



## aqueous batteries in energy storage applications

Why are aqueous batteries important for energy storage? Aqueous batteries have gradually entered the stage of energy storage systems due to their low cost and high safety. Driven by the need for safer and more efficient energy storage, aqueous batteries attract significant research attention. Should aqueous secondary batteries be used for energy storage? Additionally, their sustainability and low manufacturing costs render them a promising candidate for large-scale energy storage applications. Nevertheless, aqueous secondary batteries generally demonstrate low energy densities and diminished performance under extreme environmental conditions. Are aqueous batteries a competitive candidate for reliable and affordable energy storage? The emergence of new materials and cell designs is enabling the transition of aqueous batteries into competitive candidates for reliable and affordable energy storage. This Review critically examines the scientific advances that have enabled such a transition and explores future research prospects. Are aqueous zinc-based batteries a good choice for energy storage? Abstract Aqueous zinc-based batteries (AZBs) are emerging as a compelling candidate for large-scale energy storage systems due to their cost-effectiveness, environmental friendliness, and inherent Are aqueous sodium ion batteries durable? Concurrently Ni atoms are in-situ embedded into the cathode to boost the durability of batteries. Aqueous sodium-ion batteries show promise for large-scale energy storage, yet face challenges due to water decomposition, limiting their energy density and lifespan. What is the research interest in aqueous batteries? Research interest in aqueous batteries, which is increasing year by year (Fig. 1A), is mainly focused on the optimization of electrode materials and electrolytes. Driven by the need for safer and more efficient energy storage, aqueous batteries attract significant research attention. However, their energy density and cycling performance are not currently satisfactory enough, impeding their industrial application. Driven by the need for safer and more efficient energy storage, aqueous batteries attract significant research attention. However, their energy density and cycling performance are not currently satisfactory enough, impeding their industrial application. Among the diverse energy storage technologies, aqueous batteries have garnered substantial attention as a promising alternative to conventional lithium-ion batteries. This Special Issue, titled "Aqueous Batteries: Materials, Mechanisms, and Applications", is dedicated to exploring the materials Aqueous batteries have gradually entered the stage of energy storage systems due to their low cost and high safety [2]. Driven by the need for safer and more efficient energy storage, aqueous batteries attract significant research attention. However, their energy density and cycling performance are Aqueous zinc-ion batteries (AZIBs) are attractive for large-scale energy storage due to their intrinsic safety, low cost, and environmental compatibility. However, the high charge-to-radius ( $q/r$ ) ratio of  $Zn^{2+}$  leads to strong solvation and sluggish solid-state diffusion, which hinder efficient Aqueous Secondary Batteries: Status and Challenges This work systematically reviewed three emerging aqueous secondary battery systems recognized as pivotal future energy storage technologies: aqueous Li-ion batteries Roadmap for advanced aqueous batteries: From Aqueous batteries (ABs), based on water which is environmentally benign, provide a promising alternative for safe, cost-effective,



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and scalable energy storage, with high power density and tolerance against mishandling. Aqueous Zinc-Based Batteries: Active Materials, Aqueous zinc-based batteries (AZBs) are emerging as a compelling candidate for large-scale energy storage systems due to their cost-effectiveness, environmental friendliness, and inherent safety. Topic: Aqueous Batteries: Materials, Mechanisms, Applications in Energy Storage: Examination of the practical applications of aqueous batteries in grid energy storage, electric vehicles, and portable electronics. Aqueous batteries: from laboratory to market Aqueous batteries have gradually entered the stage of energy storage systems due to their low cost and high safety [2]. Driven by the need for safer and more efficient energy Interfacial energy storage in aqueous zinc-ion batteries Aqueous zinc-ion batteries (AZIBs) are attractive for large-scale energy storage due to their intrinsic safety, low cost, and environmental compatibility. However, the high Emerging role of aqueous batteries in next generation energy Aqueous metal batteries are emerging as promising candidates for next-generation energy storage, offering safer, more sustainable, and cost-effective alternatives to lithium-ion batteries Alkaline-based aqueous sodium-ion batteries for large-scale Aqueous sodium-ion batteries show promise for large-scale energy storage, yet face challenges due to water decomposition, limiting their energy density and lifespan. Proton storage and transfer in aqueous batteries: Matter Aqueous batteries are promising energy-storage devices due to their high safety, large capacity, and low cost. Recent studies have revealed significant proton involvement in aqueous batteries, even in non-acidic Enhancing aqueous battery energy storage through 1. Introduction Lithium-ion batteries (LIBs) and supercapacitors (SCs) with organic electrolytes have found widespread application in various electrochemical energy storage Iron anode-based aqueous electrochemical energy The ever-growing demands for green and sustainable power sources for applications in grid-scale energy storage and portable/wearable devices have enabled the continual development of advanced aqueous Advanced aqueous batteries: Status and challenges | MRS Energy Highlights The status for advanced aqueous batteries are summarized in detail. The challenges for the application of aqueous batteries are discussed. Discussion The Aqueous batteries as grid scale energy storage solutions As a result of these considerations, the inherent safety and potential low cost offered by the aqueous-based electrochemical energy storage devices discussed in the Aqueous batteries: from laboratory to market This perspective discusses the fundamental benefits and drawbacks of aqueous batteries and the challenges of the development of such battery technology from laboratory scale to industrial applications.

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