Northeastern University
College *of* Engineering

Please join us for a
Special Chemical Engineering Seminar

Wednesday, February 20, 2013
108 West Village H
11:45 a.m. – 1:00 p.m.

"Solid State Electrolytes and Lignin-based Carbon Fibers for Safe and Inexpensive Lithium Batteries"

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ABSTRACT

Significant challenges associated with dense energy storage in lithium ion batteries for transportation applications must be solved. Cost, safety, and range (i.e. total stored energy) are paramount among these challenges. Two ongoing projects concerning solid state electrolytes and lithium ion battery anodes will be discussed. The specific charge storage capacity of lithium metal is an order of magnitude greater than graphite's. However, graphitic anodes are employed in commercial lithium ion batteries due to safety concerns. We are developing solid composite electrolytes where both phases contribute to Li^+ transport to enable facile, safe, and reversible cycling of lithium metal. Efforts to understand Li^+ transport at interfaces between two solid electrolytes will be discussed. It was discovered that interfacial resistances between electrolytes in laminated structures often dominate the resistive response but can be essentially eliminated through fabrication approaches. The study was extended to particulate composites designed to optimize conductivities and mechanical properties. Initial results suggested that negligible lithium transport occurred through the particulate inorganic phase despite its higher conductivity. Efforts to understand and reduce the interfacial resistances in these composites will be presented.

In the second project, lignin-derived carbon fibers (LCFs) were developed as low cost lithium ion battery anodes. Lignin is the second most abundant naturally occurring biopolymer and comprises 18-35% of wood by weight. Synthetic techniques were developed to controllably fuse LCFs at fiber-fiber contact points, resulting in monolithic mats that were electrically interconnected. By virtue of their mixed electronic and ionic conductivities, LCFs functioned as both current collector and active material, eliminating the need for massive copper foil current collectors. LCF mats were galvanostatically cycled in half cells against Li metal, and specific capacities as high as 250 mAh g^{-1} were achieved with a capacity retention greater than 99% over 70 cycles.

Research was sponsored by the Laboratory Directed Research and Development Program of Oak Ridge National Laboratory, managed by UT-Battelle, LLC, for the U. S. Department of Energy. This work was also supported by the Assistant Secretary for Energy Efficiency and Renewable Energy, Office of Vehicle Technologies of the U.S. Department of Energy under the Batteries for Advanced Transportation Technologies (BATT) Program.

BIOGRAPHY: Dr. Wyatt E. Tenhaeff is a staff scientist at Oak Ridge National Laboratory (ORNL) in the Physical Chemistry of Materials group. He received ORNL's Alvin M. Weinberg Fellowship in 2009 and then transitioned to a staff scientist position in 2011. Dr. Tenhaeff received an Honors BS in chemical engineering from Oregon State University in 2004 and his Ph.D. in chemical engineering from MIT in 2009. His academic awards include the Oregon State University Presidential Scholarship and NSF Graduate Research Fellowship. His primary research interests are polymer science, thin film technology, chemical vapor deposition, and electrochemical energy storage. Current research efforts at ORNL emphasize the development of new materials for lithium batteries. He has authored 20 publications, 8 as first-author, and filed two patent applications.

Refreshments will be served.