Mechanical Properties at the Protected Lithium Interface

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

PI/Co-PI: Nancy Dudney (ORNL)/Jeff Sakamoto (University of Michigan) /Erik Herbert (Michigan Technological University)

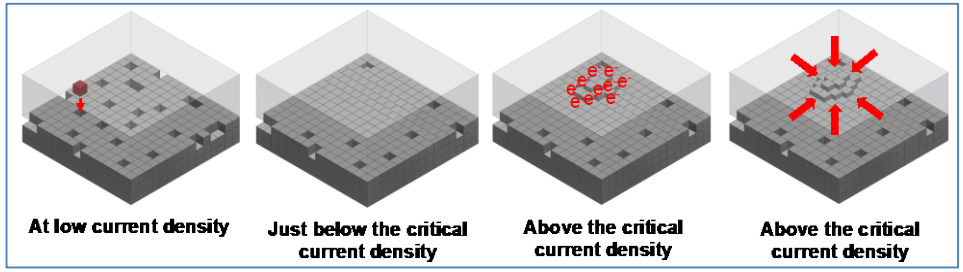
Objective:

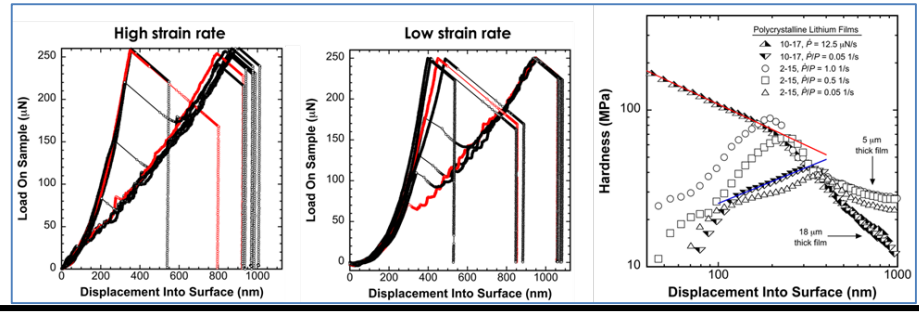
- Assess the mechanical properties that determine the stability of the of the solid electrolyte to Li metal interface.
- Evaluate the effect of cycling on the interface.

Impact:

- Critical interface, solid electrolyte, and lithium mechanical parameters are available for modeling and projections of performance.

Nanoindentation and a model indicate changes when defect diffusion in metal cannot match high ionic flux.





Accomplishments:

- The mechanical properties of pristine Lithium metal thin films has been probed by nanoindentation to extract elastic and ductile creep behavior. The observed volume and strain rate dependence have important implications for cracks emanating from critical flaws.
- The interface resistance of the Li-LLZO ceramic interface is strongly dependent on the fabrication methods. Measures of the adhesion strength shows a similar variation. Well formed interfaces are strong and conductive.

FY19 Milestones:

- Analysis of creep tests for glassy Lipon electrolyte (Q1)
- Analysis of neutron imaging for Li transport in LLZO (Q2)
- Evaluation of defect and microstructure in cycled Li (Q3)
- With German partners, assess whether dynamic impedance will detect early onset of voids in the Li (Q4)

FY19 Deliverables:

- Measures of how flaws, current density and materials properties effect the interface at Li metal anode.
- Incorporate results into models of the interface.

Funding:

— FY19: $150,000, FY18: $350,000, FY17: $300,000