Interfacial Processes – Advanced Diagnostics

U.S. DEPARTMENT OF ENERGY
Energy Efficiency & Renewable Energy

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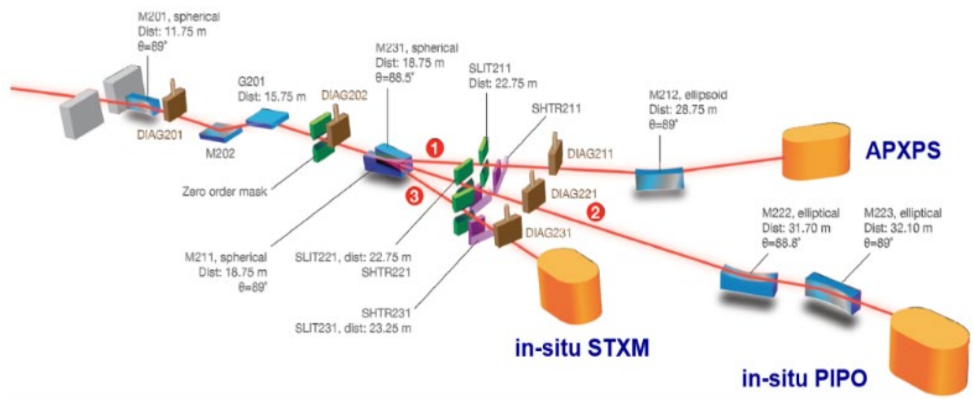
- ***Objective:*** Develop and apply advanced *in situ* and *ex situ* far- and near-field optical multifunctional probes and synchrotron-based advanced x-ray techniques and experimental methodologies to study and understand the mechanism of operation and degradation of materials for rechargeable cells for PHEV and EV applications. This project supports development of new electrode materials for high-energy Li-metal based rechargeable cells
- ***Impact:*** A better fundamental understanding of the underlying principles of battery electrodes operation is inextricably linked with successful development and implementation of high energy density materials/electrodes and cells for PHEVs and Evs.

Advanced Materials Beamline for Energy Research



High-intensity, wide-energy-range (50-2500 eV) beamline and its three end-stations are optimized for understanding and tailoring properties of the interfacial chemistry of metallic lithium anode for energy storage systems.

Accomplishments:

- This is a new start focused on basic studies of interfacial chemistry in lithium-based batteries.
- Li passivation is achieved by a physical barrier between the lithium surface and the electrolyte that prevents continued reduction. The exact mechanism of corrosion reactions in Li anodes is still unclear.

➢ *A greater understanding of the reactions of the electrolyte and the nature of passivity will be essential to utilize metallic Li.*

➢ *A surface science approach may provide additional insight to approaches currently being used.*

FY19 Milestones:

- Manufacturing of model thin-film and composite LLZO and LPS solid-state electrolytes by pulsed laser deposition (PLD)
- Characterize the bulk and surface structure of Li anode, NMC cathode electrodes and solid-state electrolytes and its relation to electrochemical and interfacial properties.
- Characterize the chemistry of solid-state electrolyte/Li and electrolyte/cathode interfaces with ex situ near-field IR, XAS and XPS.
- Design and develop new XAS/XPS experimental setup to characterize in situ solid/solid (e.g., NMC/SSE Li/SSE) interfaces.

FY19 Deliverables: *Demonstrate feasibility of in situ measurements of solid-solid electrochemical interfaces*

Funding: FY19: $460k, FY18: $460k, FY17: $460k