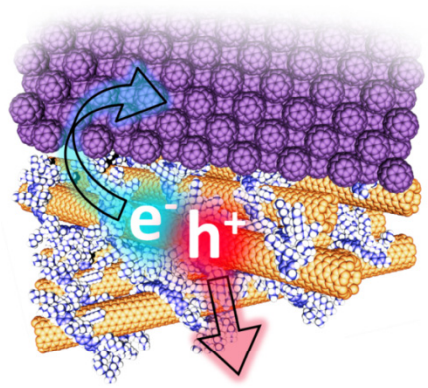

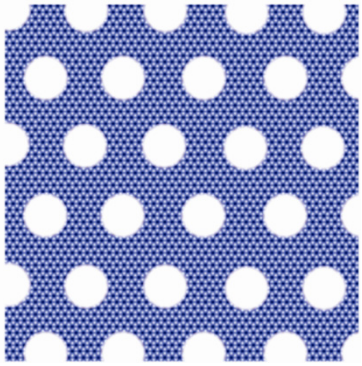

(Right) Photogenerated charge separation using electronic-type controlled carbon nanotube/C_{60} fullerene heterojunctions. **(Left)** Semiconducting nanoperforated graphene.

Advancing Semiconducting Nanocarbon for Electronics and Photovoltaics

Semiconducting sp2-bonded carbon nanomaterials such as carbon nanotubes and quantum-confined graphene nanostructures have exceptional properties that make them highly attractive for applications in semiconductor electronics and optoelectronics. In this talk, I will detail two recent advances in carbon-based electronic materials that we have realized in my research group. 1) First, we have pioneered a new class of photovoltaic materials and devices based on structure-controlled and electronic-type controlled semiconducting carbon nanotubes in which we are uniquely employing the nanotubes as the primary optical absorber. We have shown that we can efficiency harvest light using semiconducting carbon nanotubes and separate the photogenerated charges using all-carbon nanotube/C_{60} fullerene heterojunctions. The carbon nanotube/carbon fullerene heterostructures are an evolution of polymer photovoltaic systems and exploit carbon nanotubes' strong near-infrared absorptivity, excellent charge transport characteristics, and chemical stability. 2) In the second part of the talk, I will introduce a new form of semiconducting graphene-based materials that we call nanoperforated graphene. Nanoperforated graphene is created by perforating large-area graphene membranes with nearly close-packed hexagonal arrays of holes with sub-20 nm dimensionality. I will detail how to rationally synthesize nanoperforated graphene using self-assembling lithographic approaches including block copolymer- and nanosphere-lithography and will show that it has semiconducting behavior with a band gap inversely proportional to its minimum feature size. I will also introduce a new synthetic approach that we have pioneered for growing nanostructured graphene materials, from the bottom-up, that avoids defect-inducing top-down etching.

Professor Mike Arnold

Materials Science & Engineering

Thursday, Sept. 8, 2011 – 12:15 p.m.

1315 Chemistry