Docket #: S22-310

A salt-philic, solvent-phobic lithium metal anode coating design

Researchers in the Zhenan Bao Group and the Yi Cui Group have developed a Salt-Philic, Solvent-Phobic (SP2) Li anode polymer coating that dramatically out performs state of the art Li anode coatings/electrolyte strategies battery cycle life. Lithium metal batteries (LMBs) show great potential as next-generation batteries, but they suffer capacity degradation caused by whisker-shaped lithium growth at the lithium metal and electrolyte interface The Salt-Philic Solvent-Phobic polymer coating selectively transports salt over solvent and fosters salt-derived solid electrolyte interface (SEI) formation (see figure 1), which stabilizes the interface and enhances cycling performance in several solvents, such as ether, carbonate, and fluorinated ether. Li||NMC cells with SP2 anodic coating enhanced cycle life by nearly 2X for a high-performance fluorinated-ether electrolyte and a standard carbonate electrolyte. The highly compatible SP2 coating can be further improved as promising electrolytes become available.

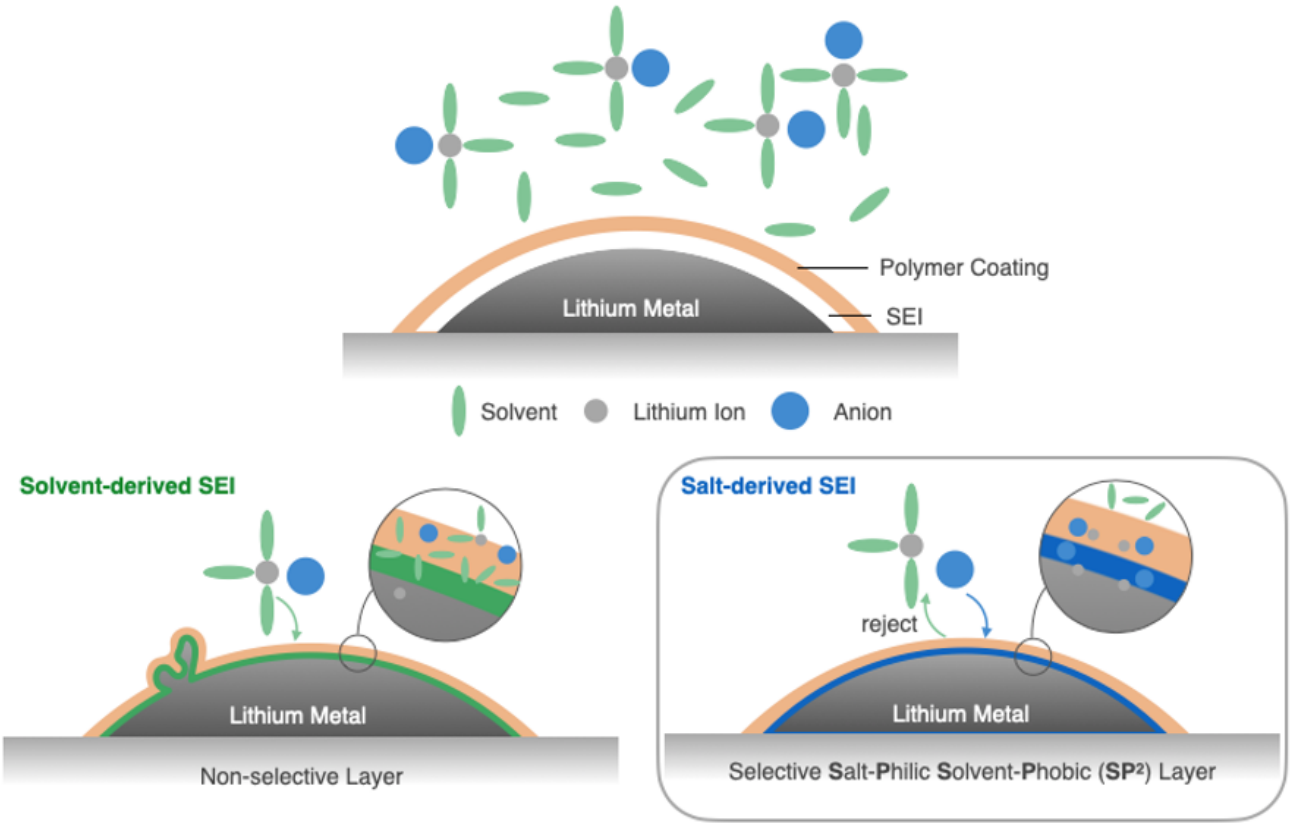

Figure 1 A Salt-Philic Solvent-Phobic (SP2) polymer coating on Li metal anode induces salt derived solid electrolyte interface formation. (Image courtesy the Zhenan Bao Group and the Yi Cui Group)

Stage of Development – Proof of Concept
The Zhenan Bao Group and the Yi Cui Group optimized the coating to improve battery cell performance for ether, carbonate, and fluorinated ether electrolytes. The SP^2 coating can be extended to other polymer chemistries and emerging electrolytes in future research.

Applications

- **Batteries** - Lithium anode coating

Advantages

- **State of the art cycle life performance** - Li|NMC cells with SP^2 anodic coating provided ~400 cycle life (50 µm Li, 2.5 mAh cm^{-2}, 80% capacity retention) and ~250 cycle life with a standard carbonate electrolyte – twice as many cycles compared to uncoated anode, and significantly better than previously reported coatings/electrolyte strategies.
- State of the art **compatibility** - coating is compatible with different electrolytes.

Publications

- Huang, Z., Lai, J.C., Liao, S.L., Yu, Z., Chen, Y., Yu, W., Gong, H., Gao, X., Yang, Y., Qin, J., Cui, Y., & Bao, Z. (2023). A salt-philic, solvent-phobic interfacial coating design for lithium metal electrodes. *Nature Energy*, 1-9.

Patents

- Published Application: WO2024050448

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