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(Invited) All Solid-State Batteries: Synthesis, Interfacial Engineering and Recycling

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Abstract

All-solid-state batteries (ASSBs) have attracted enormous attention over recent years because they have many advantages over their liquid counterparts such as the enhanced safety, absence of electrolyte leakage, and improved energy density by enabling the use of metallic anodes. However, the performance of ASSBs is still hard to meet the requirements for commercialization. Many challenges have remained in order to improve the interfacial properties, increase the cycling life and energy density. Herein, we demonstrate the progression to build practical ASSBs by using sulfide-based superionic conductors as electrolytes since they have high ionic conductivities, facile synthesis procedures, and favorable mechanical properties. We show that each step is critical to achieving high-performance ASSBs, from synthesis optimization, interfacial engineering to scalable fabrication. Particularly, we succeeded to construct a stable interface between the electrolyte Li_6PS_5Cl (LPSCl) and the cathode $LiNi_{0.85}Co_{0.1}Al_{0.05}O_2$ (NCA). We will also show how to make lithium metal a feasible anode for all solid state battery through the knowledge we obtained from advanced diagnosis of lithium metal anode.