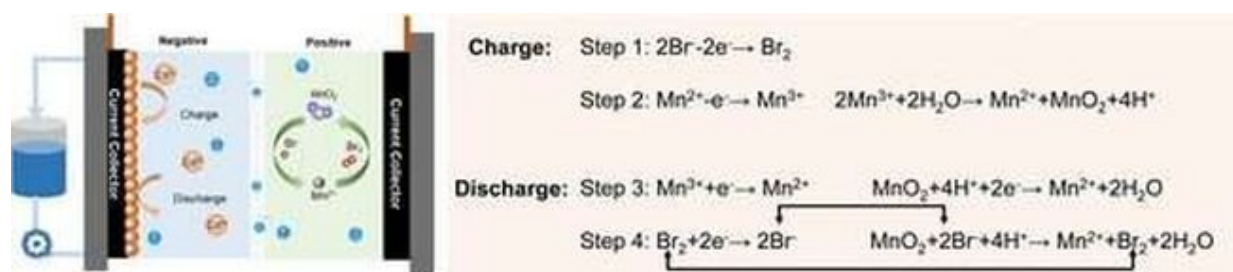


Scientists develop a manganese-based hybrid single flow battery with high energy density

November 30 2022, by Li Yuan



Graphical abstract. Credit: *Angewandte Chemie International Edition* (2022).
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A research group led by Prof. Li Xianfeng from the Dalian Institute of Chemical Physics (DICP) of the Chinese Academy of Sciences (CAS) has developed a bromine-assisted- MnO_2 -based hybrid single flow battery that exhibits advantages of high energy density and reversibility.

This study was published in *Angewandte Chemie International Edition* on Oct. 26.

The $\text{Mn}^{2+}/\text{Mn}^{3+}$ redox pair has been considered as a promising cathode for high-[energy-density](#) batteries, due to its attractive features of high redox potential, solubility and outstanding kinetics. However, the disproportionation side reaction of Mn^{3+} , which results in accumulation of "dead" MnO_2 , limits its reversibility and energy density.

In this study, the researchers provided a new concept to solve the issue of "dead" MnO_2 by introducing Br^-/Br_2 into $\text{Mn}^{2+}/\text{MnO}_2$ catholyte in a highly acidic environment.

Br^- was first oxidized to Br_2 during charge, and then Mn^{2+} was oxidized to Mn^{3+} , which could be partially disproportionated to form MnO_2 simultaneously. During discharge, Mn^{3+} and part of MnO_2 were reduced to Mn^{2+} first and Br_2 was reduced to Br^- . Then the produced Br^- could react with "dead" MnO_2 to Br_2 , participating in [discharge](#), completing the reduction process, and avoiding the accumulation of "dead" MnO_2 .

Furthermore, the researchers assembled a bromine-manganese flow battery (BMFB) coupling with Cd/Cd^{2+} as the anode. The battery exhibited high energy density of 360 Wh L^{-1} and stable running for over 500 cycles at a [current density](#) of 80 mA cm^{-2} .

"The [battery](#) assembled with silicotungstic acid as anode could continuously run for over 2000 cycles at 80 mA cm^{-2} , which further confirmed the reliability and universality of the catholyte," said Prof. Li. "We believe the BMFB has great potential for large-scale energy storage."

More information: Yun Liu et al, Bromine Assisted MnO_2 Dissolution Chemistry: Toward a Hybrid Flow Battery with Energy Density of over 300 Wh L^{-1} , *Angewandte Chemie International Edition* (2022). [DOI: 10.1002/anie.202213751](https://doi.org/10.1002/anie.202213751)

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