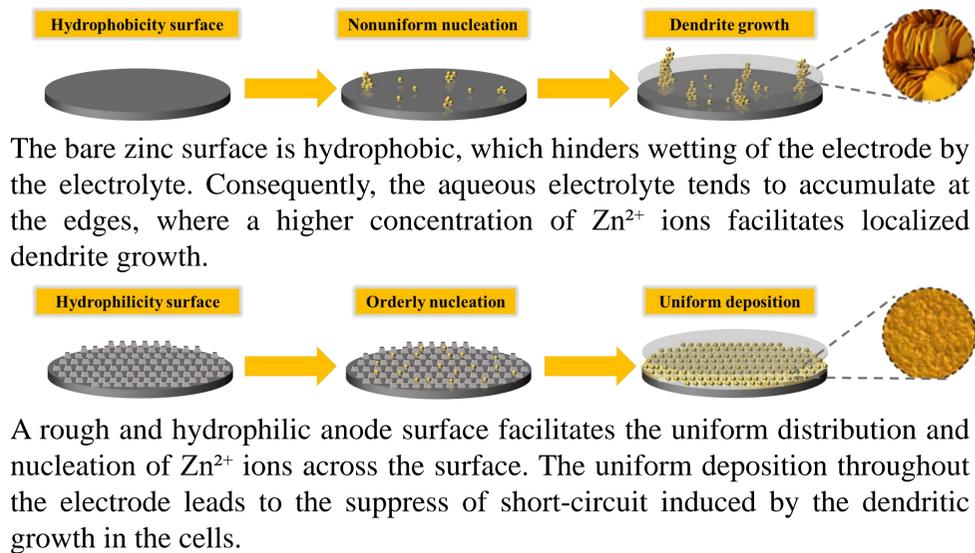


## Abstract

Aqueous zinc-ion batteries (AZIBs) are promising for large-scale energy storage due to their safety, low cost, and high energy density. However, issues such as dendrite growth, hydrogen evolution, and by-product formation at the zinc anode/electrolyte interface hinder commercialization. In this study, commercial zinc foil was subjected to low-pressure annealing using a horizontal tube furnace at 300 °C for 2 hours to modify surface microstructure. Surface and structural analysis and electrochemical testing showed that the resulting nanostructures increased surface roughness, enhancing electrolyte wettability and enabling uniform zinc-ion deposition. This suppressed dendrite formation and side reactions, thereby improving electrochemical performance and extending cycle life.

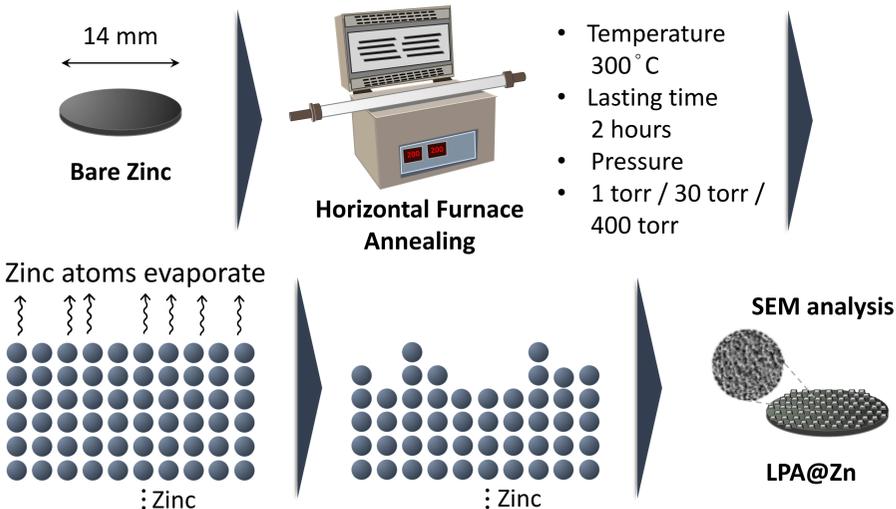
## Issue and Proposed Method



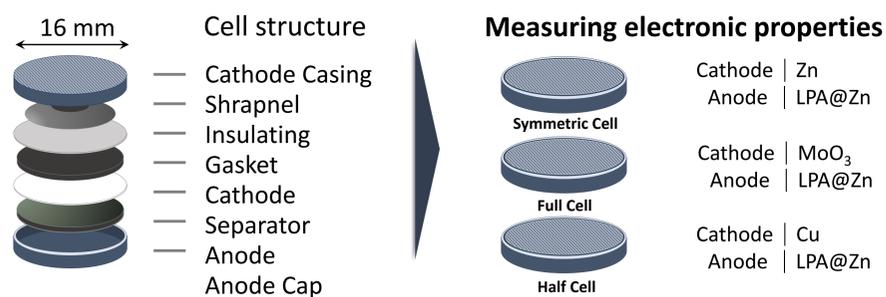
## Experimental Procedures

### I. Annealing and Low-pressure Evaporation

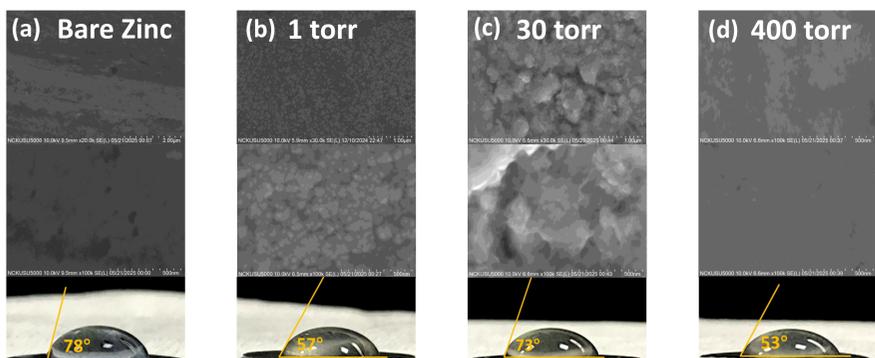
- Constructing nanostructures with a rough surface topography



### II. Cell Assembling - button cell battery

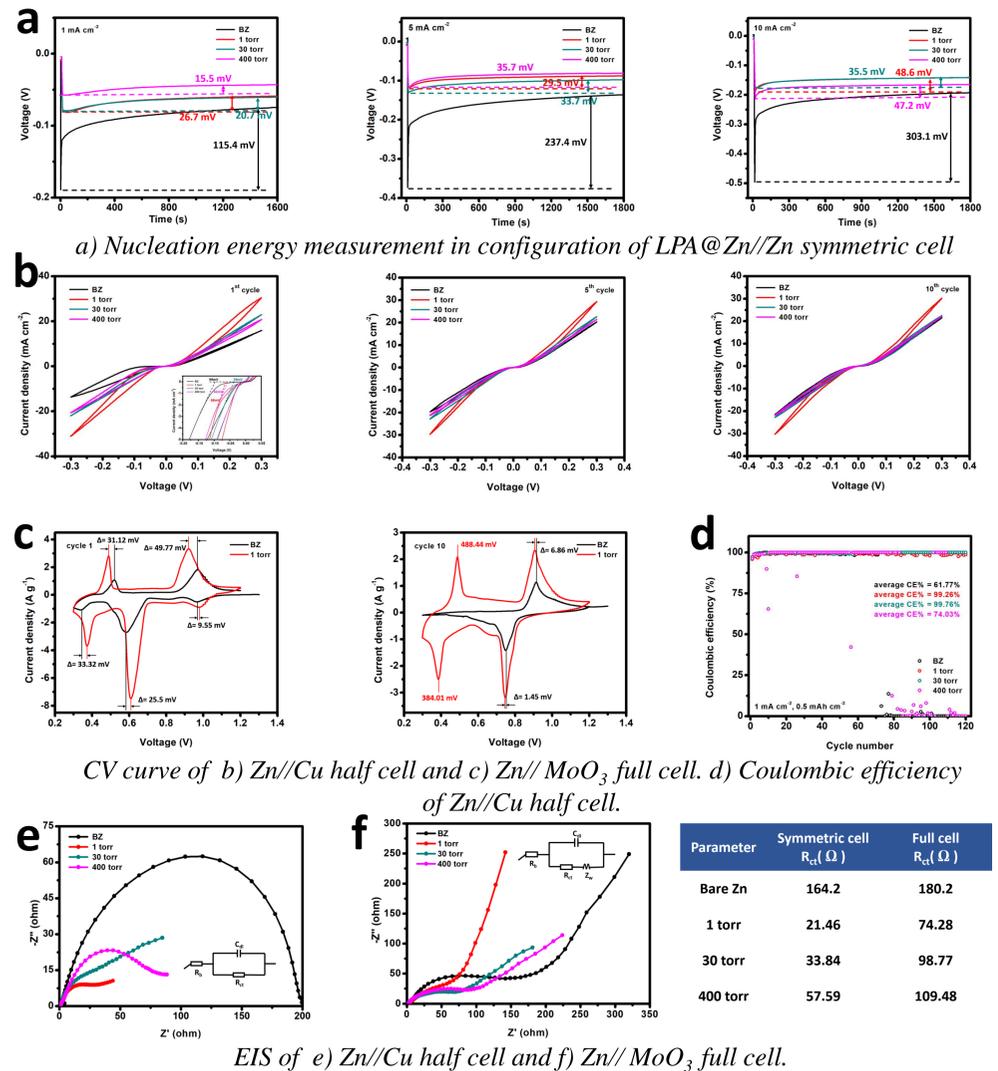


## Material Characterization

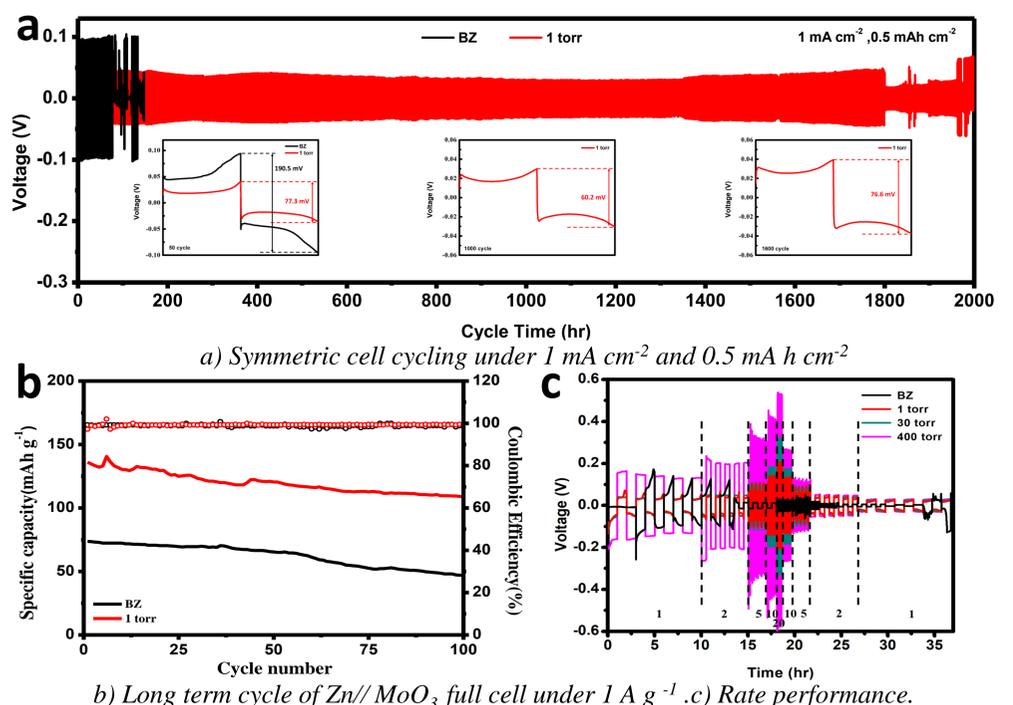


SEM images and contact angle picture of a) bare zinc b) Zn foil with treatment of annealing at 300°C for 2hr under 1 torr c) Zn foil with treatment of annealing at 300°C for 2hr under 30 torr d) Zn foil with treatment of annealing at 300°C for 2hr under 400 torr.

## Electrochemical Test



## Cycling Test



## Conclusion

We successfully induced nanostructure formation on zinc anodes through low-pressure annealing, effectively enhancing surface roughness and thereby promoting the wettability of the electrode surface by the electrolyte, achieving uniform deposition of zinc ions. LPA@Zn under 1 torr exhibited optimal performance, demonstrating a lower nucleation overpotential and charge transfer resistance, thus extending cycle life and improving electrochemical performance.