Mesoscale Phase Distribution in Li-ion Battery Electrode Materials

Scientific Achievement
We have used TXM-XANES to produce chemical maps at 30 nm resolution of the distribution of species involved in the delithiation of micron-sized LiFePO$_4$ plate-like crystals.

Significance and Impact
The high spatial and chemical resolution of TXM-XANES can be used to build a complete picture of the fundamental mechanisms of diffusion and phase transformation at the single particle level.

Research Details
– Chemical maps of partially delithiated LiFePO$_4$ microplates were obtained at 30 nm resolution using TXM-XANES. These maps were compared to morphological information collected by STEM, which revealed the existence of cracking during delithiation due to strain buildup.
– The results revealed the interplay between crystal microstructure and redox reactions at the mesoscale. The specific mechanism was found to be controlled by kinetic limitations, as well as thermodynamic effects.


Work was performed at Lawrence Berkeley National Laboratory and at SLAC National Accelerator Laboratory.