Advanced Microscopy and Spectroscopy for Probing and Optimizing Electrode-Electrolyte Interphases in High Energy Lithium Batteries

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

PI: Y. Shirley Meng (University of California San Diego)

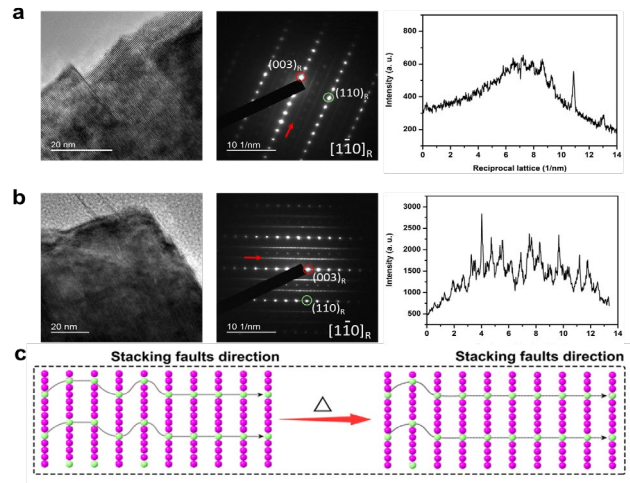
- ***Objective:***

The proposed diagnostic tools will ultimately lead to quantitative understanding careful manipulation of the anion activities (anion redox and oxygen evolution) in both the bulk structure and interfaces in lithium excess layered oxide materials to improve energy density, stabilize the operation voltage

- ***Impact:***

The insights and knowledge provided by the characterization tools will have the critical importance of enabling a major breakthrough in commercial applications for high voltage and high energy density cathode material for lithium ion batteries used for vehicle applications

Our approach successfully identified the role of defects and strain in the voltage vade issue in Li-excess NMC cathode materials.



Accomplishments:

- We successfully extended our characterization tools to study the chemical composition and structure of electrochemically deposited Li metal at nanoscale
- We have found through a combination of computation and experiments that defect generation and dynamics play a key role in the voltage fading issue. We quantitatively identified the correlation between strain/dislocation and voltage fade.
- We proposed mitigation strategies to modify the Li excess NMC cathodes. One of the most effective methods is the mild heat treatment.

FY 19 Milestones:

- Benchmarking new electrolyte performance
- XPS and DEMS Characterization of anion evolution on modified Li-excess NMC
- STEM/ EELS Characterization on modified Li-excess NMC single particle using optimized electrolyte
- EELS and XPS Characterization of SEI on electrochemically deposited Li metal

FY19 Deliverables:

Characterizing single particle behavior of modified Li-excess layered NMC materials with new electrolytes

Funding:

— FY19 ($327.6K BMR funding, $36.4K cost share)