High Conductivity and Flexible Hybrid Solid State Electrolyte

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

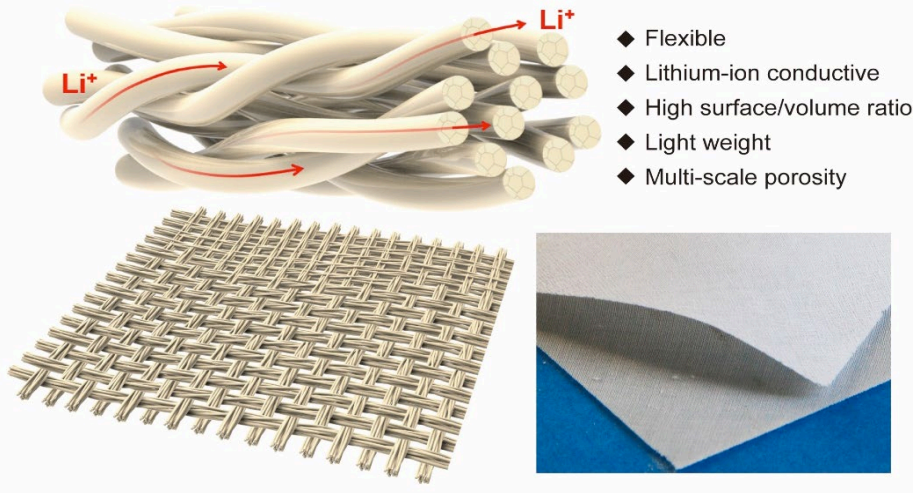
PI/Co-PI: Eric Wachsman (UMD) / Liangbing Hu (UMD) / Yifei Mo (UMD)

- ***Objectives:***
- Develop flexible, high mechanical strength (~ 10 MPa) and thermally stable, hybrid solid state electrolytes.
- Achieve high room temperature ionic conductivity (≥0.5 mS/cm) and stable interface with Li metal that blocks dendrites at current densities up to 3 mA/cm^2.
- Demonstrate Li-S battery performance of 450 Wh/kg and 1000 Wh/L, for 500 cycles.
- ***Impact:***

Success of this project will enable high-energy density, safe Li metal batteries with 2-3X energy density, that can be processed within the existing battery manufacturing infrastructure.

Hybrid Solid State Electrolyte

Flexible, solid-state, ion-conducting membrane with 3D garnet fiber networks for lithium batteries



Accomplishments:

- Fully characterized electrochemical, mechanical and thermal properties of hybrid SSE.
- Fabricated hybrid SSE with a thickness of ~ 20 µm and studied the Li-hybrid SSE interface through Li-SSE-Li symmetric cell cycling.
- Modeled ion diffusion, mechanical effects, and dendrite mechanisms in garnet nanofiber SSE
- Studied Li stripping and platting in thin SSE at a current density of ~ 3mA/cm^2 without shorting.
- Achieved Li metal cycling of hybrid SSE with no Li dendrite for 500 cycles ay ~ 3 mA/cm^2.

FY 19 Milestones:

- Model Li dendrite protection to understand Li dendrite growth and protection effect of polymer and interphase layers on garnet nanofiber.
- Fabricate and evaluate porous framework of mixed electron and ion conductors to fill S cathode.
- Fabricate and evaluate Li-SSE-S full 1 cm by 1 cm cells.
- Achieve full cells with ~ 10 mAh and ~ 450 Wh/kg energy density.

FY19 Deliverables: Quarterly and annual reports

Funding:

— FY19: $430,938, FY18: $415,679, FY17: $403,384