# Hydrated eutectic electrolytes help improve performance of aqueous zinc batteries

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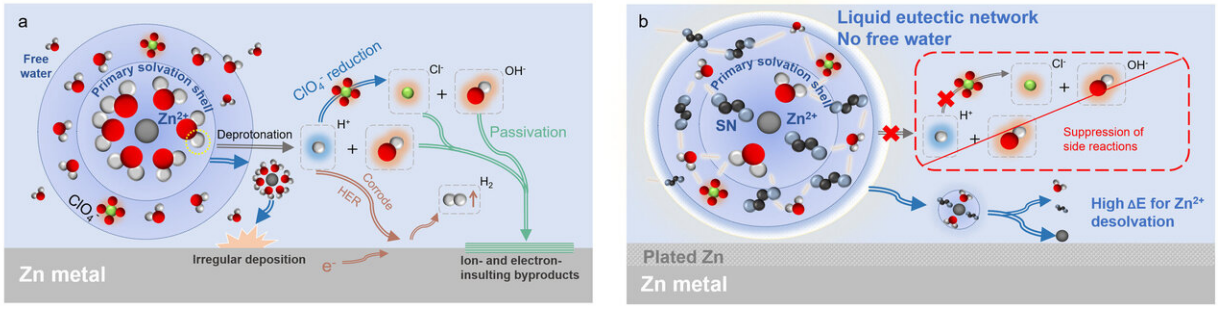


Schematic diagrams of $Zn^{2+}$ solvation structure and interfacial reactions in (a) traditional aqueous electrolyte and (b) hydrated eutectic electrolyte. Credit: Zhao Jingwen and Yang Wuhai

Zinc (Zn) batteries have attracted increasing attention due to their large volumetric capacity, their Earth-abundance, and environmental friendliness. Zn batteries provide a promising solution to safety hazards and economic challenges facing prevailing Li-ion batteries.

However, the currently available aqueous Zn electrolytes are far from ideal. Aqueous Zn batteries struggle with rapid performance degradation arising from the poor reversibility of Zn anodes and the dissolution of cathodes. A research team led by Prof. Cui Guanglei from the Qingdao Institute of Bioenergy and Bioprocess Technology (QIBEBT) of the Chinese Academy of Sciences has proposed a new class of aqueous

electrolytes called hydrated eutectic electrolytes to ensure better performance of aqueous Zn batteries. The study will be published in the journal *Joule* on July 1.

The new aqueous electrolyte was fabricated by coupling a hydrated Zn salt ($Zn(ClO_4)_2 \cdot 6H_2O$) exclusively with a neutral ligand (succinonitrile, SN).

"The aqua cationic Zn species and corresponding water molecules' coordination states are reorganized. SN enters the primary solvation shell of $Zn^{2+}$, while all water molecules contribute to the formation of the eutectic structure and remain bound in the metal coordination sphere," said Dr. Zhao Jingwen from QIBEBT, co-corresponding author of the study.

That's why the electrochemical behaviors of the hydrated eutectic electrolytes were different from those of traditional aqueous electrolytes. Hydrated eutectic electrolytes were highly suitable for the Zn-organic batteries from both anode and cathode aspects.

"It is known that the perchlorate anions are reactive and susceptible to decomposition in aqueous solutions," Cui said. "However, due to the suppressed $Zn^{2+}$-$H_2O$ interplay, the commonly accepted nonideal perchlorate anion can be stabilized in the eutectic network."

Owning to the rich intermolecular interactions in the hydrated eutectic electrolytes, stable low-temperature operation even at -20°C was also obtained.

The study offers a simple and promising way to tame the multivalent electrolyte structure toward creating long-life rechargeable aqueous batteries.

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