Docket #: S17-198

Stable Interface for Lithium Batteries via Stitching Two-Dimensional Atomic Crystals by Atomic Layer Deposition

Stanford researchers at the Yi Cui Lab have demonstrated a new method to increase stability of lithium battery interfaces via stitching of two-dimensional atomic crystals by atomic layer deposition (ALD) which provides an innovative way to prepare chemically and mechanically stable hybrid film. This hybrid LiF/h-BN film successfully suppresses lithium dendrite formation during both the initial electrochemical deposition onto a copper foil and the subsequent cycling. The protected lithium electrodes exhibit good cycling behavior with more than 300 cycles at relatively high coulombic efficiency (>95%) in an additive-free carbonate electrolyte.

Figure

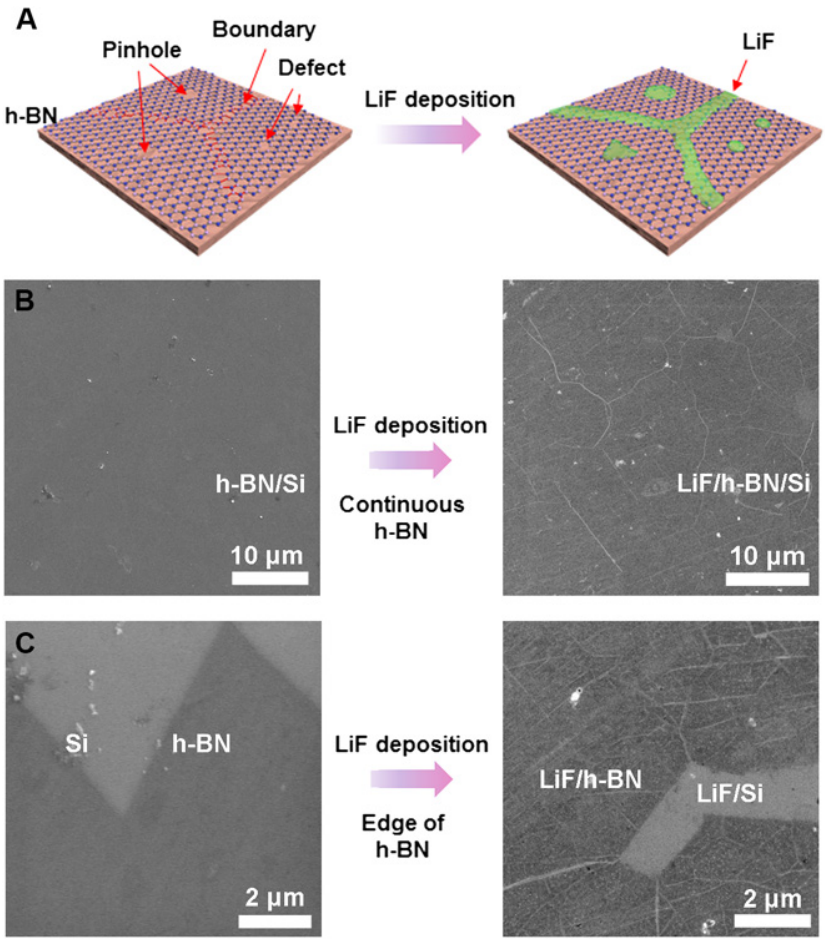


Figure description - SEM characterization
(A) Schematics of selective ALD LiF deposition on h-BN. (B) SEM characterization of 50 cycles of ALD LiF deposition on continuous h-BN. (C) SEM characterization of 50 cycles of ALD LiF deposition on the edge of h-BN.

Stage of Research

- Demonstrated the selective ALD of LiF at defect sites of h-BN with enhanced chemical reactivities
- With its superior chemical and mechanical properties, the LiF/h-BN hybrid film effectively suppressed Li dendrite formation and improved the coulombic efficiency of Li metal cycling during long cycle

Applications

- **Lithium batteries** to reduce side reactions in between electrolyte and electrode

Advantages

- Innovative method to increase stability of lithium battery interfaces
- Suppresses lithium dendrite formation
- Improves safety of batteries
- Improves the Coulombic efficiencies of batteries
- Prolongs the cycle life of batteries
- Interfacial layer is extremely thin
- Adoption of interfacial layer does not compromise the overall energy density of the battery
- Expandable to other metal anodes or electrochemical metal plating
- Provides a promising route to commercialization of lithium metal anode based batteries

Publications

- Xie, J., Liao, L., Gong, Y., Li, Y., Shi, F., Pei, A., Sun, J., Zhang, R., Kong, B., Subbaraman, R. and Christensen, J., 2017. Stitching h-BN by atomic layer deposition of LiF as a stable interface for lithium metal anode. *Science advances*, 3(11), p.eaao3170.

Patents

- Published Application: 20200131638
- Issued: 11,499,228 (USA)

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