# Difficulties of aluminum-sulfur batteries

Are aluminum-sulfur batteries a 'beyond lithium'?
Among the plethora of contendersin the 'beyond lithium' domain,the aluminum-sulfur (Al-S) batteries have attracted considerable attention in recent years due to their low cost and high theoretical volumetric and gravimetric energy densities (3177 Wh L -1 and 1392 Wh kg -1).

What challenges do aluminum batteries face?
These challenges encompass the intricate Al 3+intercalation process and the problem of anode corrosion,particularly in aqueous electrolytes. This review aims to explore various aluminum battery technologies,with a primary focus on Al-ion and Al-sulfur batteries.

Does corrosion affect lithium ion batteries with aluminum components?
Research on corrosion in Al-air batteries has broader implicationsfor lithium-ion batteries (LIBs) with aluminum components. The study of electropositive metals as anodes in rechargeable batteries has seen a recent resurgence and is driven by the increasing demand for batteries that offer high energy density and cost-effectiveness.

Do al-s batteries have a sulfur cathode?
So far, the publications on Al-S batteries mostly reported ex-situ studies of the Al-ion electrolyte and the sulfur cathode during cycling. After discharge, it has been determined the presence of all possible sulfur species, i.e. elemental sulfur, S 82-, S 62-, S 42-, S 22- and S 2-.

Should aluminum batteries be protected from corrosion?
Consequently,any headway in safeguarding aluminum from corrosionnot only benefits Al-air batteries but also contributes to the enhanced stability and performance of aluminum components in LIBs. This underscores the broader implications of research in this field for the advancement of energy storage technologies. 5.

What are the disadvantages of lithium ion batteries?
Their notable drawback lies in larger volume change. During repeated (dis)charging processes,the sulfur material inside the battery will experience volume expansion and contraction,leading to structural deformation and capacity attenuation of the battery (Figure 1b).

Aluminum-sulfur batteries (AlSBs) exhibit significant potential as energy storage systems due to their notable attributes, including a high energy density, cost-effectiveness, and abundant availability of aluminum and sulfur. ...

In this work, we offer an overview of historical and present research pursuits in the development of Al-S batteries with particular emphasis on their fundamental problem-the ...

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A battery using aluminum and sulfur potentially has five times the storing capacity as a lithium-ion battery, Fahlman said. That added capacity comes without increasing the battery"s weight. Since more than half of an electric vehicle"s total weight comes from its batteries, this additional capacity without added weight is a tremendous advantage.

Multivalent M-S batteries face significant hurdles at the cathode, including poor sulfur conductivity, low sulfur utilization, active sulfur loss from the shuttle effect, and structural breakage with associated safety risks caused by volume expansion of the cathode. Researchers are therefore dedicated to designing, optimizing, and ...

Molten salt aluminum-sulfur batteries are based exclusively on resourcefully sustainable materials, and are promising for large-scale energy storage owed to their high-rate capability and moderate ...

This review aims to explore various aluminum battery technologies, with a primary focus on Al-ion and Al-sulfur batteries. It also examines alternative applications such as Al redox batteries and supercapacitors, with pseudocapacitance emerging as a promising method for accommodating Al 3+ ions.

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Alternatively, the formation of Al 2 S 3 from sulfur is expected at E° = 1.03 V, in line with previous investigations of aluminum-sulfur batteries 30. Regardless of the precise mechanism, the ...

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The research on the electrochemical reaction mechanism, capacity degradation mechanism, and strategies to improve charge transfer kinetics of aluminum sulfur batteries is crucial for improving their electrochemical performance. From this perspective, this paper comprehensively summarizes the electrochemical performance, charging/discharging ...

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Lithium-sulfur (Li-S) batteries have received great attention due to their high theoretical specific capacity and energy density, wide range of sulfur sources, and environmental compatibility. However, the development of Li-S batteries is limited by a series of problems such as the non-conductivity and volume expansion of the sulfur cathode and the shuttle of lithium ...

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