

Docket #: S19-400

High-Safety and High-Capacity Lithium Metal Batteries in an Ionic Liquid Electrolyte with a Sodium Additive

The Dai lab has developed an ionic liquid (IL) electrolyte for lithium metal batteries that eliminates electrolyte flammability concerns without sacrificing performance. Traditional lithium batteries electrolytes are based on flammable organic solvents, which pose safety risks. This new 1-ethyl-3-methylimidazolium (EMIm) and bis(fluorosulfonyl)imide (FSI) ionic liquid electrolyte is non-flammable and thus safer. Unlike prior examples of IL electrolytes, the EMIm cation's smaller size reduces viscosity and allows for practically relevant cathode mass loading. To increase reversibility, sodium bis(trifluoromethanesulfonyl)imide (NaTFSI) is added as the sodium ions incorporate into the passivation interphases. This helps prevent lithium dendrite formation, one of the most common issues with rechargeable batteries. The resulting lithium metal batteries with EMIm-5Li-Na IL electrolyte has high Coulombic efficiency (99.6-99.9%), long cycle life (>1200 cycles), and no flammability risk.

Stage of Research

- Proof of concept

Applications

- **Portable electronics**
- Grid energy storage
- Electric vehicles

Advantages

- **Electrolyte safety: high thermal stability & non-flammable**
- High-capacity lithium metal batteries without traditional safety issues
- Long battery cycle life: >1200 cycles

Publications

- Sun et al. Advanced Materials (2020) ["High-Safety and High-Energy-Density Lithium Metal Batteries in a Novel Ionic-Liquid Electrolyte"](#)

Patents

- Published Application: [20230048095](#)

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