Tracking Lithium Transport Pathways in Solid Electrolytes for Batteries

Jin Zheng¹, Mingxue Tang¹, Po-Hsiu Chien¹, Kevin Huang², Hailong Chen³, Yan-Yan, Hu¹

1. Florida State University; 2. University of South Carolina; 3 Georgia Institute of Technology
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Most commercially-available rechargeable lithium batteries contain liquid-based electrolytes and, thus, face several challenges, including safety issues, energy density, and cost. New all-solid-state batteries are addressing these challenges, yet fundamental research is necessary at this early stage to help realize their potential.

By developing a new method to track lithium (Li) transport pathways in solid electrolytes, this work develops a fundamental understanding that facilitates improvement of Li ion conductivity for future technologies. Experts in electrolyte synthesis produced our high-performance solid electrolytes. These new Lithium-6 \( \rightarrow \) Lithium-7 isotope replacement experiments reveal that Li transport pathways vary significantly, depending on the composition and structure of the solid electrolytes. The experiments were performed in the MagLab’s 11.7-T magnet with a 2.5 mm magic-angle-spinning NMR probe and an in operando NMR probe designed by the MagLab for battery research.

The in operando NMR measurements provide real-time tracking of Li ion transport under real battery operating conditions. The gained knowledge will help guide battery materials design and device fabrication for future high-performance, all-solid-state rechargeable batteries.

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