Docket #: S19-148

Membrane-Free Zn/MnO2 Flow Battery for Large-Scale Energy Storage

Stanford researchers have developed a low cost, safe, environmentally friendly, rechargeable Zn/MnO_2 flow battery with the potential for grid scale energy storage. Due to capacity decay, primary (non-rechargeable) Zn/MnO_2 batteries have dominated until now. The Yi Cui Group addresses capacity decay/poor cathode reaction reversibility in their membrane-free aqueous flow Zn/MnO_2 battery, where the anode is zinc-based chemistry with the reversible Zn2+/Zn deposition/stripping reaction, and the cathode is based on the dissolution-precipitation reaction (Mn2+/MnO2).

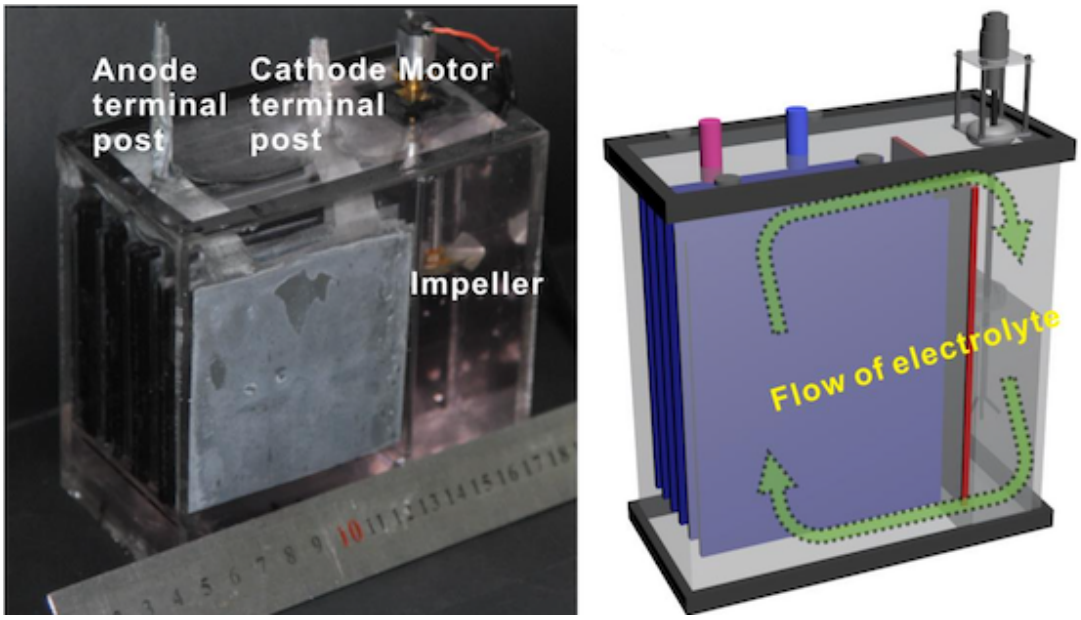


Figure 1 Zn/MnO2 based battery cell

The cell consists of $MnSO_4$ solution as catholyte and $ZnSO_4$ solution as anolyte, that mix without a membrane between the two electrodes with carbon felt as cathode collector and Zn metal foil as current collector (figure 1). This redox flow battery exhibits excellent energy density and cycling stability (figure 2), and has great potential to achieve large-scale energy storage.

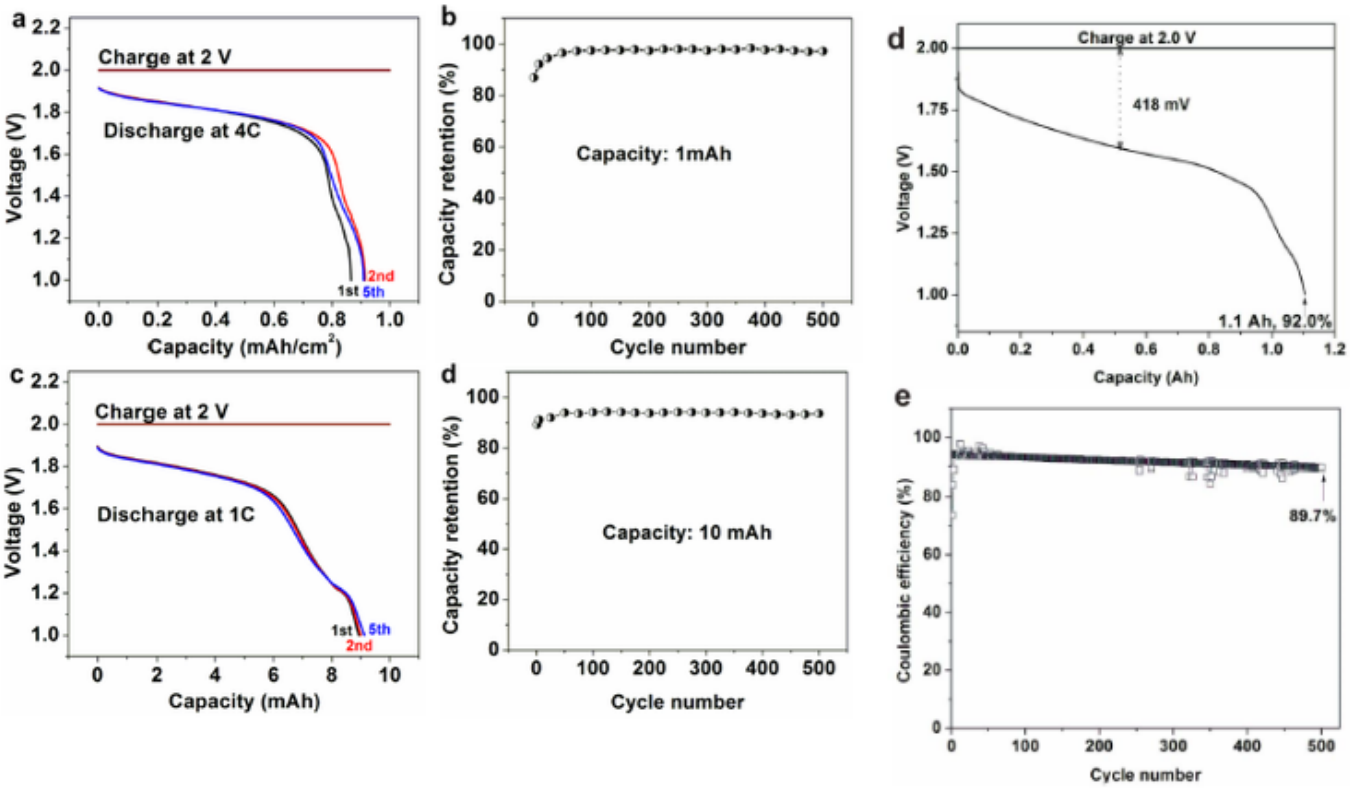


Figure 2 Bench scale flow cell results

Stage of Development - Proof of Concept

Applications

- **Grid scale energy storage** systems

Advantages

- Low cost, safe, rechargeable, and environmentally friendly.
- Good rate capability (10C discharge) and high discharge voltage ~1.78 V.

- Excellent cycling stability (1000 cycles without decay) at the areal capacity ranging from 0.5 to 2 mAh/cm2. Bench scale flow cell of 1.2 Ah and capacity retention of 89.7% at the 500th cycle.

Publications

- Li, Guodong, Wei Chen, Hao Zhang, Yongji Gong, Feifei Shi, Jiangyan Wang, Rufan Zhang et al. "Membrane-Free Zn/MnO2 Flow Battery for Large-Scale Energy Storage." *Advanced Energy Materials* (2020): 1902085.

Patents

- Published Application: WO2020214604
- Published Application: 20220199971
- Issued: 12,463,200 (USA)

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