GRIDS: Rechargeable Zn – MnO_2 Battery Developments

Low Cost Storage for the Grid Scale

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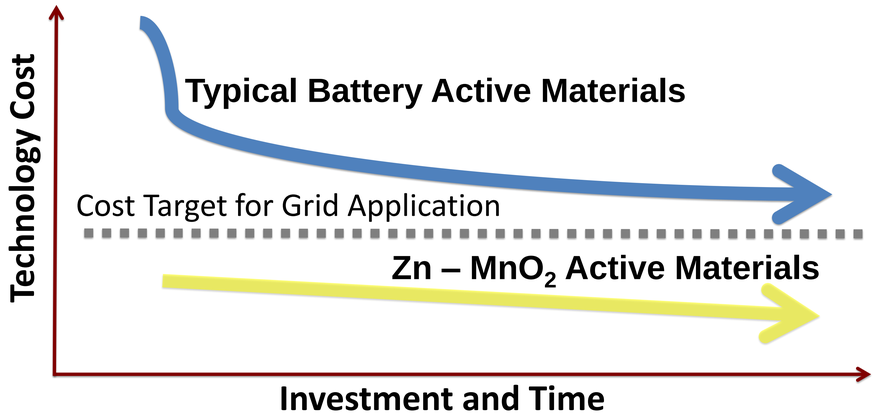
Cathode active material: **EMD γ-MnO_2**
Anode active material: **Zn metal**

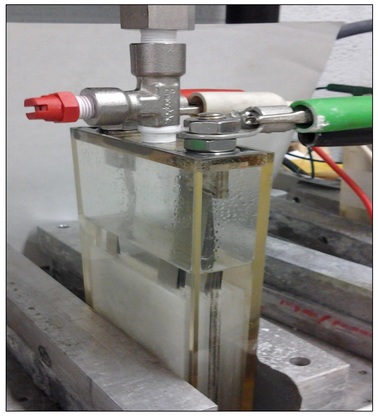
Zinc (Zn) and manganese dioxide (MnO_2)

- *Inexpensive*
- *Safe*
- *Water compatible*
- *Abundant*

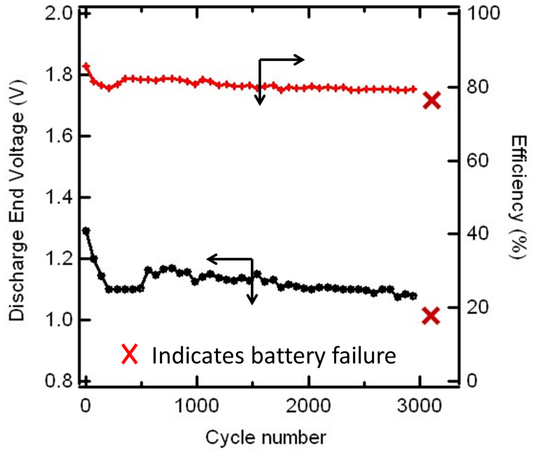
Electrolytic MnO_2 (EMD, γ-MnO_2) is reversibly converted to MnOOH during its initial stage of discharge. By cycling in a well-controlled range of cell potential and depth-of-discharge, cycle life of greater than 3,000 is achieved. By controlling zinc material migration, shape-change and zinc dendrites are avoided.



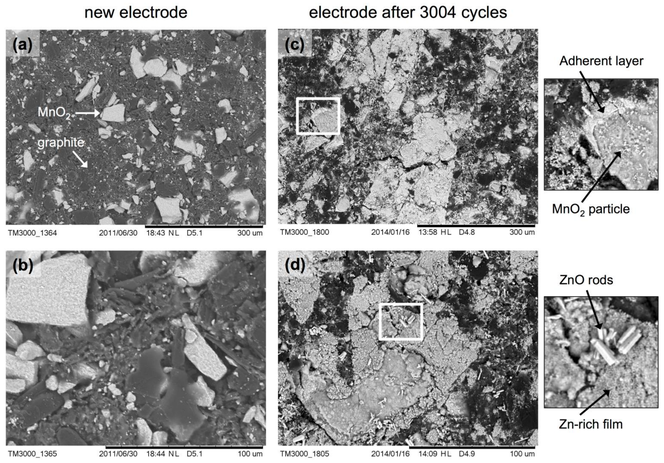
EMD MnO_2 Cathode: Long Cycle Life Demonstration, Failure Studies



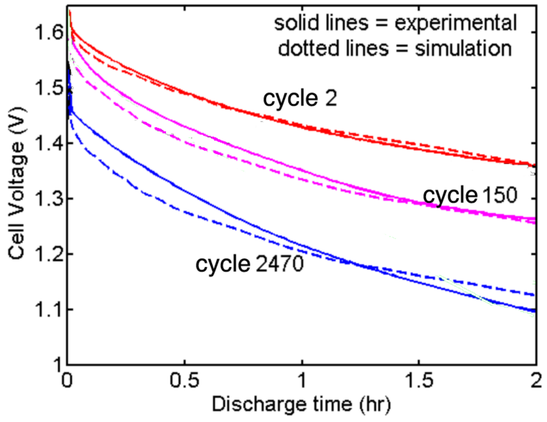
Zn-MnO_2 Research Cell
~200 Battery Tester Channels



Cycle Life Demonstrated > 3,000



Dissection Analysis Shows Formation of Zinc Surface Layers

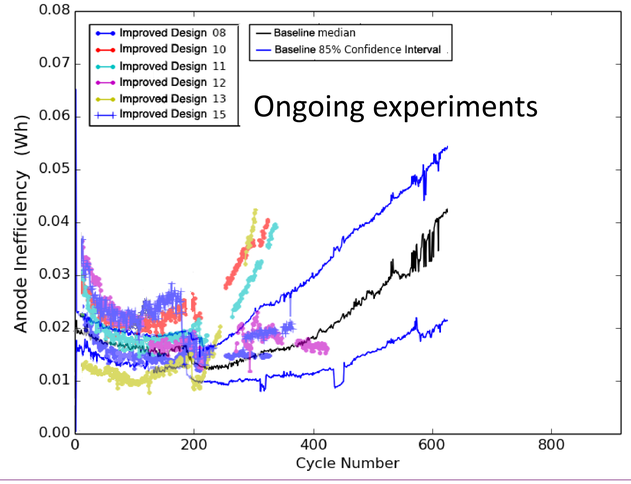


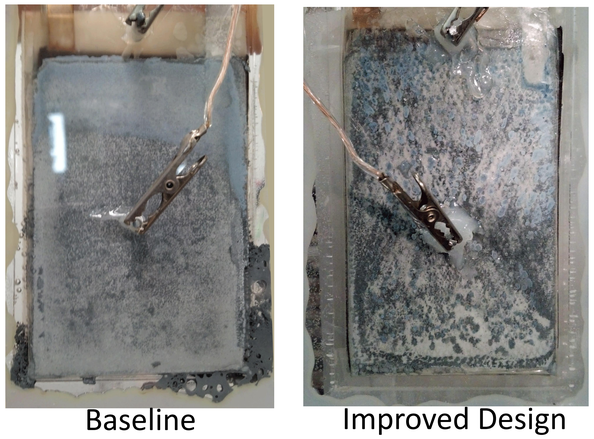
1-D Computational Modeling
Film Theory Predictions

Pasted Zinc Anode: Design of Experiment Results, Failure Studies

Pre-cycling and Cycling Metrics: Baseline vs Improved Designs

- Porosity, Permeability, Tortuosity
- Wettability
- 4-Point Conductivity
- Shape Change, Zinc Migration
- Anode Energy Storage Efficiency
- Additives: Paste and Electrolyte
- Separators



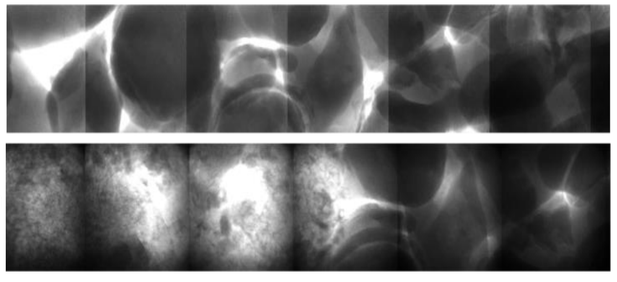


Baseline Improved Design

Control of Zinc Shape Change

In-Operando X-Ray Observations of Zinc Paste Degradation at Brookhaven National Laboratory, NSLS

Before Cycling
20 um



After Cycling
Same Location

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