Microscopy Investigation on the Fading Mechanism of Electrode Materials

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

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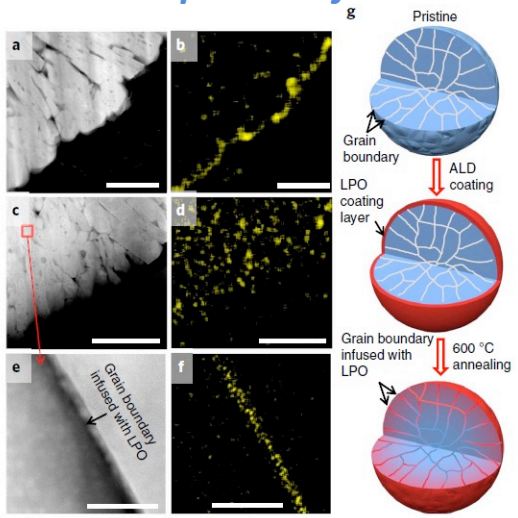
Objective:

- Explore the fading mechanism of the electrode materials. using advanced microscopy and spectroscopy techniques
- Establish the structure and properties correlation, feed back to materials synthesis for better electrode materials.

Impact:

- Direct observation of fading mechanism provides insights for developing strategy to mitigate fading of battery.
- Establishing of structure properties relationship can lead to novel concept for materials design for better batteries.
- In-situ TEM observation provides structural, chemical, and electronic information with atomic level resolution forms the key for better design of battery materials.

Infusion of solid electrolyte into the grain boundaries of secondary particle can eliminate the fading of cathode associated with solid-liquid interfacial reaction



Accomplishments:

- Established the correlation of fast charge with the structural evolution of the NMC cathode.
- Revealed the solid-liquid interfacial reaction controls the layer to spinel phase transition.
- In-situ environmental TEM revealed that coupling of electrochemically triggered thermal and mechanical effects can aggravate failure of layered cathode.
- Discovered that interfacial reaction affects the bulk lattice behavior.
- Revealed reaction mechanism for Na-O_2 battery using in-situ ETEM.

FY 19 Milestones:

- Resolve the true structural nature of the intragranular cracks in Ni-rich NMC and answer the questions on the origin of such a cracking behavior.
- Revealing the true structural and chemical information of Li metal anode-liquid SEI layer by cryo-TEM and EELS.
- Identify the critical factor that control the correlation between charging rate and fading behavior of Ni-rich NMC.

FY19 Deliverables: Quarterly reports, quantitative analysis and establishment of structure-property relationship for guiding materials design.

Funding:

— FY19: $400k, FY18: $300k, FY17: $300k