doi.org/10.1002/batt.202100068


Special Collection

# Lithium Metal Anode: Processing and Interface Engineering

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Targeting higher energy density and higher specific energy, the introduction of the lithium metal anode in working batteries is among the key challenges and aims for energy storage applications that require higher energy densities, such as next-generation urban mobility and electric aircrafts. The global significant research across the world is addressing this topic for a wide range of cathodes and cell types. Not only oxide-based cathodes but also sulfur batteries and emerging energy chemistries are enabled by the lithium metal anode. For all-solid-state batteries lithium metal anodes are fundamental. Research progress in both academia and industry has led to emerging enterprises and systems on the verge of commercialization.

However, many fundamental challenges remain: dendritic or mossy lithium growth, dead lithium formation, irreversible electrolyte consumption, etc., need to be suppressed. Both chemical and mechanical factors are interconnected and lead to complex degradation phenomena. The high reactivity of the metal surface hampers progress in understanding and commercial implementation. Exploring such technologies requires interdisciplinary approaches covering interface design, electrolyte innovation, understanding dendrite suppression, the development of porous hosts and many more. Moreover, modeling such complex interfaces by in silico design is still in a state of infancy.

The current **Special Collection** features 5 reviews and 8 original articles affords new insights into state-of-the-art technologies for system integration. Park and co-workers highlight the decisive role of interface engineering in his review (10.1002/batt.202000016), whereas **Nojabaee et al.** provide a more fundamental view of the solid–electrolyte interphase (SEI) formation on lithium metal anodes. **Brandell and co-workers** give insights into surface analysis of lithium-sulfur batteries through in depth XPS insights. In contrast, **Tao and co-workers** demonstrate how polysulfides can be blocked from the anode using MXene coatings. **Kang et al.** elaborate further in their review on the deliberate control of artificial SEI formation. The minireview by **Zhang and co-workers** addresses important benefits of garnet coatings as interfacial layers. As an alternative to traditional chemical approaches, **Rangasamy and Vanhulsel** highlight the potential of plasma surface processing for interfacial control.

Several additional original articles in this Special Collection demonstrate the continuous scientific progress in this timely field defying the pandemic. The major trends are focusing on controlling lithium deposition and interfacial control. An example is the contribution by **Liu and co-workers**, in which lithium deposition is regulated by coating copper current collectors. One of the most advanced lithium metal batteries in terms of understanding and technology readiness level is based on the lithium sulfur system. Another major area of research are solid state batteries, for example, **Zhang and co-workers** describe the all-solid-state batteries with slurry-coated sulfur/sulfide cathode, **Li and Nan's group** presented the role of residual solvent in the PVDF based electrolyte in working batteries, and **Ye and co-workers**Ye and co-workers probed the role of ionic liquid in the triazine frameworks-based quasi-solid-state electrolyte. Lithium sulfur battery technology is also advanced worldwide while the Li metal protection is quite the challenge. **Kaskel and co-workers** found the addition of polysulfides decreases and stabilizes the overpotential in Li/Li cells and therefore delays the cell degradation. The application of composite Li metal anode and Li alloy is strongly considered. Herein, **Li and co-workers** present the fast $Li^+$ transport of Li–Zn alloy protective layer. There is plenty of space in the field of processing and interface engineering of Li metal anodes in future. The Special Collection nicely illustrates the current status, challenges and future directions in the emerging field of lithium metal anode technology.

To close, we would like to express our sincere thanks to the editorial team of *Batteries & Supercaps*, in particular Dr. Rosalba A. Rincón and Dr. Greta Heydenrych. All the authors and reviewers are highly appreciated for their great contribution to this high-quality collection.

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*This Editorial is part of a Special Collection on Lithium Metal Anode Processing and Interface Engineering.*

doi.org/10.1002/batt.202100068



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