Docket #: S19-515

Fireproof, Lightweight, Polymer-Polymer Solid-state Electrolyte for Safe Lithium Batteries

Researchers in the Cui lab have designed a polymer-polymer solid-state electrolyte for lithium batteries that is fireproof, lightweight, and mechanically robust. This solid-state electrolyte (SSE) is comprised of a porous polymer scaffold (PI), fire-retardant additive (DBDPE), and polymer electrolyte (PEO/LiTFSI). The increased mechanical strength and fireproof properties of this SSE help prevent internal short circuiting and thermal runaway while maintaining the same energy density as conventional liquid electrolyte. Direct flame tests of the SSE show that it neither catches fire nor degrades battery performance. LiFePO4/Li half cells using this SSE maintain high Coulombic efficiency over 300 cycles whereas other solid electrolytes begin to fail after 120 cycles.

Video description: Flame abuse test of a pouch cell with polymer-polymer solid electrolyte (PI/DBDPE/PEO/LiTFSI). LED light remains on throughout the flame test. From Cai et al. Nano Letter (2020).

Stage of Research

- Prototype

Applications

- **All-solid-state battery**
- Li-ion battery

Advantages

- **Fire retardant**
- Continued operation under extreme heat and direct flames
- Long cycle life
    - Stable over 300 cycles at C/2 rate, 60 °C for LiFePO4/Li half cells
- **High mechanical stability**

Publications

- Cui et al. Nano Letters (2020) "A fireproof, lightweight, polymer-polymer solid-state electrolyte for safe lithium batteries "

Patents

- Published Application: WO2021133923
- Published Application: 20230034644

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