Special Issue

Advances in High-Performance Solid-State Batteries

Message from the Guest Editors

Recent advances in high-performance solid-state batteries focus on developing novel solid electrolytes (sulfide/oxide hybrids, halides) with enhanced ionic conductivity (>10 mS cm−1 at RT) and electrochemical stability, while interface engineering strategies (artificial SEI layers, buffer coatings) address critical challenges of interfacial instability and dendrite formation. Significant progress has been made in mechanochemical synthesis of cost-effective electrolytes (e.g., argyrodites), high-voltage cathode designs (>4.5 V), and advanced characterization techniques (in situ TEM/XAS) to elucidate degradation mechanisms. Current research emphasizes scalable manufacturing processes, AI-accelerated discovery of materials, and alternative chemistries (Na/K-based systems), aiming to achieve commercially viable SSBs with energy densities exceeding 500 Wh/kg and cycle lives of over 1000 cycles for next-generation energy storage applications.

- High-voltage cathodes (>4.5 V vs. Li+/Li);
- Li-metal anode stabilization;
- Halide solid electrolytes;
- Solid-state sodium batteries;
- AI-driven screening of materials;
- Scalable manufacturing techniques.

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Deadline for manuscript submissions

15 April 2026

Batteries

an Open Access Journal by MDPI

Impact Factor 4.8
CiteScore 6.6

mdpi.com/si/252997

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