Principles of solid-state battery scale design

Can theoretical calculation method be applied in solid-state batteries?
We introduce the application of theoretical calculation method in solid-state batteriesthrough the combination of theory and experiment. We present the concept and assembly technology of solid-state batteries are reviewed.

What is a novel design strategy in high energy solid-state lithium batteries?
This book offers a comprehensive analysis of novel design strategies in higher energy solid-state lithium batteries. It describes synthesis and experimental techniques to characterize the physical, chemical and electrochemical properties of the electrode and electrolytes.

Why is theoretical computation important in battery development?
Understanding the fundamental physical and chemical science of ASSBs is of great importance to battery development. To confirm and supplement experimental study,theoretical computation provides a powerful approach to probe the thermodynamic and kinetic behavior of battery materials and their interfaces,resulting in the design of better batteries.

How to predict the performance of battery materials?
The prediction in the performance of battery materials is mostly based on energy calculation. Ceder et al. researched the electrochemical stability of cathode/SSEs by DFT and calculated the reaction energy of various cathode/SEs interfaces (Fig. 10 a) .

How can sulfide electrolyte improve the performance of solid-state batteries?
In addition to the improvement of calculation methods, the improvement of sulfide electrolyte performance is also the key to improve the overall performance of solid-state batteries. At present, the design of composite electrolyte is a good way to be applied and expected to realize industrial production.

What is a rechargeable solid-state battery?
In recent years, due to the increasing demand for portable electronic devices, rechargeable solid-state battery technology has developed rapidly. Lithium-ion batteries are the systems of choice, offering high energy density, flexible and lightweight design, and longer lifespan than comparable battery technologies.

The all-solid-state lithium-ion battery is a promising next-generation energy storage technology. Here, we review state-of-the-art computation techniques and their application in the research and development of solid electrolyte materials and interfaces in all-solid-state batteries. We summarize how computational studies have contributed to fundamental understanding and ...

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Solid-state batteries with features of high potential for high energy density and improved safety have gained considerable attention and witnessed fast growing interests in the past decade. Significant progress and numerous efforts have been made on materials discovery, interface characterizations, and device fabrication.

1.2.3.7 All-Solid-State Lithium Metal Batteries. All-solid-state lithium metal batteries are promising candidates since lithium, with its ultrahigh capacity (3860 mAh g -1), remains a holy grail for all battery technology and a metal possessing the lowest reduction potential [].The Li dendrite growth is prevented by alternate methods of either encapsulating ...

Solid-state batteries use non-flammable solid electrolytes instead of the flammable liquid electrolytes found in lithium-ion batteries, making them safer and less prone to fire. Additionally, they offer the advantage of ...

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The realization of successful all-solid-state lithium-ion batteries requires significant research and development in solid electrolyte materials and solid electrolyte-electrode interfaces. Computational studies play a critical role in providing fundamental understanding and in accelerating the design of new electrolyte materials and interfaces ...

Combining theoretical simulation with experiments, this review presents an overview on the scientific challenges, fundamental mechanisms, and design strategies for ...

They have also developed a solid-state battery design toolkit using the design principles. This breakthrough addresses a critical gap in battery design research, which previously lacked ...

Conventional design of all-solid-state battery limits the portable device fabrication due to sluggish interfacial contact, safety, and high manufacturing cost. Additionally, unfavorable Li-dendrite formation and low coulombic efficiency hinder the further use.

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This review highlights recent advancements in fabrication strategies for solid-state battery (SSB) electrodes and their emerging potential in full cell all-solid-state battery fabrication, with a focus on 3D printing (3DP), atomic layer deposition (ALD), and plasma technology. It details how these techniques enhance the compatibility between ...

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In terms of their practical application, large format all-solid-state pouch cells using halide SSEs are simulated toward energy density targets of 400 Wh kg -1 (all-solid-state Li-ion batteries) and 500 Wh kg -1 (all-solid-state Li-S batteries). In addition, specific requirements of each component are listed to aid future endeavors.

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In 2017, a brand-new solid-state battery with a metal anode consisting of lithium, sodium, and potassium with a glass electrolyte was demonstrated . Solid-state batteries have similar characteristics to lithium-ion batteries (LIBs). The main difference compared to lithium-ion batteries is that solid electrolyte does not need a separator and the ...

Solid-state batteries use non-flammable solid electrolytes instead of the flammable liquid electrolytes found in lithium-ion batteries, making them safer and less prone to fire. Additionally, they offer the advantage of significantly increasing energy density through efficient cell and system structural design.

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