SALIENT ENERGY

Zinc ion Batteries

The Future of Stationary Energy Storage

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Who We Are

- Salient Energy Inc has developed and is now producing their state-of-the-art Zn-ion battery.

- Salient Energy is simultaneously scaling up their proprietary battery technology while developing Zn-ion stationary energy storage systems

- Salient Energy came out of the University of Waterloo in 2017.

- Salient Energy is currently headquartered in Dartmouth NS in a 24,000 sq ft facility where fundamental science and technology development is conducted, as well as cell design and manufacturing.

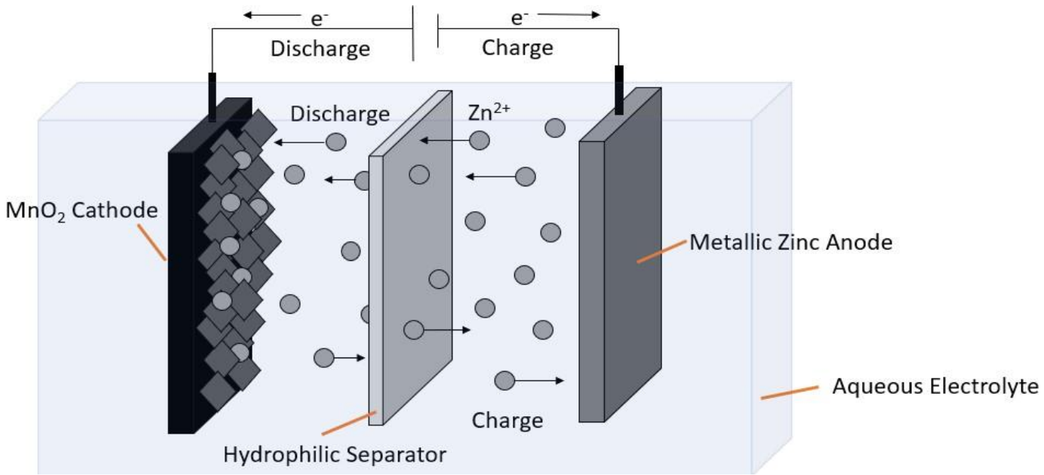
- Salient Energy is led by CEO Ken Rudisuela and CTO Brian Adams

The Salient Energy Zn-ion Battery

Salient Energy utilizes the well understood design of Li-ion batteries while leveraging inexpensive, safe, and abundant alternative materials

- On discharge, zinc ions are stripped from the metal anode and shuttled into the porous MnO_2 cathode. On charging, the zinc ions are shuttled back to the anode and replated as metallic zinc.

Zn-ion

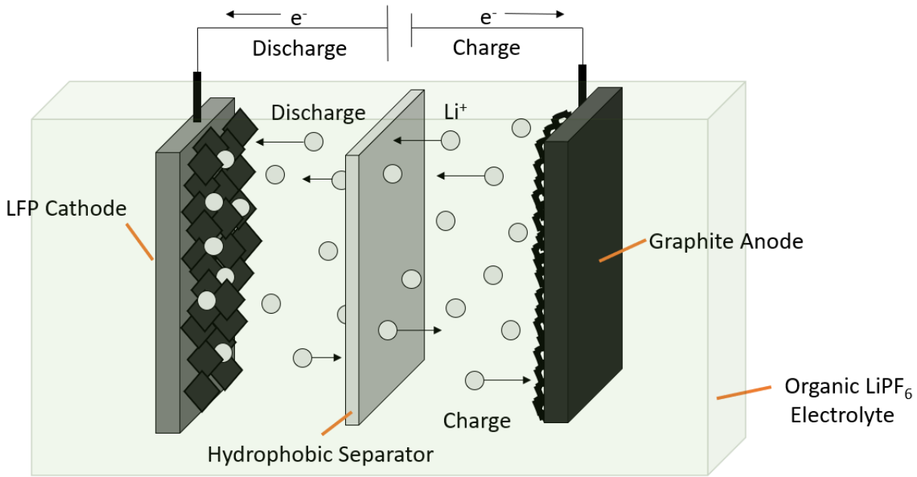


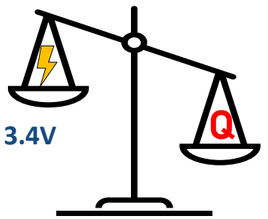
Cell Voltage = 1.35V

Max Specific Capacity = 308mAh/g

Cycle Life = 3000+ cycles

Li-ion





Cell Voltage = 3.4V

Max Specific Capacity = 170mAh/g

Cycle Life = 3000+ cycles

Salient Energy's IP Portfolio

Separator

1 patent pending:

- Broad coverage of separators for Zn-ion batteries (US and EP)

Electrolyte

1 patent pending:

- Electrolyte additives in zinc sulfate-based electrolyte (US and EP)

Positive Electrode

1 patent granted:

- Cathode active material (US and CAN)

3 patents pending:

- Family of layered cathode materials (US and EP)
- Polymer coatings on active materials for dissolution suppression (US)
- Cathode architectures including primer layer and hydrophilic binders (US and EP)

Cell Case

1 patent pending:

- Cell designs and manufacturing methods mimicking Li-ion (US and EP)

Negative Electrode

1 patent granted:

- Electroplated Zinc Electrodes (US)

1 patent pending:

- Protection Layer on Zinc Surface (US and EP)

Stationary Energy Storage

The global stationary storage market is forecast to grow from **60 GWh/year in 2023 to 250 GWh/ year by 2030**. When compared to total generating capacity these forecasts appear conservative. (US generating capacity in 2022 was 4,243,000 GWh).
Supply chain security, supply/demand challenges for lithium, and the massive scale required creates the **perfect environment for battery technologies that are alternatives to Lithium**.

BEHIND THE METER (BTM)

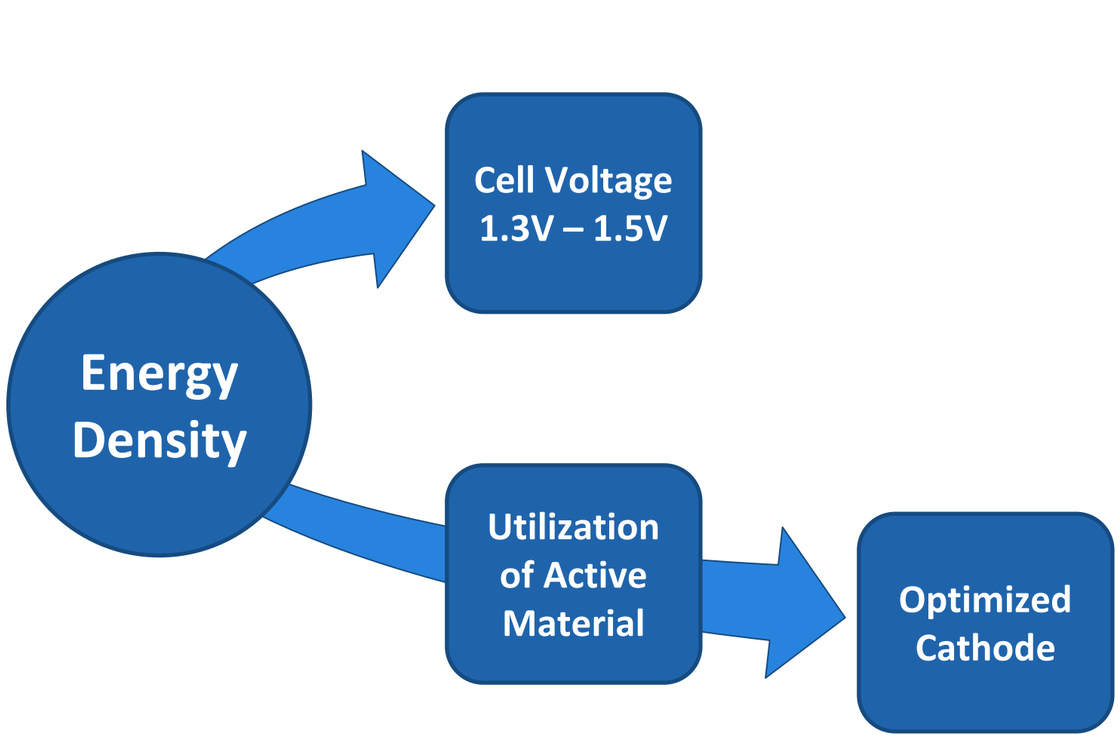
- Consumer facing energy systems (residential, commercial, etc.)
- Energy arbitrage and demand charge management for commercial and residential customers. (Tesla, Sonnen, Panasonic, LG etc.)
- Typically, 15 kWh systems for residential and between 50 kWh and multi-MWh for commercial and communities.

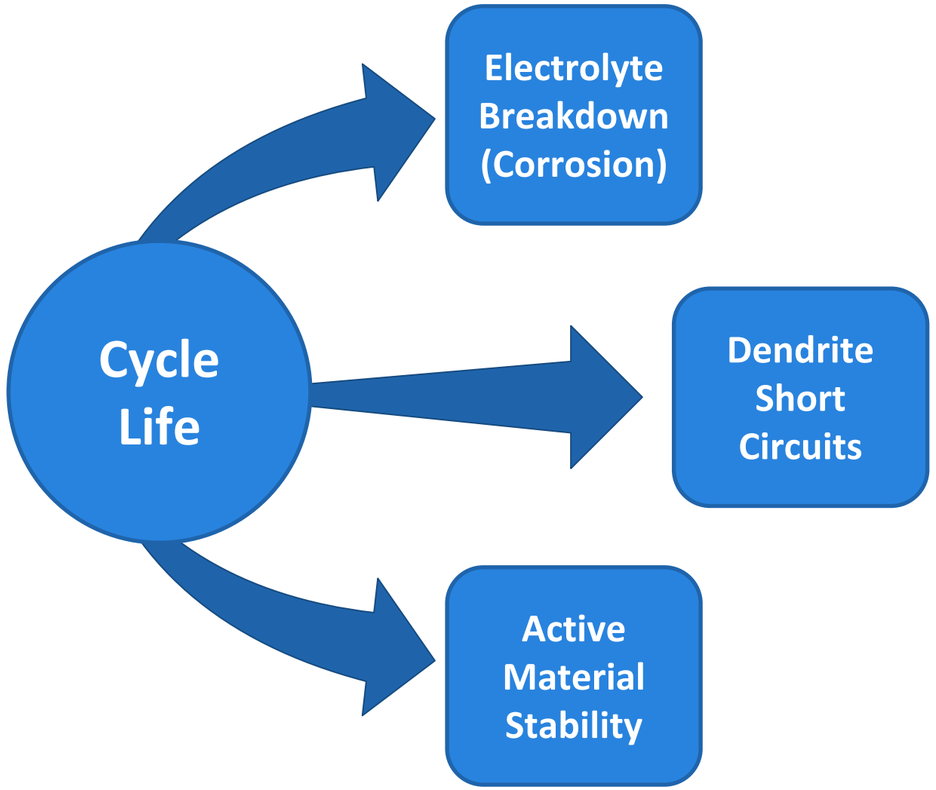
FRONT OF THE METER (FTM)

- Utility facing energy systems (large scale grid, and energy generation storage)
- Solar, wind, peak demand management for utility and independent power producing customers. (Fluence, Tesla, Powin Energy, etc.)
- Average FTM system size is about 14 MWh, up to the largest in the world at 1.6 GWh. (with plans to expand up to 3.0 GWh).

Key Areas of Development

To create a commercially successful battery technology two key ingredients are required: **Cycle Life** and **Energy Density!**



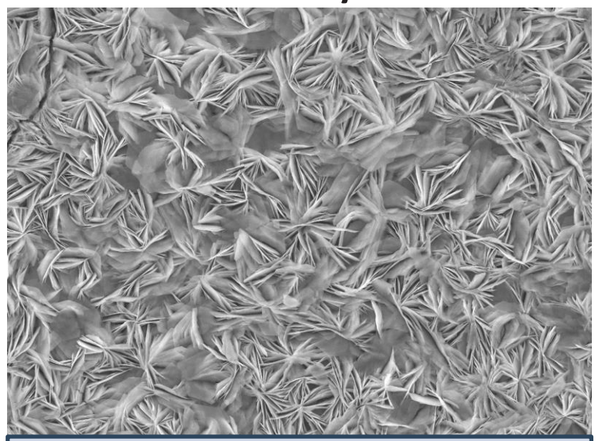


Cycle Life - Corrosion

In an aqueous system, zinc will corrode readily causing the pH of the electrolyte to increase. Electrolytes are only stable under a certain pH – when that value is exceeded byproducts form in the electrolyte insulating our electrodes and producing hydrogen gas! **Salient Energy has eliminated the effects of corrosion** preventing the insulating byproducts from forming, hence also **eliminating the resultant gassing**.

Salient's Cathode Cycling in 2022 Electrolyte

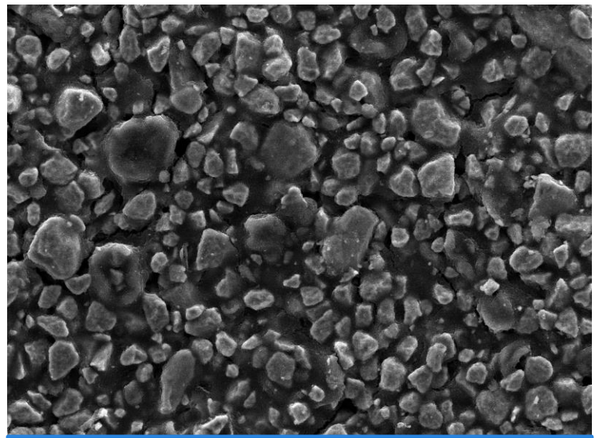
99.2% CE



Flakey ZHS insulating byproduct covers the surface

Salient's Cathode Cycling in 2023 Electrolyte

99.8% CE



No flakey byproduct observed!

Failed at 10 cycles

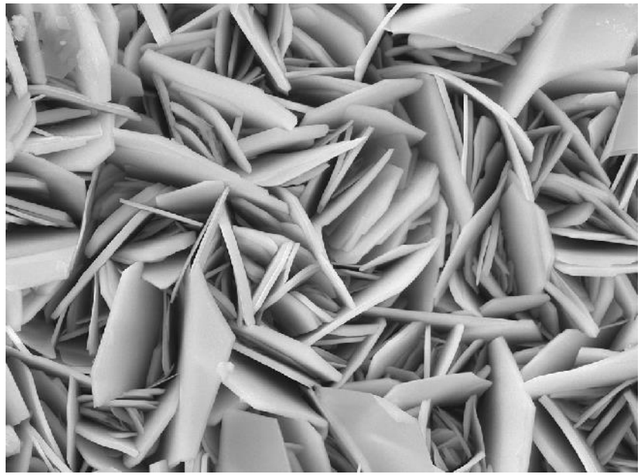
No. of Cycles	2022 Electrolyte	2023 Electrolyte
0	4.5	4.8
10	5.2	4.9
20	5.2	4.9
30	5.3	4.9
60	5.3	5
90	5.3	5
200	5.3	5.1

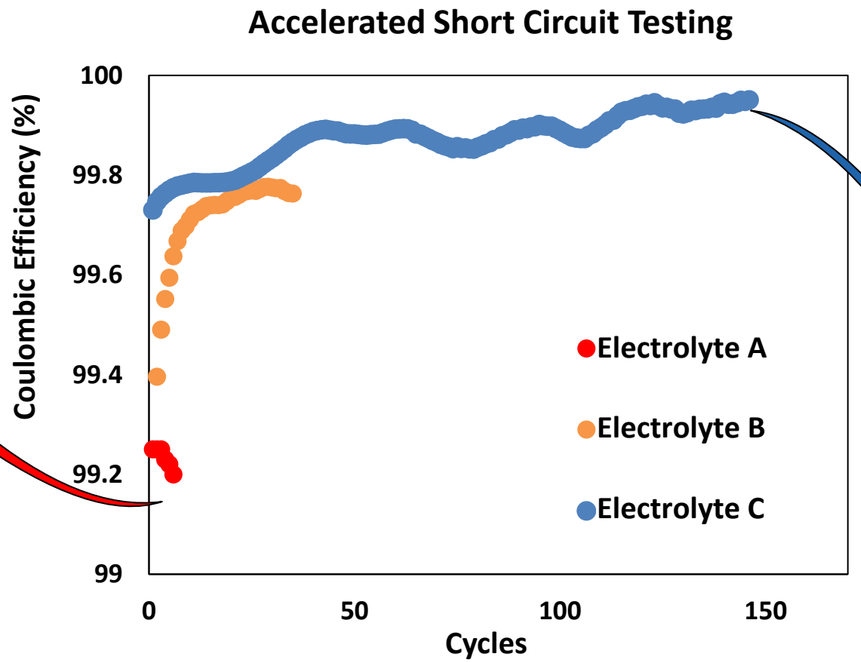
Stability to 1000 cycles

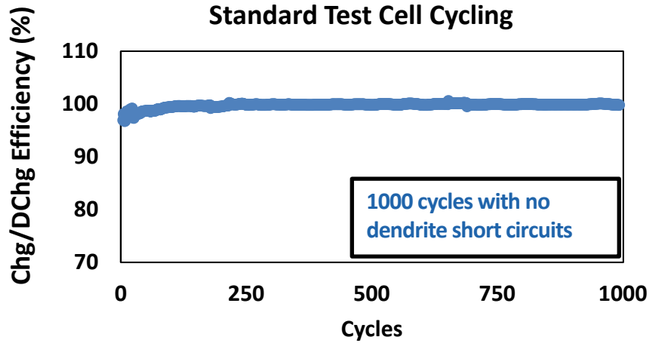
[Patent Pending, Electrolyte Additives For Zinc Metal Electrodes, US20200176198A1]

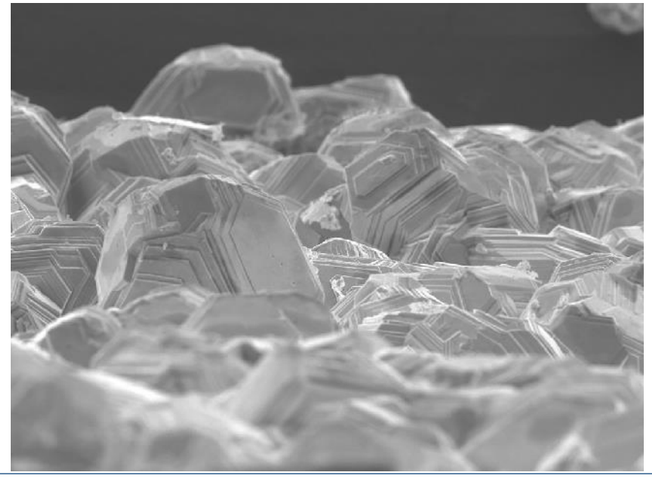
Cycle Life - Dendrites

Salient Energy has developed a **new aqueous electrolyte composition** to **prevent the formation of dendrites** in the Zn-ion battery technology. Salient has currently achieved 1000 cycles with no failures but aims to push this to 3500+









[Patent Pending, Electrolyte Additives For Zinc Metal Electrodes, US20200176198A1]

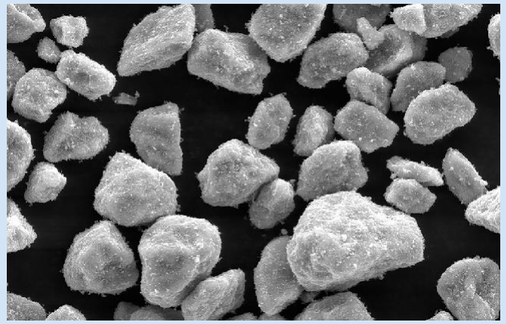
Cycle Life – Active Material Stability

To ensure active material stability **two areas of development are required**: Using **a pure MnO_2 material** with desirable specifications and **encapsulating dissolved Mn** within the cathode particles.

Salient has developed a **low-cost, scalable, synthesis method** to produce a pure and stable select phase of MnO_2 using readily available and abundant precursor materials and simple chemical reactors.

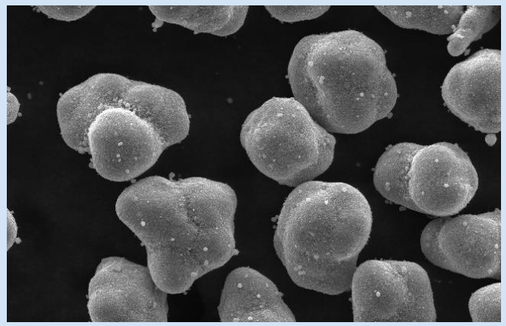
Commercial MnO_2

- Impure material
- Uncontrolled Phase
- Uncontrolled Morphology

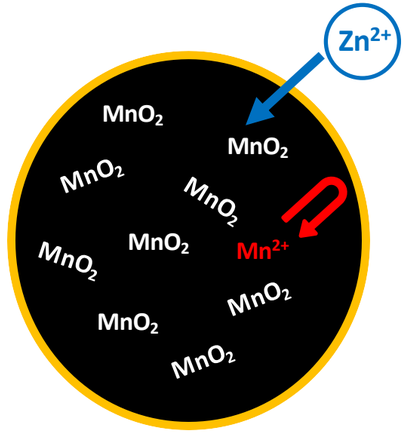


Salient's MnO_2

- >99% purity MnO_2
- Controlled Select Phase
- Desired material characteristics



Salient has developed hydrophilic polymer coatings on the surface of MnO_2 particles which **encapsulate dissolved materials** mitigating the failure mechanism known as Mn dissolution enabling long cycle life.

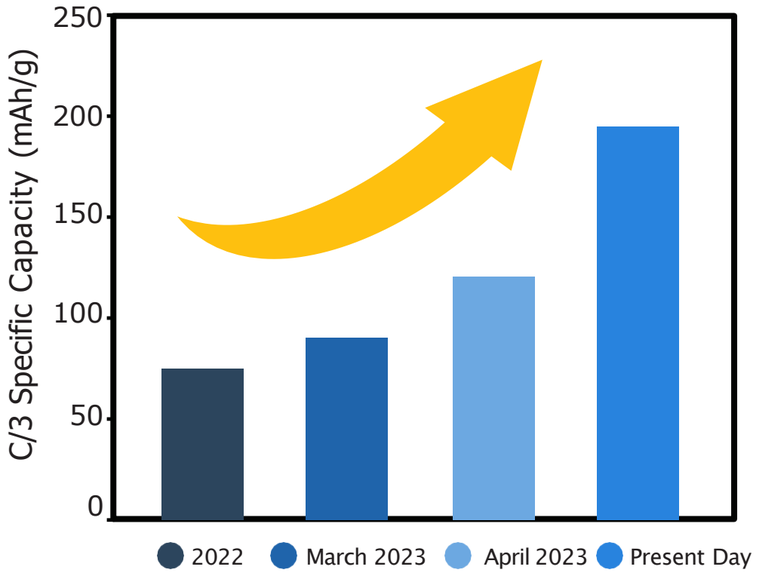


Functionalized hydrophilic polymer layer encapsulating MnO_2

[Patent Pending, Encapsulated Electroactive Materials For Use In Rechargeable Aqueous Zinc Cells and Batteries And Methods Of Preparing Encapsulated Electroactive Materials, US20220376231A1]

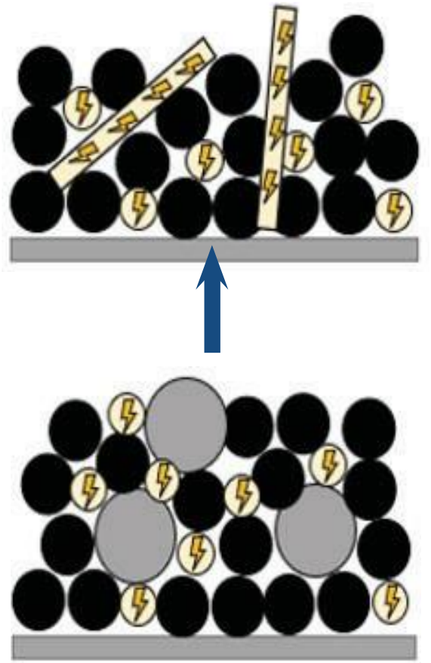
Energy Density Development

Salient has achieved a significant improvement in the specific capacity of the cathode by focusing on improving the matrix formulation, **boosting the amount of active material percentage by 25%** while increasing the active material **utilization by 150%**, exceeding our commercialization performance target. The high specific capacity of MnO_2 compensates for the low voltage of the aqueous system.



	Specific Capacity (mAh/g) at a 3hr Dchg	Utilization
Theoretical Max. for LFP (Li-ion)	170	100%
Commercial Targets (2025)	180	60%
Present Day	195	63%
April 2023	110	36%
February 2023	85	27%
January 2023	75	25%

150%



[Patent Pending, Positive Electrode Compositions And Architectures For Aqueous Rechargeable Zinc Batteries, US20230307617A1]

Thank you

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