

Lithium batteries and lithium-sulfur batteries



Overview

The lithium-sulfur battery (Li-S battery) is a type of rechargeable battery. It is notable for its high specific energy. The low atomic weight of lithium and moderate atomic weight of sulfur means that Li-S batteries are relatively light (about the density of water). They were used on the longest and highest-altitude unmanned solar-powered aeroplane flight (at the time). Li-S batteries were invented in the 1960s, when Herbert and Uhlir patented a primary battery employing lithium oxide. Chemical processes in the Li-S cell include lithium dissolution from the surface (and incorporation into Li_2S_x) during discharge, and reverse lithium to the anode while charging. Historically, the "shuttle" effect is the main cause of degradation in a Li-S battery. The lithium polysulfide Li_2S_x ($6 \leq x \leq 8$) is highly soluble in the common electrolytes used for Li-S batteries. They are formed and leaked from the cathode.



Article Content

Formulating energy density for designing practical lithium-sulfur batteries

The lithium-sulfur (Li-S) battery is one of the most promising battery systems due to its high theoretical energy density and low cost. Despite impressive progress in its development, there ...

A review of cathode for lithium-sulfur batteries: progress and ...

Lithium-sulfur batteries have attracted widespread attention as they have a high theoretical energy density (2600 Wh/kg) and theoretical specific capacity (1675 mAh/g). In addition, sulfur is abundant and non-toxic in nature, which makes it an environmentally friendly electrode active substance. However, there are still some problems, such as the volume ...

Lithium-air and lithium-sulfur batteries | MRS Bulletin

Reducing our dependence on fossil fuels increases the demand for energy storage. Lithium-ion batteries have transformed portable electronics and will continue to be important but cannot deliver the step change in energy density required in the longer term in markets such as electric vehicles and the storage of electricity from renewables. There are a ...

Recent Advances and Applications Toward Emerging Lithium-Sulfur ...

For example, the all-solid-state lithium-sulfur batteries (ASSLSBs) founded on Li₁₀SnP₂S₁₂ electrolyte with an excellent ionic conductivity ($3.2 \times 10^{-3} \text{ S cm}^{-1}$ at RT) delivered a high reversible capacity and superior cyclic performance along with a Coulombic efficiency approaching 100%. What's more, there are other innovative efforts. PAN-based double-layer ...

Lithium Sulfur Batteries

Lithium-sulfur batteries operates based on the non-topotactic reaction between lithium and sulfur, which have high theoretical specific capacities of 3860 and 1675 mAh g⁻¹, respectively. Combing with an average cell voltage of 2.2 V vs Li⁺/Li, lithium-sulfur batteries can provide an unparalleled energy density of 2600 Wh kg⁻¹, 4 times higher than that of lithium-ion batteries ...

Lithium-ion and Lithium-Sulfur Batteries

Chapter 3 is on fundamentals and perspectives of lithium-sulfur batteries, with a reference list of 53 articles. The author is optimistic about the future developments of lithium-sulfur battery chemistry. The final chapter of the book is on cathodes for lithium-sulfur batteries. Overall, this is a very fine piece of work on electrochemistry of ...

Review Key challenges, recent advances and future perspectives ...

Lithium-sulfur (Li-S) battery, which releases energy by coupling high abundant sulfur with lithium metal, is considered as a potential substitute for the current lithium-ion ...

Tailoring Cathode-Electrolyte Interface for High-Power and Stable ...

Global interest in lithium-sulfur batteries as one of the most promising energy storage technologies has been sparked by their low sulfur cathode cost, high gravimetric, volumetric energy densities, abundant resources, and environmental friendliness. However, their practical application is significantly impeded by several serious issues that arise at the ...

A review on lithium-sulfur batteries: Challenge, development, and ...

Lithium-sulfur (Li-S) battery is recognized as one of the promising candidates to break through the specific energy limitations of commercial lithium-ion batteries given the high ...

Solid-state lithium-sulfur batteries: Advances, challenges and ...

Lithium-sulfur (Li-S) batteries are considered as a particularly promising candidate because of their high theoretical performance and low cost of active materials. In spite of the recent progress in both fundamental understanding and developments of electrode and electrolyte materials, the practical use of liquid electrolyte-based Li-S batteries is still hindered ...

Advances in Lithium-Sulfur Batteries: From Academic ...

Lithium-sulfur (Li-S) batteries, which rely on the reversible redox reactions between lithium and sulfur, appears to be a promising energy storage system to take over from the conventional lithium-ion batteries for next-generation energy ...

Lithium-Sulfur Batteries: Electrochemistry, Materials, ...

Starting from a brief history of Li-S batteries, this Review introduces the electrochemistry of Li-S batteries, and discusses issues resulting from the electrochemistry, such as the electroactivity and the polysulfide ...

Stellantis and Zeta Energy Announce Agreement to Develop Lithium-Sulfur ...

Lithium-sulfur batteries are expected to cost less than half the price per kWh of current lithium-ion batteries. "Our collaboration with Zeta Energy is another step in helping advance our electrification strategy as we work to deliver clean, safe and affordable vehicles," said Ned Curic, Stellantis Chief Engineering and Technology Officer. "Groundbreaking battery ...

Lithium-Sulfur Battery

5.2.3 Lithium-sulfur batteries. Lithium sulfur (Li-S) battery is a promising substitute for LIBs technology which can provide the supreme specific energy of 2600 W h kg⁻¹ among all solid state batteries . However, the complex chemical properties of polysulfides, especially the unique electronegativity between the terminal Li and S ...

Recent advancements and challenges in deploying lithium sulfur ...

Lithium sulfur batteries (LiSB) are considered an emerging technology for sustainable energy storage systems. LiSBs have five times the theoretical energy density of ...

Solid-state lithium-sulfur batteries: Advances, challenges and ...

Compared with liquid electrolyte-based Li-S batteries, solid-state Li-S batteries may offer several advantages: (1) the improved cycling ability and increased energy efficiency ...

Lithium-ion and Lithium-Sulfur Batteries

1.3.4 Performance measuring key battery attributes 1-8 1.4 Lithium-ion battery 1-8
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1.4.5 Fundamental principle of LIB electrochemistry 1-12

A review on 1D materials for all-solid-state lithium-ion batteries ...

In all-solid-state lithium-ion batteries (ASSLIBs) and all-solid-state lithium-sulfur batteries (ASSLSBs), as an important ingredient of ASSBs, solid electrolytes include three types: inorganic solid electrolytes (ISEs), solid polymer electrolytes (SPEs) and composite solid electrolytes (CSEs) ISEs, sulfides (Li₁₀GeP₂S₁₂ and Li₇P₃S₁₁) , exhibiting high ...

Sulfide-Based All-Solid-State Lithium-Sulfur Batteries: ...

Lithium-sulfur batteries with liquid electrolytes have been obstructed by severe shuttle effects and intrinsic safety concerns. Introducing inorganic solid-state electrolytes into lithium-sulfur systems is believed as an effective approach to eliminate these issues without sacrificing the high-energy density, which determines sulfide-based all-solid-state lithium-sulfur ...

2021 roadmap on lithium sulfur batteries

There has been steady interest in the potential of lithium sulfur (Li-S) battery technology since its first description in the late 1960s []. While Li-ion batteries (LIBs) have seen worldwide deployment due to their high power density and stable cycling behaviour, gradual improvements have been made in Li-S technology that make it a competitor technology in ...

Lithium-ion and Lithium-Sulfur Batteries

This research text explores the fundamentals, working mechanisms, electrode materials, challenges, and opportunities for energy storage devices of lithium-ion and lithium-sulfur ...

Comparative sustainability assessment of lithium-ion, lithium-sulfur ...

As currently used lithium-ion batteries (LIBs) have reached a mature stage of development, prospective battery technologies such as lithium-sulfur batteries (LSBs) and all-solid-state batteries (ASSBs) are being intensively researched because it is predicted that these battery technologies can provide higher specific energies, higher safety, and lower cost ...

Lithium-Sulfur Batteries: State of the Art and Future Directions

Sulfur remains in the spotlight as a future cathode candidate for the post-lithium-ion age. This is primarily due to its low cost and high discharge capacity, two critical requirements for any future cathode material that seeks to dominate the market of portable electronic devices, electric transportation, and electric-grid energy storage. However, before Li-S batteries replace ...

Lithium-Sulfur Batteries vs. Lithium-Ion Batteries: A Comparative ...

Lithium-sulfur Batteries vs. Lithium-ion Batteries. Let's continue by listing the respective strengths, and weaknesses of Li-S batteries and Li-ion batteries, and their potential to influence the future of electric vehicles. 1. Unprecedented Energy Density: Li-S batteries boast an impressive theoretical energy density that surpasses that of Li-ion batteries. This is to say, Li-S ...

Introduction, History, Advantages and Main Problems in Lithium/Sulfur ...

Lithium-sulfur (Li-S) batteries are an emerging energy storage technology that has gained significant attention in recent years. They offer the potential for higher energy densities and lower costs compared to traditional lithium-ion batteries, making them a promising alternative for various applications, including electric vehicles, renewable energy storage, and portable ...

Lithium-air and lithium-sulfur batteries | Semantic Scholar

Reducing our dependence on fossil fuels increases the demand for energy storage. Lithium-ion batteries have transformed portable electronics and will continue to be important but cannot deliver the step change in energy density required in the longer term in markets such as electric vehicles and the storage of electricity from renewables. There are a ...

Review Key challenges, recent advances and future perspectives ...

Interestingly, lithium-sulfur (Li-S) batteries based on multi-electron reactions show extremely high theoretical specific capacity (1675 mAh g⁻¹) and theoretical specific energy (3500 Wh kg⁻¹) sides, the sulfur storage in the earth's crust is abundant (content ~ 0.048%), environmentally friendly (the refining process in the petrochemical field will produce a large ...

Lithium Sulfide Batteries: Addressing the Kinetic Barriers and ...

Ever-rising global energy demands and the desperate need for green energy inevitably require next-generation energy storage systems. Lithium-sulfur (Li-S) batteries are a promising candidate as their conversion redox reaction offers superior high energy capacity and lower costs as compared to current intercalation type lithium-ion technology. Li₂S with a ...

A Comprehensive Guide to Lithium-Sulfur Battery Technology

Part 3. Advantages of lithium-sulfur batteries. High energy density: Li-S batteries have the potential to achieve energy densities up to five times higher than conventional lithium-ion batteries, making them ideal for applications where weight and volume are critical factors. Low cost: Sulfur is an abundant and inexpensive material, which helps to reduce the overall cost of ...

Lithium-Sulfur Batteries

The Li-S battery is considered as a good candidate for the next generation of lithium batteries in view of its theoretical capacity of 1675 mAh g⁻¹, which corresponds to energy densities of 2500 Wh kg⁻¹, 2800 Wh L⁻¹, assuming complete reaction to Li₂S based on the overall redox reaction 2Li + S = Li₂S [1,2,3,4]. Therefore, the energy density of 400-600 Wh ...

Future potential for lithium-sulfur batteries

In this review, we describe the development trends of lithium-sulfur batteries (LiSBs) that use sulfur, which is an abundant non-metal and therefore suitable as an inexpensive cathode active material. The features of LiSBs are high weight energy density and low cost. LiSBs have the potential to be an alternative to LIBs, which are in increasing demand but suffer from ...

Lithium-Sulfur Batteries: Current Achievements and ...

In this Editorial, Guest Editors Stefan Kaskel, Jia-Qi Huang, and Hikari Sakaebe introduce the Special Collection of Batteries & Supercaps on Lithium-Sulfur batteries. They discuss the challenges that lithium-ion batteries ...

Bi-Functional Materials for Sulfur Cathode and Lithium Metal ...

Lithium-sulfur batteries (LSBs) have attracted attention as one of the most promising next-generation batteries owing to their high theoretical energy density (2600 Wh kg⁻¹), [1-3] which is attributed to their unique operating reaction (Figure 1a) that is quite different from the intercalation-deintercalation electrochemical reaction of lithium-ion batteries (Figure 1b). The ...

Material design and structure optimization for rechargeable lithium ...

The emergence of Li-S batteries can be traced back to 1962. Herbert and colleagues first proposed the primary cell models using Li and Li alloys as anodes, and sulfur, selenium, and halogens, etc., as cathodes. In the patent, the alkaline or alkaline earth perchlorates, iodides, sulfocyanides, bromides, or chlorates dissolved in a primary, secondary, ...

How sulfur could be a surprise ingredient in cheaper, ...

When it comes to new options for batteries, “we need something that we can make a lot of, and make it quickly. And that's where lithium-sulfur comes in,” says Celina Mikolajczak, chief battery ...

Li-S Batteries: Challenges, Achievements and Opportunities

Lithium-sulfur (Li-S) batteries are regarded as one of the most promising next-generation battery devices because of their remarkable theoretical energy density, cost ...

Recent advancements and challenges in deploying lithium sulfur ...

The Lithium-Sulfur Battery (LiSB) is one of the alternatives receiving attention as they offer a solution for next-generation energy storage systems because of their high specific capacity (1675 mAh/g), high energy density (2600 Wh/kg) and abundance of sulfur in nature. These qualities make LiSBs extremely promising as the upcoming high-energy storing ...

Realizing high-capacity all-solid-state lithium-sulfur batteries using ...

Lithium-sulfur all-solid-state batteries using inorganic solid-state electrolytes are considered promising electrochemical energy storage technologies. However, developing positive electrodes with ...

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