PREFACE

“锂硫电池”专辑序言

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锂硫电池是指采用硫或含硫复合物作为正极，锂或含锂材料为负极，以硫-硫键的断裂/生成来实现电能与化学能相互转换的一类电池体系。由于活性物质具有质轻、多电子反应等特性，从而能够实现高达1675 mAh·g^{-1}的理论比容量和2600 Wh·kg^{-1}的质量比能量。这比传统的锂离子电池的能量密度高出7倍左右，极有潜力成为新一代高能量密度电化学储能体系，近年来一直是高能锂金属电池领域的研究热点之一。

然而，锂硫电池的实用化依然存在着诸多问题。最为典型的是电池充放电过程中生成高阶态多硫化物（Li_2S_n，$8 \geqslant n \geqslant 4$）溶解在电解质中导致的“穿梭效应”，继而对硫基正极、锂基负极和电解液等电池关键组成部分产生深刻影响，导致电池出现容量衰减快、库仑效率低、循环寿命短等问题。其次，硫正极必须和金属 Li 配对使用才能体现锂硫电池高能量密度的优势。但在实际的锂硫电池中，锂基负极的充放电效率低、循环性能差，同时存在着严重的安全隐患。这些挑战仍需科研工作者对其背后的科学问题和工程技术问题进行逐一突破。

本专辑收录了在锂硫电池领域具有丰富研究经验的团队撰写的 8 篇论文，包括 5 篇综述论文和 3 篇研究论文，分为上下两期出版。专辑涉及硫正极催化宿主材料、电解液功能添加剂、固态电解质等为主题的综述论文，以及双金属合金硫正极催化剂、金属有机框架材料修饰的功能隔膜、原位聚合的硫正极功能粘结剂为主题的研究性论文。专辑内容涵盖了锂硫电池的研究现状和最新进展，以及针对现存问题的解决策略与思路，并对锂硫电池未来的发展方向与研究趋势进行了概要。希望借此专辑能为读者了解和深入开展锂硫电池领域的研究提供参考，以期推动锂硫电池的实用化进程。

最后，对为本专辑撰稿的所有作者、审稿人及编辑部工作人员给予的支持与贡献表示衷心的感谢！

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Preface to the Special Issue on Lithium-Sulfur Batteries

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Lithium sulfur battery (LSB) is a kind of electrochemical energy storage system that uses sulfur-containing cathode and lithium-containing anode to realize the conversion between electric energy and chemical energy. Due to the light weight and multi-electron reaction characteristics of the active material, LSB can achieve a theoretical specific capacity of 1675 $mAh \cdot g^{-1}$ and a specific energy of 2600 $Wh \cdot kg^{-1}$. This is about seven times higher than the energy density of conventional lithium ion batteries. It shows great potential to become a new generation of high energy density electrochemical energy storage systems and become one of the research hotspots in the field of high-energy lithium metal batteries in recent years.

However, there are many issues in the practical application of LSB. The most typical is the "shuttle effect" caused by the dissolution of high-order polysulfides (Li_2S_n, $8 \geq n \geq 4$) in the electrolyte during the charge and discharge process of the battery. This further turns into serious influence on the sulfur-based cathode, the Li-based anode and the electrolyte, resulting in a rapid capacity decay, low coulomb efficiency, and short cycle life. Meanwhile, the sulfur cathode must be paired with metallic Li to achieve a high energy density. However, Li-based anodes suffer from low charge-discharge efficiency, poor cycle performance, and serious safety hazards practically. Such issues require researchers devote more efforts on scientific and engineering exploration.

In this regard, this special issue consists of 8 articles contributed by teams with rich research experience in LSB, including 5 review articles and 3 research articles. It covers the review articles on the theme of catalyst host materials for sulfur cathode, electrolyte functional additives, solid electrolytes, etc. The research articles focused on the theme of bimetallic alloy sulfur cathode catalysts, metal organic framework materials modified functional separators, and *in-situ* polymerization of sulfur cathode functional binders. The special issue presents the latest research progress of LSB and summarizes the future development direction and research trend. We hope this special issue can provide readers with knowledge and references to understand and carry out in-depth research in this field.

Finally, we would like to take this opportunity to express our heartfelt thanks to all the authors, reviewers and editorial staffs for their contributions and fruitful work!