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Electron microscopy characterization of Li-based cathode materials for battery applications

PATRICK PHILLIPS, University of Illinois at Chicago

While recent advances in energy storage have revolutionized the consumer electronics market, we still lack an understanding of the aging effects that currently limit the batteries' lifetime and energy storage capacity. Aberration-corrected scanning transmission electron microscopy (STEM) is becoming one of the most promising characterization tools to study the effects of repeated charging/discharging cycles on electrode aging in Li-ion battery materials, due to the wide-range of techniques available on advanced STEM instruments, including the direct imaging of both heavy and light elements, energy-dispersive X-ray and electron energy loss (EEL) spectroscopies and a variety of in-situ methods. This talk will focus on the structural and chemical characterization of Li-ion battery electrode materials, both in a pristine and lithiated/delithiated state. We will examine the nucleation of structural transitions with STEM experiments utilizing various imaging modes, including annular dark field and bright field imaging, and in-situ electro-chemical experiments using the open-cell design. These results will be combined with EELS measurements and first principle density functional theory calculations to elucidate the role of the observed transitions on the material's structural stability.

In collaboration with Robert Klie, University of Illinois at Chicago; Hakim Iddir, Roy Benedek, and Daniel Abraham, Chemical Sciences and Engineering Division, Argonne National Laboratory.