



ENGINEERING REUSABLE ALUMINUM-AIR BATTERIES THROUGH ACTIVE PRECIPITATE CAPTURE AND ELECTROLYTE MICRO-DOSING

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Inventors: James Pikul, Yichao Shi

The Invention

UW-Madison researchers have developed a novel design for a reusable aluminum-air battery that overcomes traditional limitations through three integrated design features. Unlike conventional batteries that require electrical recharging, this system enables rapid mechanical recharging by simply replacing the aluminum anode, similar to refueling. The system incorporates: (1) a porous cloth barrier that actively captures aluminum hydroxide precipitates before they contaminate the hydrogel electrolyte, preserving conductivity and enabling multiple anode replacements; (2) a controlled micro-dosing manifold that periodically injects fresh electrolyte to replenish water, maintain ionic pathways through passivation layers, and sustain long-duration discharge; and (3) a spring-loaded modular enclosure with perforated aluminum anodes that maintains consistent interfacial pressure while continuously expelling hydrogen gas bubbles. Together, these features transform aluminum-air technology from a single-use primary battery into a practical, field serviceable power source. The modular design allows spent anodes to be quickly swapped without replacing the cathode or electrolyte, providing rapid energy replenishment for remote applications where electrical charging infrastructure is unavailable. The system achieves stable discharge for extended duration and oxidizing up to 1.5 mm thick aluminum anodes, the highest utilization reported in the literature, producing over 3000 Wh per kg of aluminum. Through efficient anode swapping, the complete battery system achieves an energy density of 550 Wh/kg while maintaining the inherent advantages of aluminum-air chemistry: nontoxic discharge products and reliance on abundant, recyclable materials.

Tech Fields

- [Clean Technology: Energy storage, delivery & resource efficiencies](#)

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