DEPARTMENT OF CHEMICAL ENGINEERING

SEMINAR

FRIDAY, October 25, 2013
11:30 AM – E6-2024
(coffee and donuts served at 11:25 AM)

"Improving Supercapacitor Performance by Functionalization and Interfacial Assembly of Graphene"

Michael A. Pope
Vorbeck Materials Corp.

ABSTRACT

The development of clean technologies requires electrochemical energy storage devices featuring improvements in energy density, power density and stability. Supercapacitors possess many advantageous attributes over current battery technologies including efficient operation at high power densities, extended lifetimes, and improved safety. However, the low energy density of commercial supercapacitors currently limits their widespread use, a problem that has inspired a tremendous research effort.

Supercapacitors are electrochemical devices which store energy in the double-layer formed between a high surface area conductor and a liquid electrolyte. The energy density is maximized when both the surface area available for double-layer charging and the intrinsic capacitance of this double-layer are large. Graphene is a promising material candidate for boosting energy density as it is atomically thin and boasts an incredibly high, conductive surface area (2630 m^2/g). Though preliminary results obtained with graphene-based devices have shown promise, many challenges still remain.

In this talk, I will discuss how production and post-processing of graphene, prepared via the graphene oxide route, creates a family of materials with a wide range of physical properties, namely the incorporation of oxygen-containing functional groups and lattice defects. To study how these properties affect the intrinsic capacitance of the graphene/electrolyte interface, I describe a newly developed experimental platform for measuring the electrochemical properties of well-defined, graphene monolayers assembled using a Langmuir-Blodgett technique. I used this system to show that the intrinsic capacitance can surpass that of pristine graphene nearly fourfold. In addition to these model studies, I will discuss the challenges associated with processing graphene into thick, dense electrodes and describe several strategies which overcome these problems. Only by both optimizing the structure of graphene and by developing improved electrode processing routes will graphene live up to its true potential.

Biosketch: Dr. Michael Pope recently obtained his PhD from Princeton University's Department of Chemical and Biological Engineering and is currently carrying out his post-doctoral work at Vorbeck Materials Corp., a large scale manufacturer of graphene and graphene-containing products. His PhD work focused on the production and processing of graphene into supercapacitors, batteries, solar cells and sensors. At Vorbeck, he currently leads a research and development program aimed to commercialize high performance batteries based on graphene.