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IAPME Seminar

Design and Optimization of Polymer-Based Electrolytes for Solid-State Batteries

17 November 2025

Prof. Liangliang LI
Lingnan University
Venue: N23-4018
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Hosted by: Prof. Kwun Nam HUI

Abstract

Solid-state batteries (SSBs) are widely regarded as promising candidates for next-generation energy storage due to their high safety, high energy density, and wide operating temperature range. Solid electrolytes are key components in SSBs. Among them, polymer-based electrolytes, such as those based on polyvinylidene fluoride (PVDF), have recently attracted significant interest because of their flexibility, low cost, facile processing, and scalability. However, current polymer-based electrolytes suffer from low ionic conductivity, limited oxidative stability, and poor interfacial stability against lithium (Li) metal anodes. To address these challenges, we developed several strategies to enhance the electrochemical properties of PVDF-based polymer electrolytes. First, we tailored the structure of Li-solvent complexes to promote Li-ion transport facilitated by PVDF chains. Next, we optimized polymeric components and additives to simultaneously improve ionic conductivity and interfacial stability between the electrolyte and the anode. We then introduced a thermo-electrochemical treatment that stabilizes the PVDF-Li metal interface. Finally, we designed and fabricated a composite electrolyte comprising electrospun PVDF and an argyrodite sulfide, which delivered excellent electrochemical performance and enabled all-solid-state batteries with a cycle life exceeding 20,000 cycles. Collectively, these strategies significantly improved the overall performance of PVDF-based electrolytes, highlighting their strong potential for use in SSBs.

Biography

Prof. Liangliang LI is an Associate Professor in the School of Interdisciplinary Studies at Lingnan University. Before joining Lingnan, he spent two years in industry at Applied Materials Inc. (U.S.) and 15 years as a faculty member at Tsinghua University. He received a B.Eng. in Materials Science and Engineering from Tsinghua University and an M.S in Electrical Engineering and a Ph.D. in Materials Science and Engineering from Stanford University. His research focuses on solid-state electrolytes and batteries. He has published in high-profile, peer-reviewed journals, including Advanced Materials, Advanced Energy Materials, and Nano Energy. He has authored over 100 academic papers and holds eight granted patents. Prof. Li received the Outstanding Young Engineer Award from the IEEE Electronics Packaging Society in 2015 and is a Senior Member of the IEEE.

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