An Enhanced Li_3AlH_6 Anode Prepared by a Solid-State Ion Exchange Method for Use in a Solid-State Lithium-Ion Battery

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Li_3AlH_6 is an anode material with an enormous potential to enhance the energy density of secondary lithium-ion batteries that is limited by severe irreversibility and instability. In this study, a high-performance Li_3AlH_6 anode is synthesized via a solid-state ion exchange reaction between a LiBH_4 electrolyte and Na_3AlH_6 . This reaction not only forms a tight contact between Li_3AlH_6 and LiBH_4 but also introduces a $\text{NaBH}_4/\text{LiBH}_4$ electrolyte layer with excellent Li^+ conductivity around Li_3AlH_6 . The as-synthesized Li_3AlH_6 anode exhibits a first discharge capacity of $1722 \text{ mAh}\cdot\text{g}^{-1}$ and a capacity loss of only 15% in the first charge. After 150 cycles under a current density of $1 \text{ A}\cdot\text{g}^{-1}$, the Li_3AlH_6 anode retains a capacity of $990 \text{ mAh}\cdot\text{g}^{-1}$ with nearly 100% coulombic efficiency. An anomalous increase in the capacity during cycling is analyzed and attributed to effects from Al electrochemical milling on the active material.

Keywords: Lithium-ion batteries; Hydride anode; Li_3AlH_6 ; Electrochemical properties; All-solid-state batteries

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