Washington University in St. Louis
Office of Technology Management

RECHARGEABLE ANODE-FREE SODIUM METAL BATTERY

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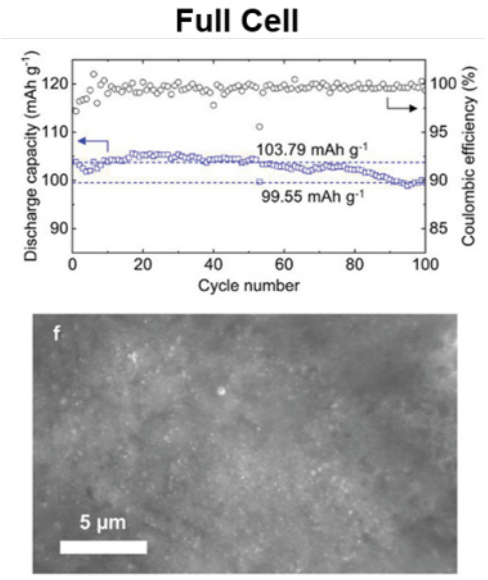
Technology Description

Researchers in Peng Bai's lab at Washington University have developed an inexpensive rechargeable sodium metal battery with a 99.93% sodium retention rate. This battery uses glyme-based electrolytes with a low moisture content and a bare copper current collector to achieve optimal interface stability.

By reducing the moisture content of the electrolyte, the researchers avoid typical rough structures called dendrites and whiskers on the Na metal, instead forming a smooth and shiny layer of Na metal. No harmful solid electrolyte interphase, which would necessitate excess sodium, forms, and the high sodium retention rate is consistent across 100 cycles.



(Top) The discharge capacity and Coulombic efficiency of a full cell was calculated over 100 cycles. (Bottom) SEM images of the Na deposits were taken after 100 cycles.

Stage of Research

The researchers have built stable half and full cell prototypes, testing them up to 100 cycles. Ongoing work involves testing in different environmental conditions and scaling up manufacturing.

Publications

- Ma B, Lee Y, & Bai P. (2021). Dynamic interfacial stability confirmed by microscopic optical operando experiments

enables high-retention-rate anode-free Na metal full cells. *Advanced Science*, 202005006.
- Ma B, & Bai P. (2022). Fast charging limits of ideally stable metal anodes in liquid electrolytes. *Advanced Energy Materials*, 2102967.

Applications

- Production of a rechargeable anode-free sodium metal battery

Key Advantages

- Rechargeable
  - No side reactions to form solid electrolyte interphase
  - Produces smooth, shiny surface in glyme electrolyte with <10ppm moisture content
  - 99.93% Na inventory retention rate per cycle
- Inexpensive
  - No traditional anode materials
  - Anode side only requires a bare copper current collector (could be replaced with cheaper aluminum foil)
  - No excess sodium required

Patents: Pending

Related Web Links: Bai Profile & Lab