

Supporting Information

Synthesis of AlI₃-doped Li₂S Positive Electrode with Superior
Performance in All-Solid-State Battery

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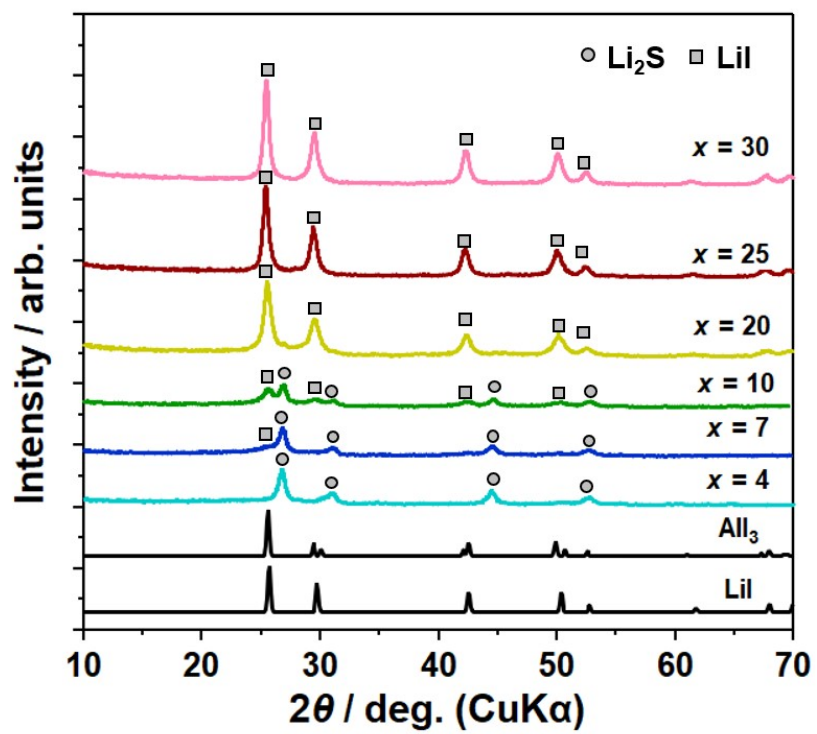


Fig. S1. X-ray diffraction patterns of $(100-x)\text{Li}_2\text{S} \cdot x\text{AlI}_3$ samples.

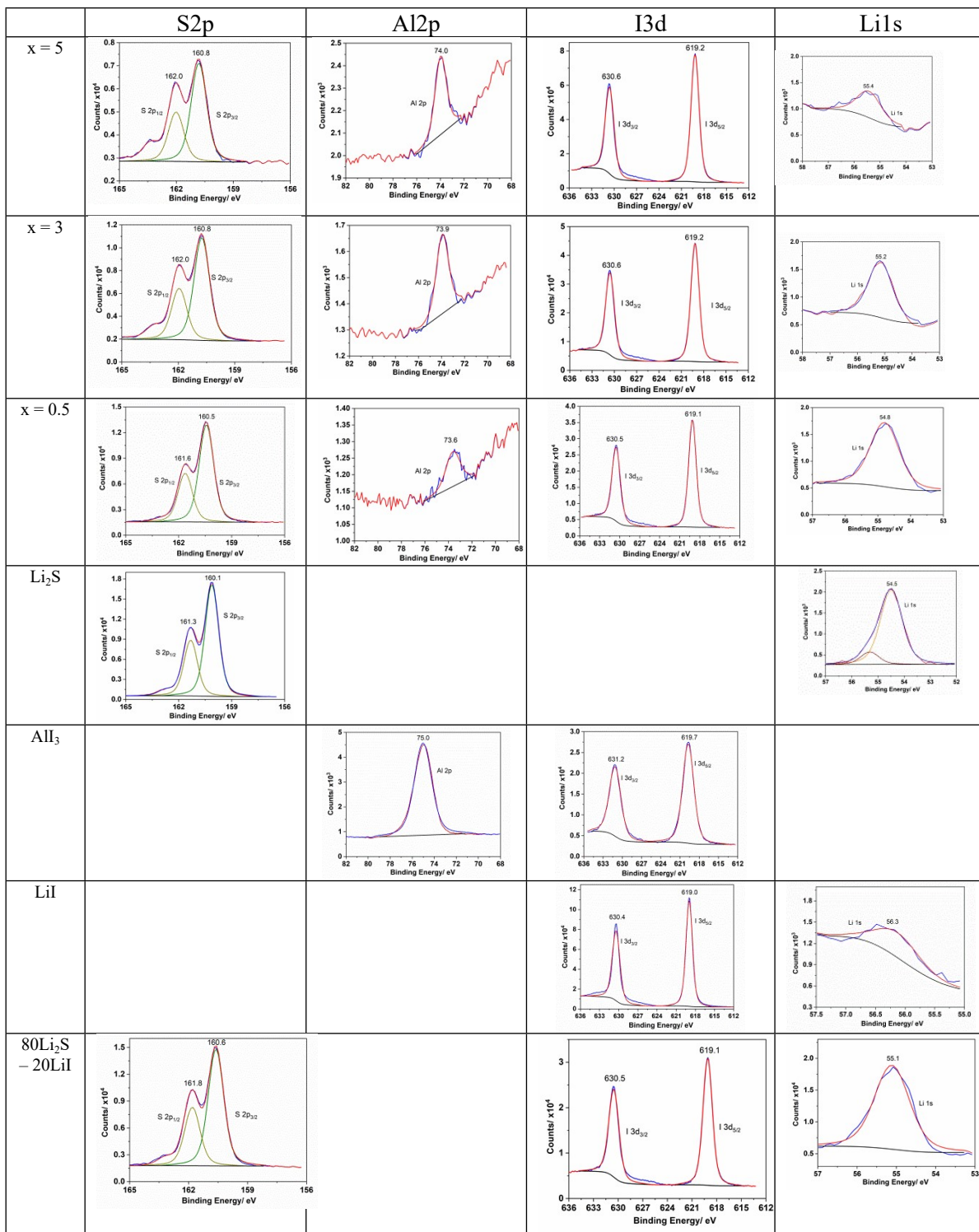


Fig. S2. X-ray photoelectron spectroscopy spectra of the prepared samples and standard materials.

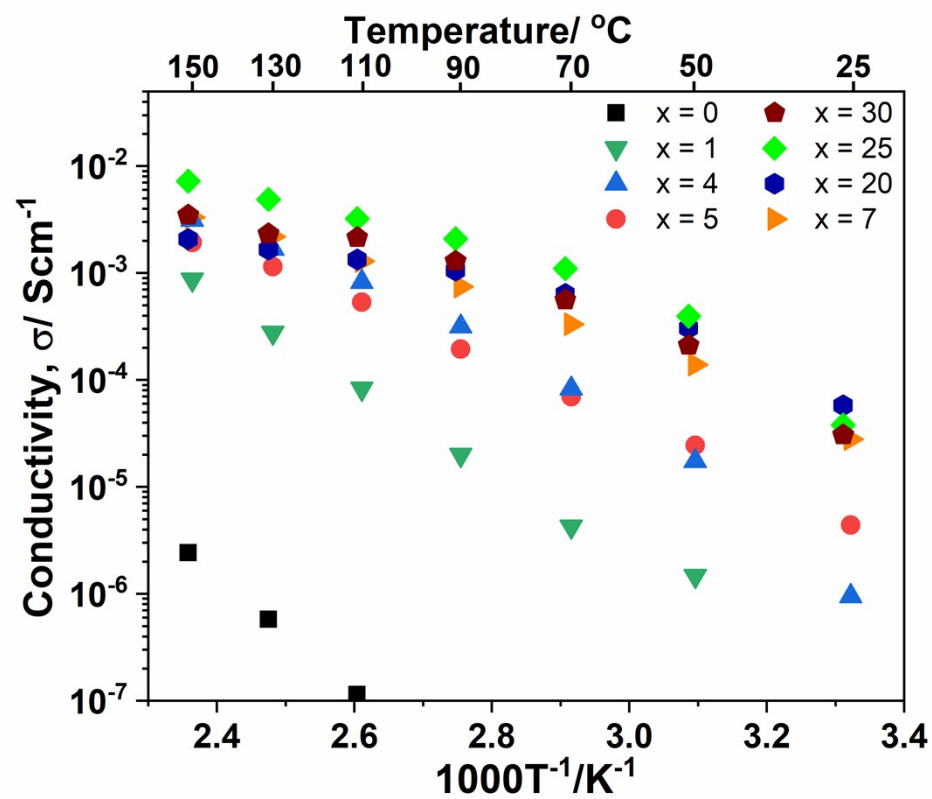


Fig. S3. Temperature dependence of ionic conductivity of $(100-x)\text{Li}_2\text{S} \cdot x\text{AlI}_3$.

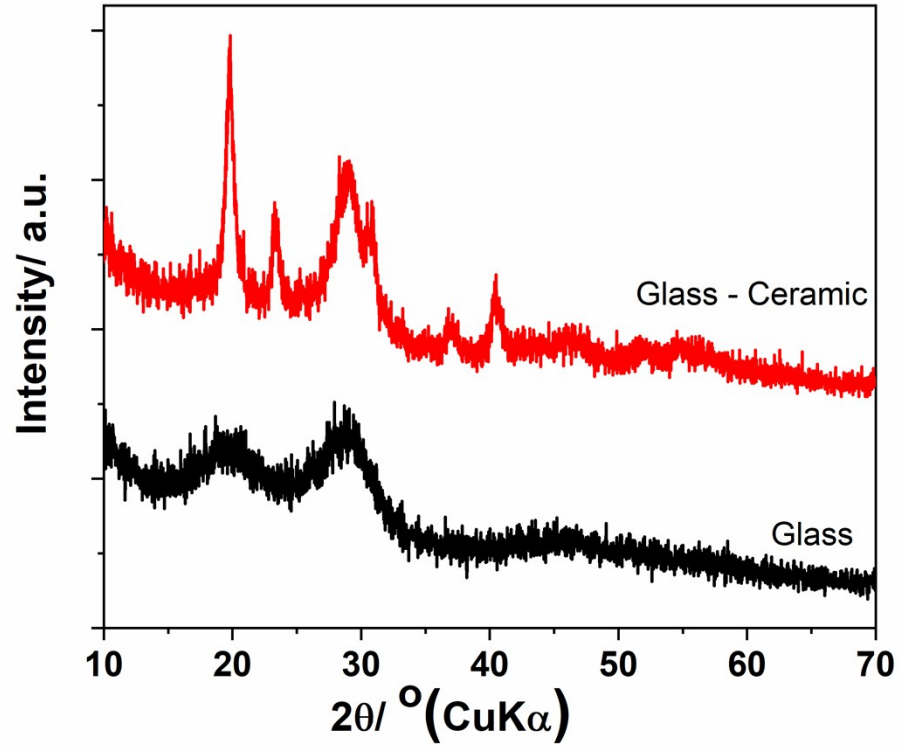


Fig. S4. X-ray diffraction patterns of $\text{Li}_{10}\text{P}_3\text{S}_{12}\text{I}$ solid electrolytes.

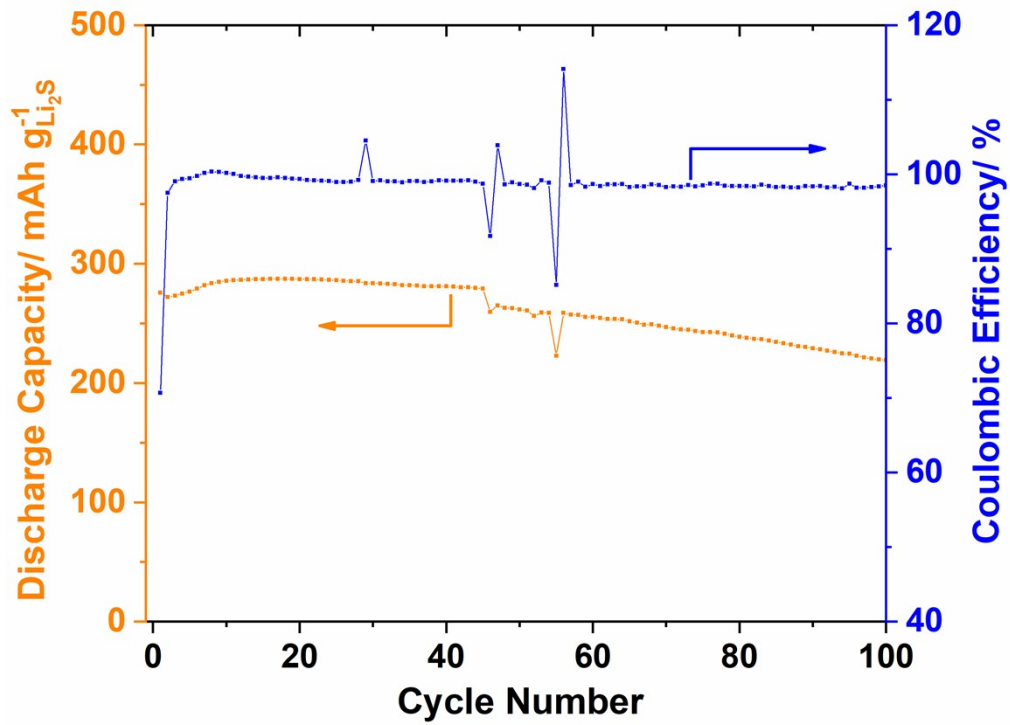


Fig. S5. Cyclic property at room temperature of the all-solid-state Li-S cell employing 80(95Li₂S·5AlI₃)–20Ketjen Black (KB) composite as the positive electrode composite (without Li₁₀P₃S₁₂I solid electrolyte in the positive electrode).

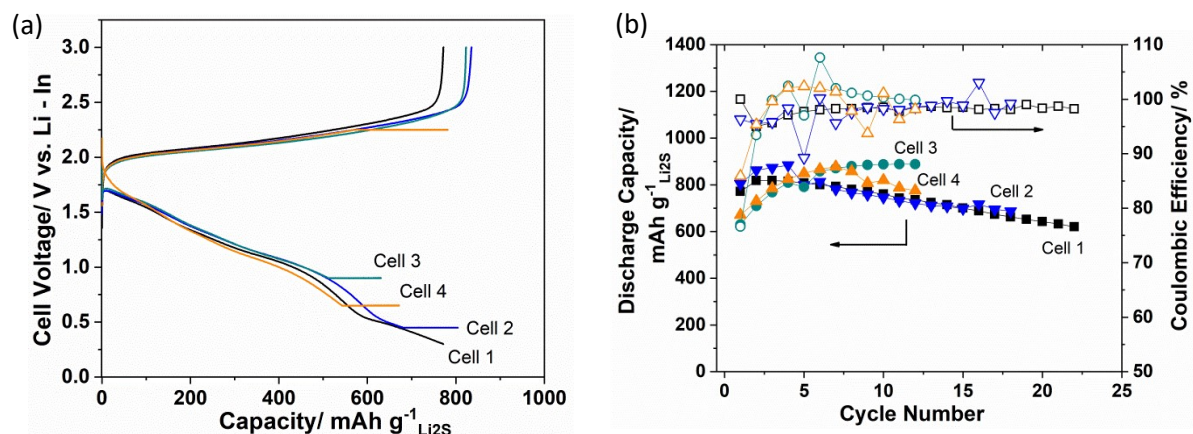


Fig. S6. Performances of four cells with different cut-off voltages. (a) charge–discharge curves at the first cycle; (b) cyclic properties of the cells.

- Cell construction:

Positive electrode: 50(97Li₂S·3AlI₃)–40Li₁₀P₃S₁₂I–10Ketjen Black (KB), ~4 mg

Separator: Li₁₀P₃S₁₂I, ~80 mg

Negative electrode: In–Li alloy

- Charge–discharge conditions:

For the first cycle:

Cell 1: CC mode, 0.1C (about 0.25 mA cm⁻²), cut-off voltage 3.0–0.3 V vs. Li–In

Cell 2: charge with CC mode (0.1C), cut-off voltage 3.0 V vs. Li–In discharge with CC–CV mode: 0.1C with CC mode until 0.45 V vs. Li–In, then change to CV mode at 0.45 V until the current reaches 0.01 mA

Cell 3: charge with CC mode (0.1C), cut-off voltage 3.0 V vs. Li–In discharge with CC–CV mode: 0.1C with CC mode until 0.90 V vs. Li–In, then change to CV mode at 0.90 V until the current reaches 0.01 mA

Cell 4: charge with CC–CV mode: 0.1C with CC mode to 2.25 V vs. Li–In, then change to CV mode at 2.25 V until the current reaches 0.01 mA discharge with CC–CV mode: 0.1C with CC mode until 0.65 V vs. Li–In, then change to CV mode at 0.65 V until the current reaches 0.01 mA

From the second cycle: The discharge modes were maintained as previously described; the charge mode was changed to 0.1C with CC mode to 2.25 V vs. Li-In, then change to CV mode at 2.25 V until the current reaches 0.01 mA