# Microscopy Investigation on the Fading Mechanism of Electrode Materials

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

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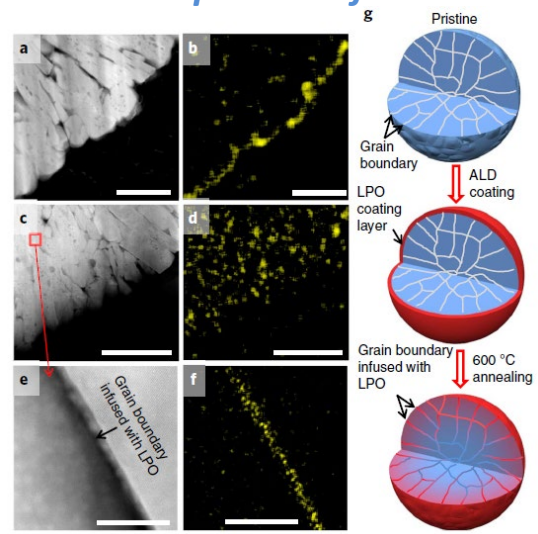
***Objective:***

- 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