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THURSDAY

FEBRUARY 12, 2015

1315 CHEMISTRY

12:15 P.M.

Analytical Seminar

Presented by

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“Visualization of electrochemical phase transformation in battery materials with Synchrotron X-ray techniques”

The energy density of current batteries is limited by the storage capacity of the electrodes, which is determined by the properties of the active material and its concentration in the composite electrode architecture. Indeed, battery electrodes are hierarchically complex structures formed by different components whose distribution determines the final properties. These structures must enable fast ion and electron transport. Because these hierarchies are assembled at scales much larger than a few nanometers, tools that can probe multiple levels of complexity are required to fully determine the parameters that control performance.

Since reactions at an electrode involve redox phase transformations, the state of charge can easily be correlated to composition. Spectroscopic and diffraction tools are widely available that can produce this chemical information. Yet such observations are particularly critical at the single particle level, where incomplete reactions and failure are prone to occur. In this talk, I will discuss examples of the visualization of phase transformations using a variety of modes within the general family of X-ray imaging, tailored to suit the scales and phenomena to be probed. Insight was gathered from the atomic to the electrode level at high resolution. Because thermodynamic pathways can be controlled by the presence of electrical potential, the harvesting of a sample from a cycled battery, while providing a useful preliminary insight, can lead to misleading results due to the relaxation of components into a different state that is more stable under open circuit conditions. Therefore, measurements performed during the electrochemical reaction were demonstrated. The mechanisms of transformation will be discussed in the context of their impact on material and architecture properties.