Solid-state inorganic nanofiber network-polymer composite electrolytes for lithium batteries

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

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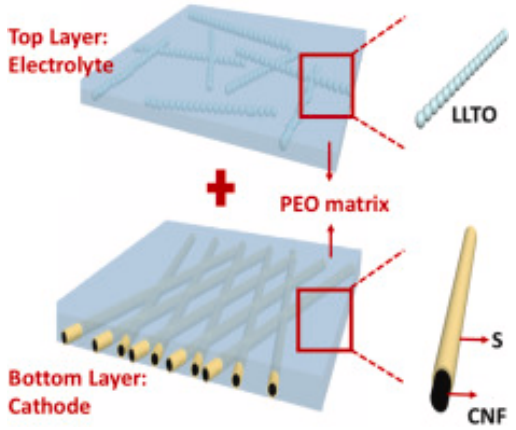
Objective: Develop the solid-state ceramic nanofiber-polymer composite electrolytes for lithium-ion batteries.

Impact:

- Result in solid-state composite electrolytes that have higher ionic conductivity and better cyclic stability than polymer counterparts, and better integration with electrodes than ceramic electrolytes.
- Enable all-solid-state Li-ion batteries.
- Suppress the lithium dendrite formation when using a Li metal anode.
- Improve safety of Li-ion batteries during operation.

Flexible electrolyte-cathode bilayer framework



A dual-function bilayer solid composite that serves as both cathode and electrolyte, which can reduce interfacial resistance and enhance electrode/electrolyte interface stability

Accomplishments:

- Developed poly(ethylene oxide) (PEO) / $Li_{0.33}La_{0.56}TiO_3$ (LLTO) composite polymer electrolytes, achieving an enlarged electrochemical stability window up to 5 V vs. Li/Li^{+}.
- Developed a Li_3PO_4 interface layer between LLTO nanofiber and polymer matrix in in solid electrolyte, improving ionic conductivity and cyclic stability.
- Developed highly ionic-conductive cross-linked PEO.
- Developed a dual-function bilayer solid composite electrolyte that serves as both cathode and electrolyte, showing the reduced interfacial resistance and enhanced electrode/electrolyte interface stability.

FY19 Milestones:

- Construct and test the Li metal/composite electrolyte/Li metal symmetric cells (Q1)
- Construct and test the Li metal/composite electrolyte/cathode full cells (Q2)
- Optimize the composite electrolytes (Q3)
- Conductivity >0.8mS/cm, decomposition voltage >4.5 V vs. Li^{+}/Li (Q4)

FY19 Deliverables: 12 Improved cells or half cells with a minimum capacity of 10 mAh

Funding:

— FY19: : $456,762, FY18: $463,711 FY17: $479,720