Unleashing ultrahigh capacity and lasting stability: aqueous zinc-sulfur batteries

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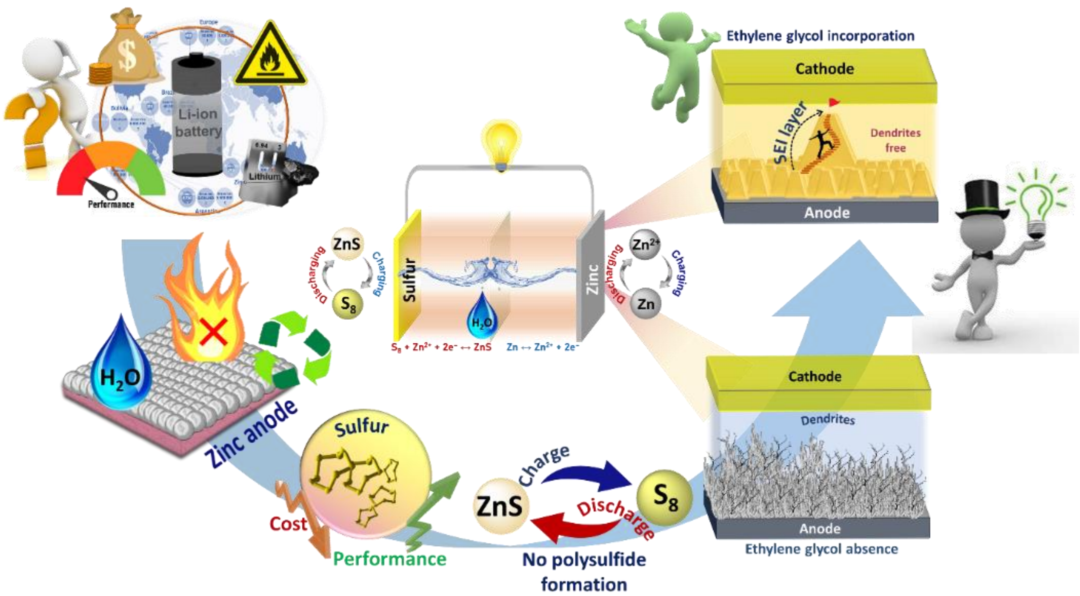
Abstract

Globalization and incessantly increasing population have led to a rapid upsurge in the world's energy demand. But their efficacious usage is unviable without energy storage devices. Li-ion batteries are market leaders but bottlenecked by challenges of dearth Li resources, fully inert and high-cost production, utilization of flammable organic solvents, limited capacity and energy density etc.[1] So, high capacity (1675 mA h g-1) sulfur-based cathodes are proved to be instrumental as they are rendered by conversion mechanism, low cost, environment-friendly and non-toxic nature along with earth abundancy.[2]

Alkali and alkaline earth metal sulfur batteries are explored, amongst which Li-S batteries are widely examined for energy storage applications that utilize organic electrolytes and sulfur-based cathodes. However, polysulfide shuttling and flammability risk are severe problems in these systems. So, along with sulfur utilization of aqueous compatible cathode is required.[1, 3] In this regard, usage of less reactive zinc anode comes with additional benefits of having high abundance, high energy density, high specific capacity (810 mAh g^{-1}), low cost, less toxicity, recyclable, moderate electrochemical potential window (−0.76 V *vs.* SHE), flammable safe and high safety *etc.* but suffered from corrosion due to which dendrites are formed. Addition of additives to the electrolytes plays a crucial role in



Scheme 1. Schematic representation of the advantages of aqueous Zn-S battery over Li-ion batteries.

providing a high stability of anode and reducing water activity.[4] We have examined additive for ZnS battery performance battery system. The assembled Zn-S battery delivered an outstanding capacity of 1210 mA h g^{-1} at 0.1 C with a 91% capacity retention even after 250 cycles, along with remarkable reversible prolonged cycling stability of 3000 cycles at 1 C, with 64.5% capacity retention.

Keywords: Aqueous Zn-S battery, Specific Capacity, Corrosion, *In-situ* Raman, Ethylene glycol

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