Interfacial Processes – Diagnostics

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

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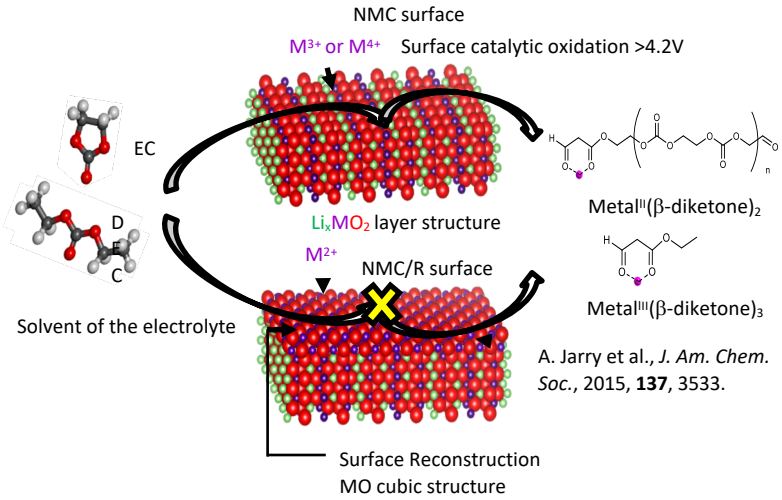
Objective: Design new experimental approaches to study and understand the mechanism of operation and degradation of high energy and high power electrode materials and cells (e.g., Li-ion, Li-S, Na-ion etc.) for PHEV and EV applications. This work constitutes an integral part of the concerted effort within the BMR Program and it supports development of next generation advanced electrode materials.

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

Surface Reactivity of High-Voltage Cathodes



Surface reconstruction layer on NMC surface inhibits electrolyte oxidation, surface film formation and Me dissolution during cycling

Accomplishments:

- Determined that surface reconstruction is NOT the root cause of impedance rise and capacity fade in Ni-rich NMC. Electrolyte decomposition and surface film formation is mainly responsible for the observed electrode degradation.
- Artificially induced surface structure reconstruction can be an effective strategy of reducing NMC surface reactivity and electrode impedance growth.

This work not only determined the exact mechanism of NMC surface structural changes but also offers a unique insight into its direct impact on the electrochemical performance and interrelated interfacial phenomena at high-voltage cathodes.

FY 18 Milestones:

- Produce NMC model thin film electrodes by PLD for fundamental diagnostic studies.
- Characterize the bulk and surface structure of model NMC thin films and its relation to electrochemical properties.
- Characterize the surface chemistry of cycled NMC electrode with NFIR and x-ray spectroscopy and microscopy
- Correlate the origins of electrochemical impedance with NMC surface local chemistry, structure and morphology.

FY18 Deliverables: Realize NMC model surfaces with high stability and low charge and mass transfer impedance.

Funding: FY18: $460k, FY17: $460k, FY16: 460k