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Insights into the Cyclability of LiF-Coated LiNi0.9Co0.05Mn0.05O2 Cathodes in Sulfide-Based All-Solid-State Batteries

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All-solid-state lithium batteries (ASSLBs) have gained increasing attention as a potential alternative to conventional liquid electrolyte-based lithium-ion batteries (LIBs), yet still face significant challenges, particularly at the cathode|electrolyte interface. In this study, the surface of a Ni-rich $LiNi_{0.9}Co_{0.05}Mn_{0.05}O_2$ (NCM90) cathode was modified with a lithium fluoride (LiF) coating to enhance interfacial stability and cycling performance, using argyrodite Li_6PS_5Cl as the solid electrolyte.

The LiF coating was applied using both solid-state and liquid-state methods, with optimization of the sintering temperature at 700 ℃. Detailed characterization, including XRD, SEM, and EDXS, confirmed the preservation of the cathode's bulk structure and the successful application of the LiF coating. The electrochemical performance of the coated cathode was evaluated, revealing that the 1% LiF coating prepared via the liquid-state mixing method significantly mitigated detrimental interfacial reactions, preserved ionic conductivity, and increased the cycling performance (reversible capacity, rate capability, etc.) and stability of ASSBs using argyrodite Li_6PS_5Cl as solid electrolyte.

Overall, the LiF-coated NCM90 cathodes exhibited superior performance, particularly when paired with the argyrodite Li_6PS_5Cl solid electrolyte, indicating the potential of surface modification strategies to address interfacial degradation and advance ASSLB technology.

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