Lithium Batteries with Higher Capacity and Voltage

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

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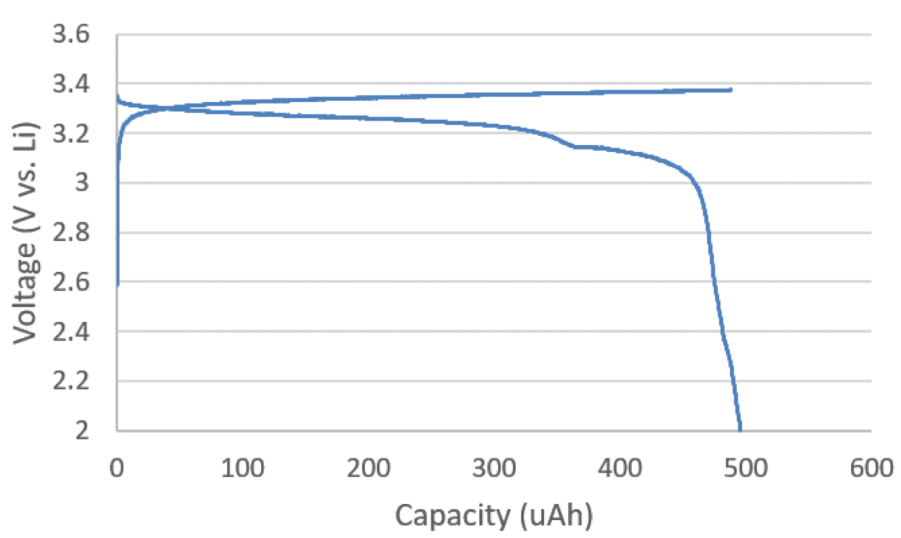
Objective:

To develop an electrochemically stable alkali-metal anode that can avoid the SEI layer formation and the alkali-metal dendrites during charge/discharge.

Impact:

- Overcome the formation of alkali-metal dendrites to enable a safe electrochemical cell
- Avoid the SEI formation to enable a long-term reversible cycling

Charge/discharge voltage curves of the Cu cathode



Accomplishments:

- Demonstrated that LiF enhanced the stability of the garnet LLZO against moisture and carbon dioxide in air.
- Demonstrated the advantages of the LiF modification on garnet LLZO that reduced the interfacial resistance.
- Introduced a 99.9% dense perovskite electrolyte $Li_{3/8}Sr_{7/16}Hf_{1/4}Ta_{3/4}O_3$ (LSHT) fired by spark plasma sintering that had a good air stability and a small interfacial resistance.
- Demonstrated Cu^{+}/Cu^{0} redox couple as a cathode in a solid state cell.
- Identified critical cell parameters for the Cu^{+}/Cu^{0} redox couple .

FY 18 Milestones:

- Test the cyclability of plating of metallic lithium through a conventional polymer/ceramic or ceramic Li^{+} electrolyte.
- Test relative energies of Cu^{+}/Cu^{0} redox couple and energy of plating/stripping of lithium on/from copper.
- Test plating/stripping of metallic lithium on carbon-coated copper current collector in different liquid electrolytes.
- Demonstrate a low-cost, 3-V cell with a copper current collector as cathode.

FY18 Deliverables: Electrochemical cells that are safe and low-cost with a long cycle life at a voltage $V > 3.0$ V.

Funding:

— FY18: 50,000, FY17: $348,000, FY16: 348,000