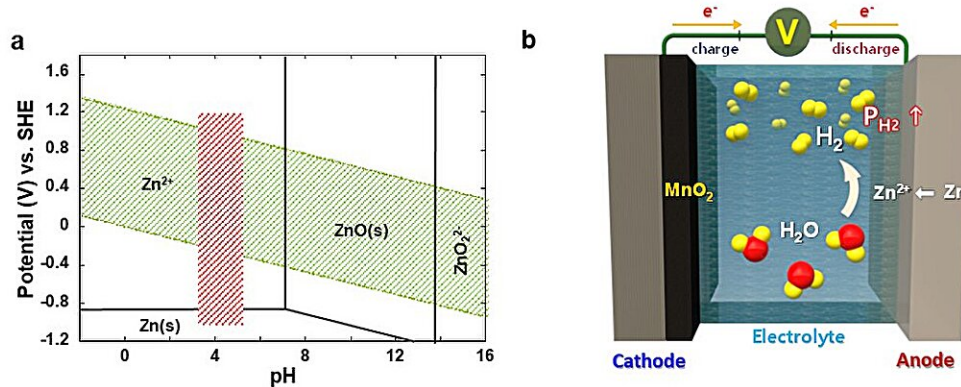


# A cheaper, safer alternative to lithium-ion batteries: Aqueous rechargeable batteries

October 13 2023



Causes of hydrogen generation and incessant accumulation within the cell in the aqueous rechargeable batteries. Credit: Korea Institute of Science and Technology

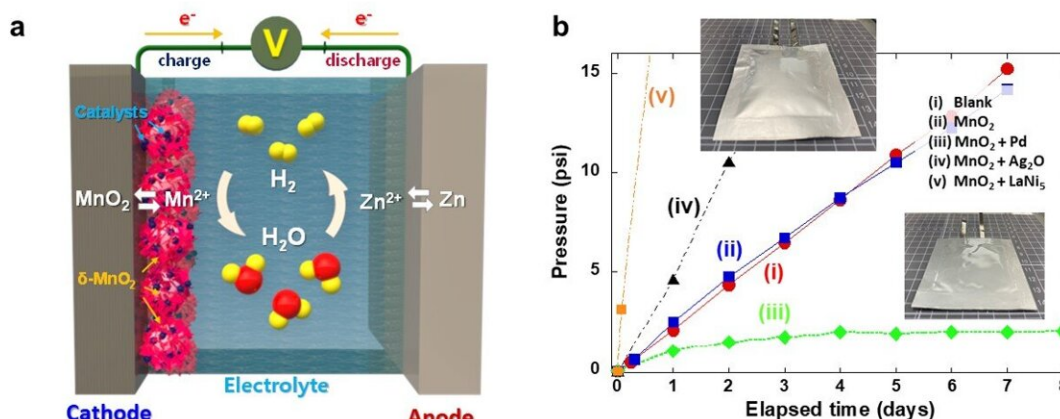
This summer, the planet has been suffering from unprecedented heat waves and heavy rainfalls. Developing renewable energy and expanding associated infrastructure has become an essential survival strategy to ensure the sustainability of the planet in crisis, but it has obvious limitations due to the volatility of electricity production, which relies on

uncertain variables like labile weather conditions.

For this reason, the demand for energy storage systems (ESS) that can store and supply electricity as needed is ever-increasing, but [lithium-ion batteries](#) (LIBs) currently employed in ESS are not only highly expensive, but also prone to potential fire, so there is an urgent need to develop cheaper and safer alternatives.

A research team led by Dr. Oh, Si Hyoung of the Energy Storage Research Center at the Korea Institute of Science and Technology (KIST) has developed a highly safe, aqueous, rechargeable battery that can offer a timely substitute that meets the cost and safety needs. The results of this research were published in the journal *Energy Storage Materials*.

Aqueous rechargeable batteries have a significant economic advantage as the cost of raw materials is much lower than LIBs. However, inveterate [hydrogen](#) gas generated from parasitic water decomposition causes a gradual rise in internal pressure and eventual depletion of the electrolyte, which poses a sizable threat on the battery safety, making commercialization difficult.



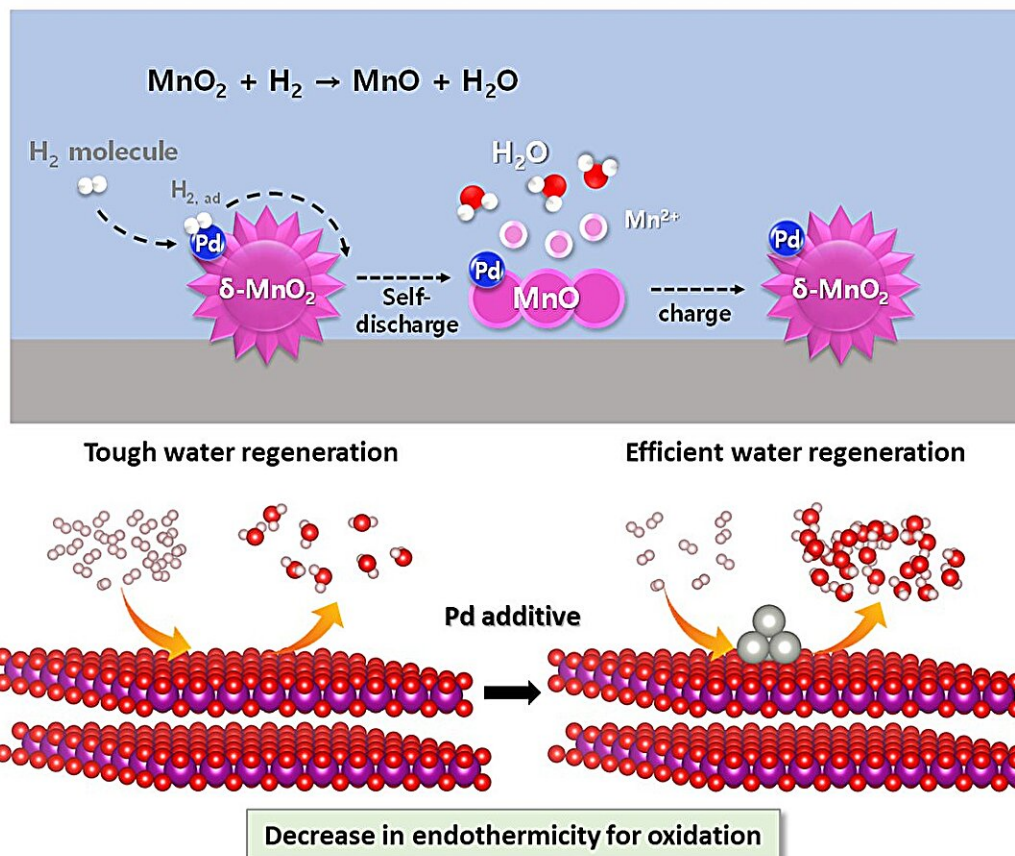
Proposed strategy for securing safety of the aqueous rechargeable batteries via water-regeneration. Credit: Korea Institute of Science and Technology

Until now, researchers have tried to evade this issue by installing a surface protection layer that minimizes the contact area between the metal anode and the electrolyte. However, the corrosion of the metal anode and accompanying decomposition of water in the electrolyte is inevitable in most cases, and incessant accumulation of hydrogen gas can cause a potential detonation in long-term operation.

To cope with this critical issue, the research team has developed a composite catalyst consisting of [manganese dioxide](#) and palladium, which is capable of automatically converting hydrogen gas generated inside the cell into water, ensuring both the performance and safety of the cell.

Manganese dioxide does not react with hydrogen gas under normal

circumstances, but when a small amount of palladium is added, hydrogen is readily absorbed by the catalysts, being regenerated into water. In the prototype cell loaded with the newly developed catalysts, the internal pressure of the cell was maintained well below the safety limit, and no electrolyte depletion was observed.



Role of composite catalysts in activating water-regeneration chemical reaction.  
Credit: Korea Institute of Science and Technology

The results of this research effectively solves one of the most concerning

safety issues in the aqueous batteries, making a major stride towards commercial application to ESS in the future. Replacing LIBs by cheaper and safer aqueous batteries can even trigger a rapid growth of global market for ESS.

"This technology pertains to a customized safety strategy for aqueous rechargeable batteries, based on the built-in active safety mechanism, through which risk factors are automatically controlled," said Dr. Oh, Si Hyoung of KIST. "Moreover, it can be applied to various industrial facilities where hydrogen gas leakage is one of major safety concerns (for instance, hydrogen gas station, nuclear power plants, etc.) to protect public safety."

**More information:** Hyun-gi Jo et al, Highly safe aqueous rechargeable batteries via electrolyte regeneration using Pd–MnO<sub>2</sub> catalytic cycle, *Energy Storage Materials* (2023). DOI: [10.1016/j.ensm.2023.102881](https://doi.org/10.1016/j.ensm.2023.102881)

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