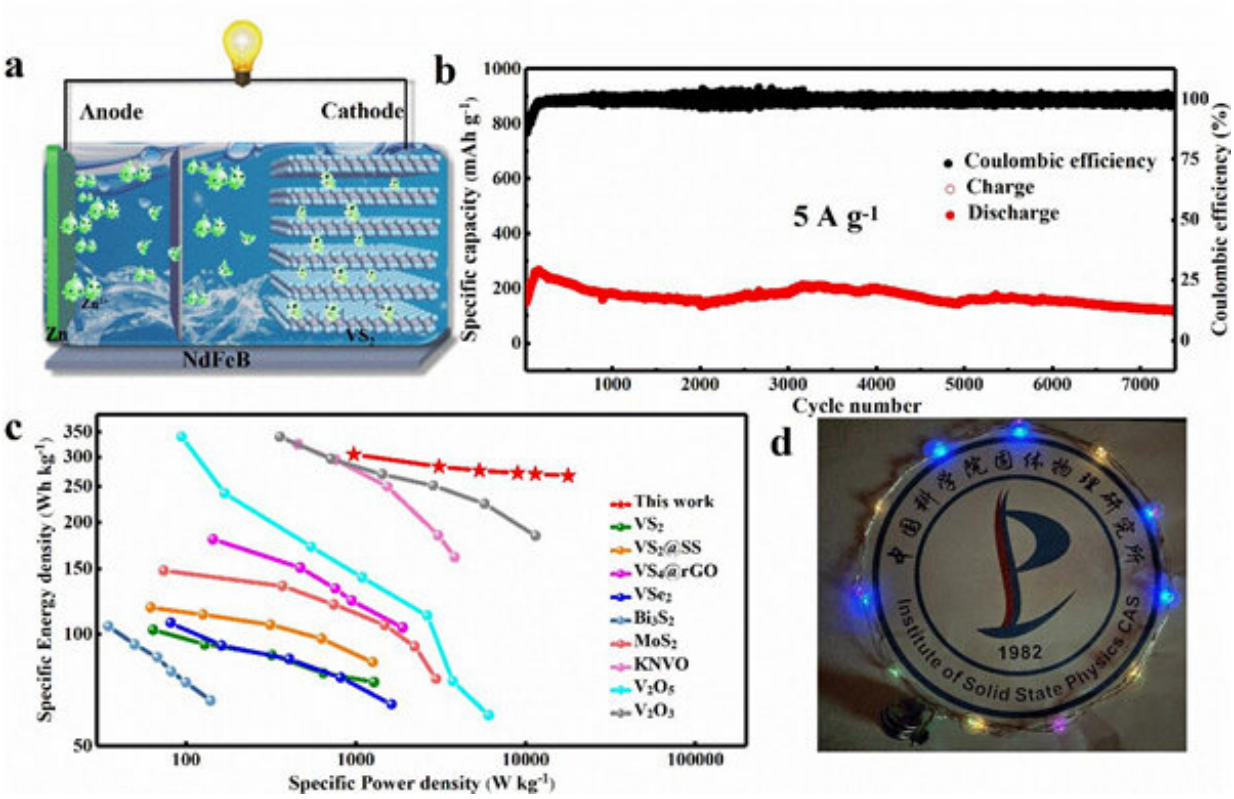
Scientists develop aqueous zinc-ion battery with high energy density and ultra-long lifetime

June 14 2023, by Zhang Nannan



Schematic illustration and electrochemical performance of the Zn-VS_2 AZIB. a. Schematic illustration of the Zn-VS_2 AZIB configuration; b. Ultralong cycle performance of the vacancy-rich Zn-VS_2 AZIB; c. Ragone plots of the vacancy-rich VS_2 compared with the other cathodes; d. Opticalphoto of an LED lamp powered by the Zn-VS_2 batteries. Credit: Mao Yunjie

A research team at the Hefei Institutes of Physical Science of the Chinese Academy of Sciences (CAS), led by Prof. Zhao Bangchuan, has developed a high-performance aqueous zinc-ion battery with ultra-long cycle life in a weak magnetic field. Their results were published in *Materials Horizons*.

Aqueous zinc-ion batteries are an inexpensive and safe alternative to lithium-ion batteries with high theoretical capacity. However, the limited electrochemical performance of the cathode material and zinc dendrite growth on the anode reduce the energy density and cycle life of aqueous zinc-ion batteries. To develop better aqueous zinc-ion batteries, it's important to design cathodes with high energy density and suppress zinc dendrite growth.

In this study, the researchers overcame the limitations of existing cathode materials and the problem of zinc dendrite growth. They used a one-step hydrothermal method with in-situ electrochemical defect engineering to create a VS_2 material. This material had rich defects that effectively reduced the electrostatic interaction between zinc (Zn) ions and vanadium disulfide (VS_2). It allowed for 3D transport of Zn^{2+} along both the ab-plane and c-axis, resulting in excellent rate capability.

While cycling stability remained an issue due to the dendrite growth, the researchers found that the introduction of an external magnetic field suppressed the growth and significantly increased battery life. When operated under a weak magnetic field, the high-performance Zn-VS_2 battery demonstrated an ultra-long cycle life and delivered a high energy density and power density.

This work could have significant implications for the future of energy storage technology, according to the team.

More information: Yunjie Mao et al, Magneto-electrochemistry

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driven ultralong-life Zn-VS2 aqueous zinc-ion batteries, *Materials Horizons* (2023). DOI: 10.1039/D3MH00303E

Provided by Chinese Academy of Sciences

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