and tailorable chemical functionality. In this manner, disparate materials (e.g., high-k gate dielectrics) can be seamlessly integrated with graphene, thus enabling the fabrication of capacitors, transistors, and related electronic/excitonic devices. Alternatively, via aryl diazaonium chemistry, functional polymers can be covalently grafted to graphene. In addition to presenting opportunities for graphene-based chemical and biological sensing, covalent grafting allows local tuning of the electronic properties of the underlying graphene.