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

hage not found or type unknown

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. <u>Stitching h-BN by atomic layer</u> <u>deposition of LiF as a stable interface for lithium metal anode</u>. *Science advances*, 3(11), p.eaao3170.

Patents

- Published Application: 20200131638
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