Solid-State Inorganic Nanofiber Network-Polymer Composite Electrolytes for Lithium Batteries

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

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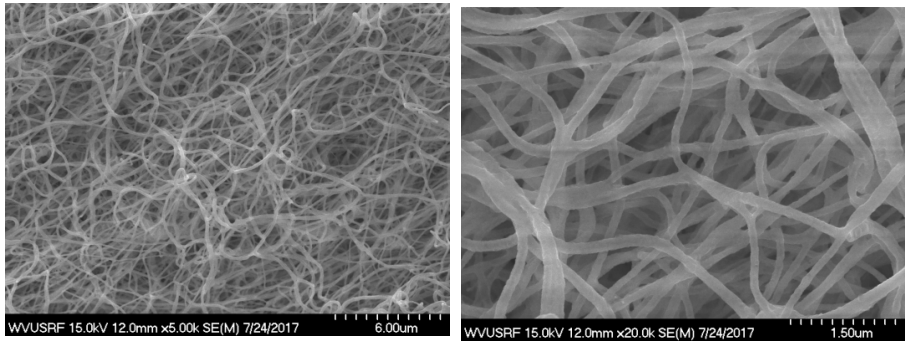
Objective: develop highly-conductive solid-state electrolytes by integrating an inorganic nanofibrous network in a conductive polymer matrix.

Impact:

- Overcome the safety issue with liquid-electrolyte-based lithium ion batteries, enabling new non-flammable battery platform for all-solid-state battery development.
- Suppress the dendrite formation between the electrolyte/electrode interface.

$Li_{0.33}La_{0.557}TiO_3$ (LLTO) nanofibers fabricate by electrospinning



The electrospun nanofibers after calcination at 900 °C, showing the stability

Accomplishments (FY17):

- Synthesized the cross-linked polymer (CLP), the lithium block cross-linked polymer and the block-co-polymer as the polymer matrix.
- The polymer shows ionic conductivity of 2.36×10^{-4} S/cm.
- Synthesized two types of inorganic nanofibers including perovskite-type oxides, $Li0._{33}La_{0.56}TiO_3$ (LLTO), and garnet-type oxides, $Li_{7-3}yAl_yLa_3Zr_2O_{12}$ (LALZO).
- The inorganic nanofibers show ionic conductivity of 1.08×10^{-3} S/cm.
- Synthesized the ceramic nanofiber-polymer composite electrolyte, showing ionic conductivity of 5.1×10^{-4}S/cm.

FY 18 Milestones:

- Synthesize composite electrolytes.
- Test the electrochemical performance of composite electrolytes.
- Test the mechanical properties of composite electrolytes.

FY18 Deliverables:

Reports and two journal papers.

Funding:

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