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Crosslinked Polymer-Brush Electrolytes: An Approach to Safe All-Solid-State Lithium Metal Batteries at Room Temperature


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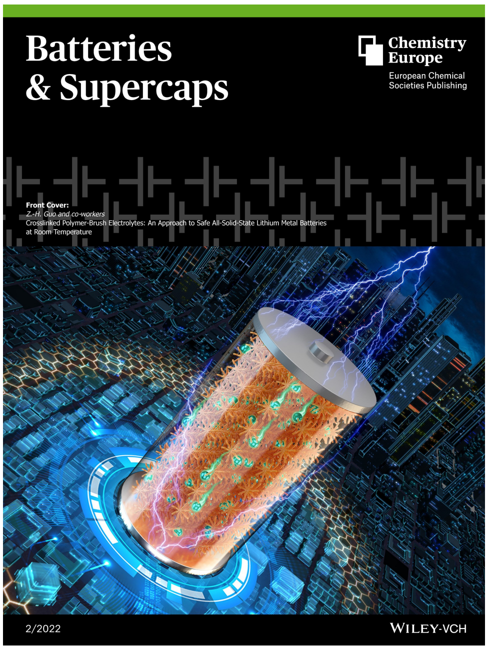
Invited for this month's cover picture is the group of Zi-Hao Guo from South China University of Technology, Guangzhou, China. The cover picture demonstrates a room-temperature lithium metal battery enabled by all-solid-state organic polymer electrolytes with crosslinked short-brush architecture, and the future world powered by next-generation high-energy solid-state batteries. Read the full text of the Research Article at 10.1002/batt.202100319.

What prompted you to investigate this topic?

Organic polymer electrolytes have been intensely studied for several decades but their slow segmental kinetics and the resulting low ionic conductivity seem to be their Achilles' heel all the time. Although high operating temperature or liquid electrolyte additive can tackle this challenge and have successfully put organic polymer batteries into commercialization, extra energy consumption to sustain high temperature and safety hazards of liquid additive limit their further advance in pursuit of higher energy density and safety, especially in today's electric vehicles, intelligent machines, and wearable electronics that are much closer to human life. Seeking powerful room-temperature electrolyte materials for high-energy solid-state batteries prompts us focusing on this topic.



What is the most significant result of this study?

We propose a judicious molecular design of organic polymer electrolyte — crosslinked short-brush architecture, which

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integrate superior ionic conductivity, dendrite resistivity, and safety in one material. And a full mechanism picture for the relationship between ionic conductivity and side chain length of polymer brush electrolytes is demonstrated, providing valuable guidance for architectural design of solid polymer electrolytes.

How did each team member/collaborator contribute to the work?

This work was cooperatively performed by chemists and material scientists in South China University of Technology (SCUT), National University of Defense Technology (NUDT), Sun Yat-Sen University (SYSU), and Yale University (Yale). The contributions of each member were crucial to developing this work. NUDT and SCUT initiated the research. Chemists at SCUT designed the crosslinked polymer-brush architecture. Material scientists at NUDT and SCUT synthesized the unique electrolyte membranes and tested the corresponding cells. Chemists at SYSU collaborated by guiding the cell assembly and measurement at early stage with their knowledge on battery setups and electrochemical characterizations. Chemists at Yale helped by guiding the polymer synthesis and thermodynamic analysis with their knowledge on polymer chemistry and physics.