In Operando Multimodal X-Ray Measurements of Coin Cell Batteries

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In order to meet the increasing demands for improved energy storage for portable electronic devices and the transition to electrification of personal transportation, the reliability and capacity of battery technology needs to be increased, while the product costs need to decrease. To meet these challenges, diagnostic measurements are needed to evaluate and understand new battery chemistries and the evolving microstructure that affect the battery performance over it's lifetime.

X-ray scattering techniques can illuminate the inner working of batteries as they undergo their (dis)charge cycling. We demonstrate the use multiple x-ray techniques (energy-dispersive x-ray diffraction, radiography, and tomography) to determine the response of the coin cell battery components as their undergo cycling. X-ray diffraction is an established technique to determine the electrochemical state of the anode and cathode materials. Using a 10 μm - 20 μm incident vertical beam size, we are able to profile the electrodes layer during cycling. We have determined that gradients exist within individual anode layer. We also apply the radiography and tomography techniques to help understand the microstructural response of these battery components and observe the evolution of the cell structure following formation and subsequent cycles. We will present examples for the graphite and graphite-silicon composite anodes to highlight the importance of this larger view for a coin cell battery and discuss how these methods can be applied to larger pouch cell batteries.