Dendrite Mitigation in Zinc–Bromine Batteries

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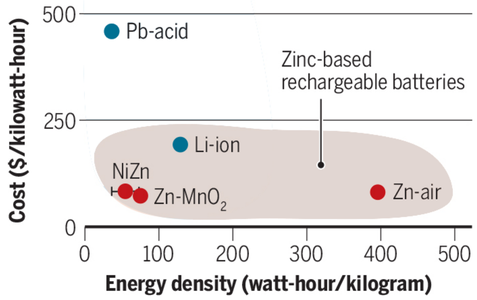
Why Zinc–Based Batteries?

- High abundance of zinc, low cost, low toxicity
- High energy density
- Safety (non-flammable aqueous electrolytes)



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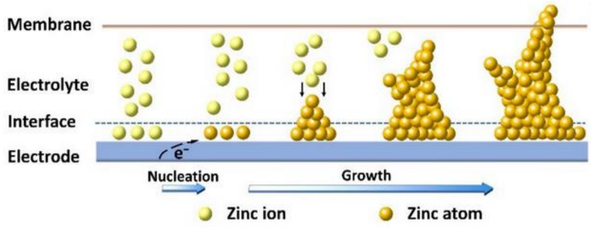
The Dendrite Problem

- Dendrites form from uneven deposition of zinc
- Can puncture the membrane, leading to short circuit
- Dendrites can lower battery efficiency



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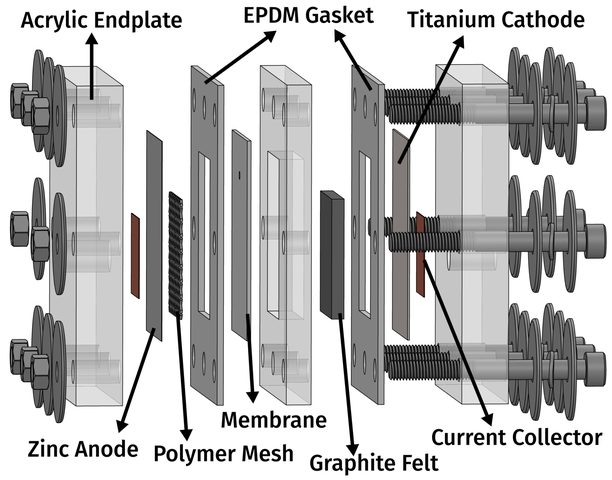
How to Reduce Dendrites?

Aim to promote more uniform zinc deposition through:

- Electrolyte additives
  - 2% Polyethylene Glycol, 0.05% Sorbitol
- Modified zinc electrode (Zn-plated Cu)

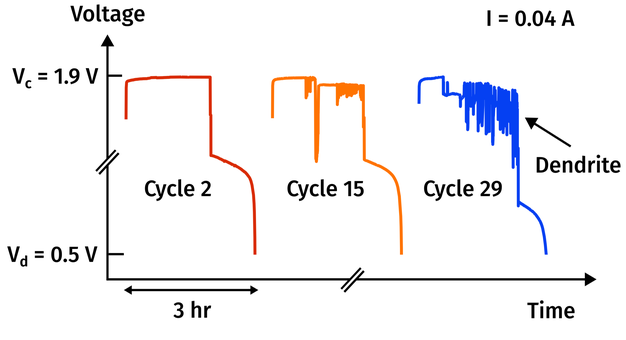
Cell Design & Fabrication

$$Zn\ (s)\ |\ Zn^{2+}\ (aq, 2M)\ ||\ Br^-\ (aq, 2M), Br_2\ (\ell)\ |\ Ti\ (s)$$



Battery Cycling

- Cells were cycled for 30 cycles at 0.1C charge rate = 0.04 Amps (Note: 1C charge rate = 1hr to full charge)

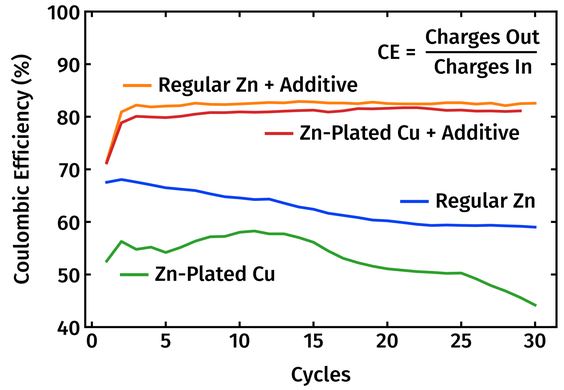


- Electrolyte = 2M $ZnBr_2$ with/without additives
- Coulombic Efficiency (CE) was measured, showing the change in charge capacity over each cycle

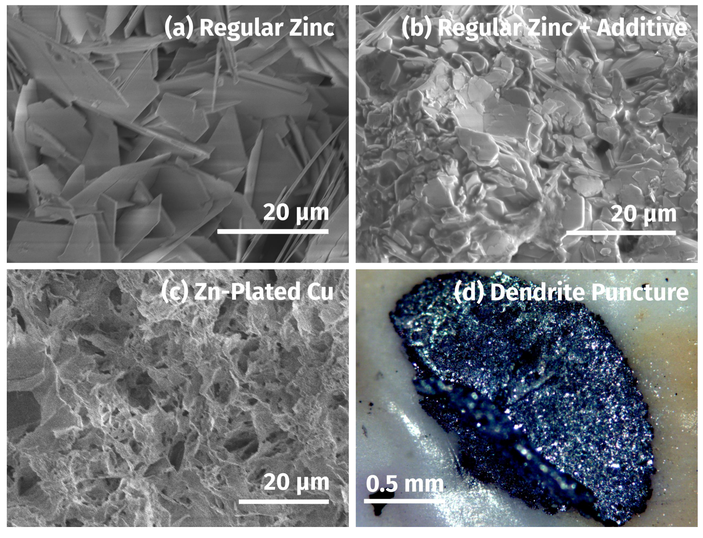
Cell Configurations Tested (Modified Anode or Additive):

1. Regular Zn + No Additive
2. Zn-plated Cu + Additive
3. Zn-plated Cu + No Additive
4. Regular Zn + Additive

Cell Performance / Microscopy



Micrographs of anodes (a)-(c) and membrane (d) after 30 cycles



Conclusion & Future Work

- Additives produced uniform flat morphology
- Zn-plated Cu produced uniform porous morphology
- Additives increased CE, Zn-plated Cu decreased CE
- Future research should vary membrane type (ion-selective), electrolyte concentration, and charge rates

Acknowledgements

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