Analytical & Materials Seminar

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12:15 pm 1315 Chemistry

Following function in real time: towards the next generation of batteries and supercapacitors for grid storage and transportation.

A full understanding of the operation of a device requires that we utilize methods that allow devices or materials to be probed while they are operating (i.e., *in-situ*). This allows, for example, the transformations of the various cell components to be followed under realistic conditions without having to disassemble and take apart the cell. To this end, the application of new *in* and *ex-situ* Nuclear Magnetic Resonance (NMR) and magnetic resonance imaging (MRI) approaches to correlate structure and dynamics with function in lithium-ion and lithium air batteries, and supercapacitors will be described. The *in-situ* approach allows processes to be captured, which are very difficult to detect directly by ex-situ methods. For example, we can detect side reactions involving the electrolyte and the electrode materials, sorption processes at the electrolyte-electrode interface, and processes that occur during extremely fast charging and discharging. Ex-situ NMR investigations allow more detailed structural studies to be performed to correlate local and long-range structure with performance. In this talk, I will describe the use of NMR spectroscopy combined with X-ray scattering methods to probe local structure changes in lithium ion batteries, focusing on our work with the anode material Si, on lithium air cathodes, and to investigate Li dendrite formation in lithium metal batteries. Finally, the application of NMR to examine double layer formation in electrolytic double layer capacitors (supercapacitors) will be described.