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Preface to special issue: Solid-state batteries

The solid-state battery is a strong candidate for next-generation rechargeable battery technology. Solid-state batteries, in which the liquid is replaced with solid electrolytes, may afford enhanced safety, high energy density, high power density, and a wide operational temperature range. Solid-state battery technology is therefore attracting great attention in both scientific and industrial communities. Despite this rapidly blooming interest in solid-state batteries, many challenges remain for the fundamental understanding, materials processing, cell manufacturing, and diagnosis of this emerging battery technology. Few solid electrolytes exhibit both high Li-ion conductivity and other attributes desirable for large-scale manufacturing and processing. The sluggish ionic transport and mechanical instability at interfaces between solid electrolytes and electrodes have yet to be addressed. Solid-state batteries with Li metal anodes, which are required to increase the cell energy density to competitive values, are plagued by lithium metal penetration through the solid electrolyte. Fundamental understanding is strongly requested to overcome these challenges, requiring advancements in materials development, interfacial engineering, battery manufacturing, and novel techniques in modeling and characterization.

Therefore, we have organized this special issue of 'Solid-State Battery' to highlight research at the forefront of this exciting field, inviting contributions (research, perspective or review articles) addressing novel materials, electrochemistry, solid interfaces, lithium metal anodes, and interfacial engineering. This special issue contains 39 contributions, including 30 research articles, 4 reviews, and 5 short communications, contributed from the world-leading experts working in the field of solid-state battery. To resolve the most urgent and critical problems of solid interfaces in solid-state batteries, the researchers made significant advancements using novel approaches of interface engineering to improve the interfaces for low resistance, high cycling stability, and better battery performances [1–14]. To mitigate current short comings in existing solid electrolyte materials, a wide range of emerging solid electrolytes materials, including ceramics [15–18], novel chemistries [16,19,20], polymers [21–27], and hybrid composites [28–31], are proposed and demonstrated, which open vast new opportunities for this exciting field. Furthermore, new materials components, such as new electrodes, processing, binders, or architectures [32–38] also enabled solid-state batteries with improved performance as new engineering avenues. Moreover, detailed mechanistic understanding and guideline principles are achieved by new theory, computer modeling, and characterizations [13,16,17,39].

Overall, we have witnessed remarkable progress and achievements in the research field of solid-state batteries over the past years and in this special issue. As guest editors, we hope that this special issue can help and inspire readers for new ideas and for subsequent research and development to further improve solid-state battery technology.

We sincerely thank all authors, reviewers, and editors for giving their valuable time and expertise to this special issue.

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