ACHIEVEMENTS

# Interfacial Insights into the Garnet-Based Lithium Metal Battery

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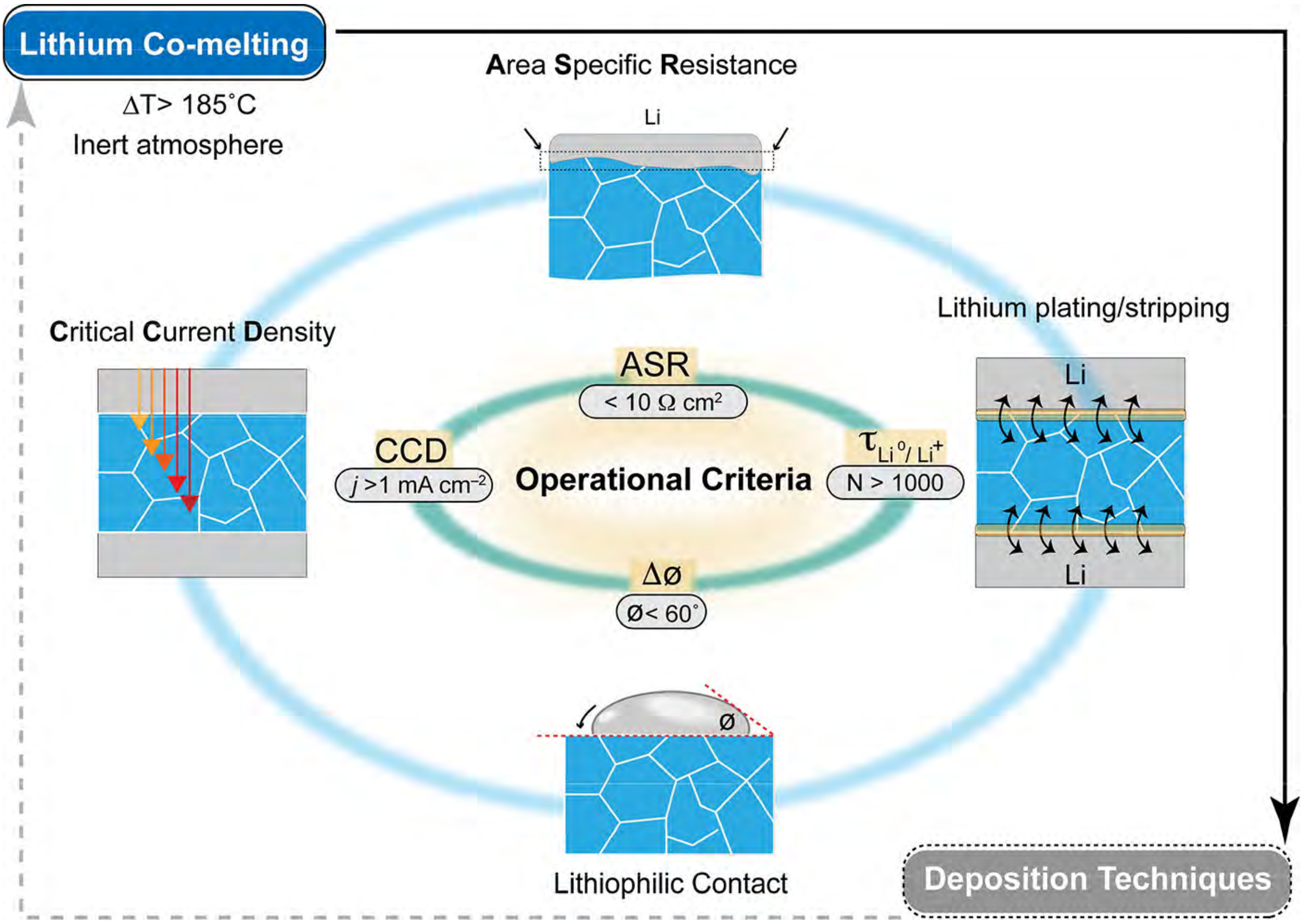


Graphic of the key operational parameters and requirements for suitable interfacial engineering of LMA/garnet-SSEs.

Prof. Ru-Shi Liu of NTU's Department of Chemistry, Advanced Research Center for Green Materials Science and Technology, and Graduate School of Advanced Technology and his research team are dedicated to finding sustainable and safe energy storage solutions, especially for batteries. Addressing the challenges posed by conventional lithium-ion batteries (LIBs) has become increasingly important. Although LIBs with liquid electrolytes are widely used, they come with significant safety risks due to their susceptibility to self-ignition under certain conditions.

This safety concern, in particular, has shifted the focus of research to solid-state electrolytes (SSEs), which offer the potential for both higher energy density and enhanced safety. Among the various SSEs, garnet or oxide-based electrolytes stand out due to their electrochemical and thermodynamic stability, making them especially attractive for practical applications. However, the moisture-sensitivity of garnet-based SSEs can lead to the formation of a lithiophobic lithium carbonate layer. This results in poor contact at the electrode/electrolyte interface, particularly at the anode, leading to high area-specific resistance (ASR) and potential battery failure.

A proposed solution to this issue is to reduce the surface tension of the molten lithium metal anode (LMA) through additives or alloy formation with specific metals to induce lithiophilicity. While this approach can mitigate the poor contact issue at the interface, additional research is necessary to better understand the factors influencing the battery's electrochemical performance. For example, while alloying LMA with metals can address high ASR, it may limit performance at higher current densities, resulting in lower critical current density (CCD), a critical parameter for commercial applications. Forming composite anodes by mixing LMA with bimetallic compounds (such as oxides, nitrides, carbides, or halides) could reduce ASR without compromising CCD.

In his source article in *Energy Chem.*, Prof. Ru-Shi Liu and his research team offer an in-depth scientific discussion on interfacial engineering solutions for issues with garnet-based lithium metal batteries. They analyze various materials that can be or have been used for this purpose and offer a clear perspective based on the latest knowledge and scientific findings. Through such efforts, they hope to contribute to advancing safe and efficient energy storage solutions.

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in *Energy Chem.*



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