

## Supporting Information

### Multifunctional phenylalanine additive stabilizing zinc anode in aqueous zinc ion batteries

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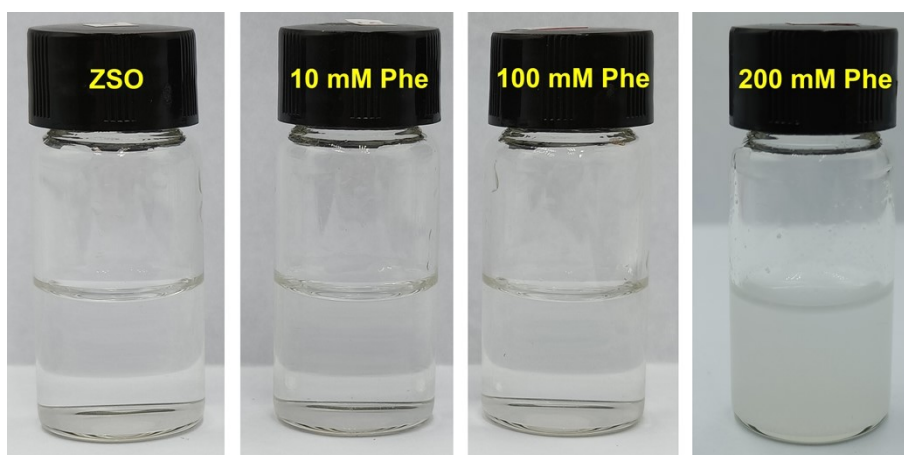


Figure S1. Photographs of ZSO and Phe electrolytes

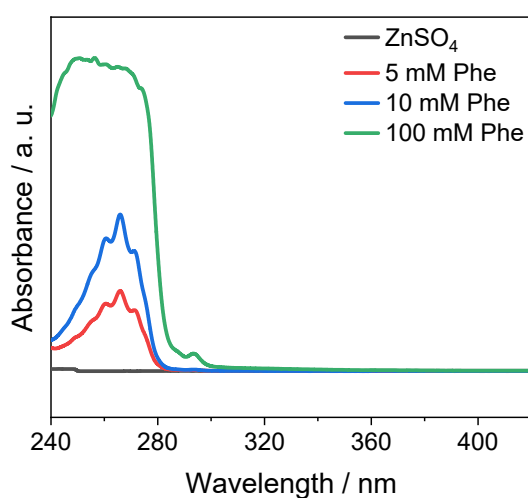


Figure S2. UV-vis spectra of ZSO and Phe electrolytes

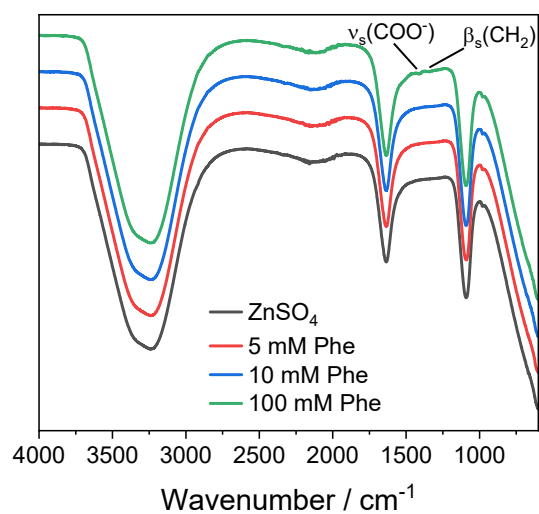


Figure S3. FT-IR spectra of ZSO and Phe electrolytes

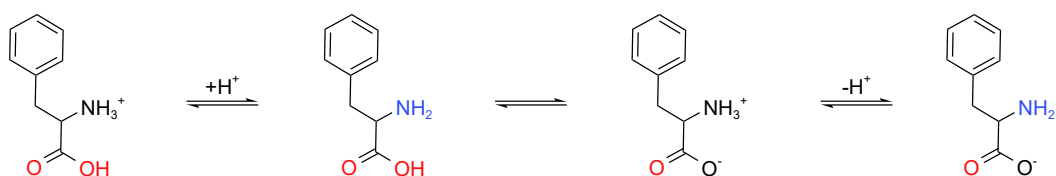


Figure S4. Acid-base equilibria of Phe

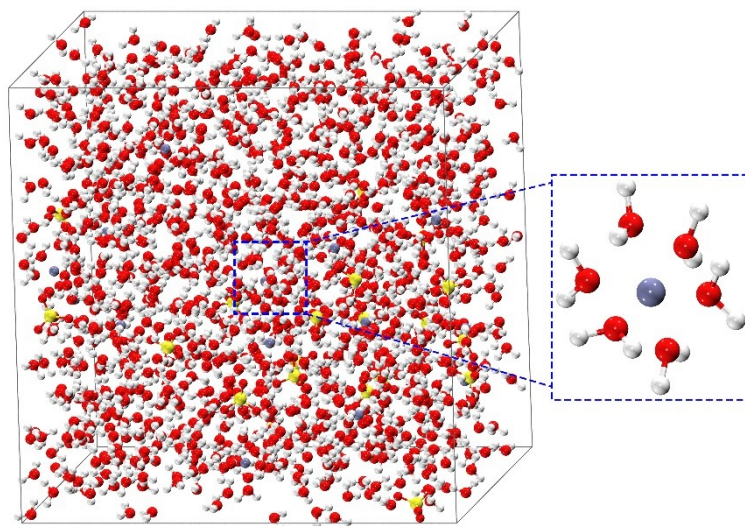


Figure S5. MD snapshot of 1 M ZSO electrolyte and the amplified view of Zn<sup>2+</sup> solvation structure

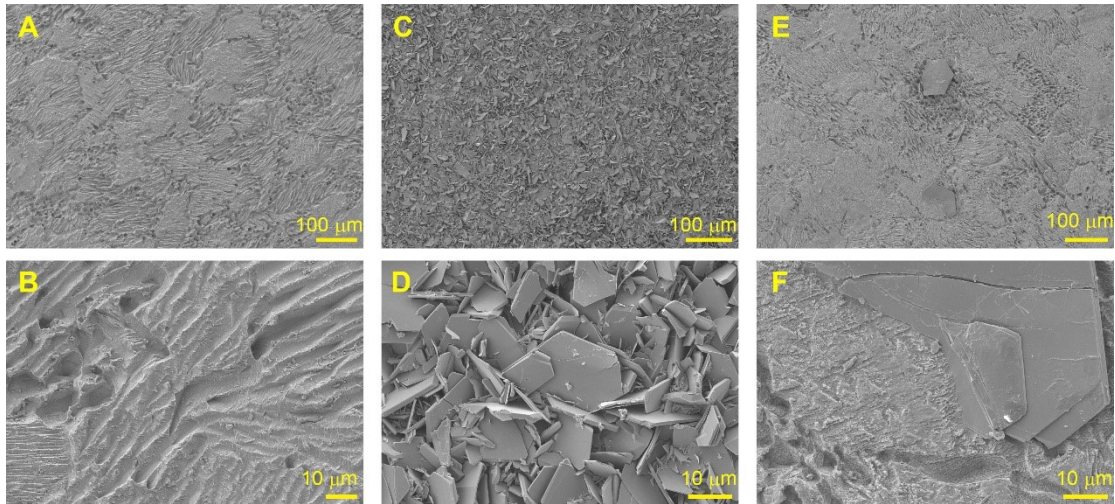


Figure S6. SEM images of (A-B) pre-treated Zn anodes and these anodes after immersed in (C-D) ZSO and (E-F) Phe electrolytes for 5 days

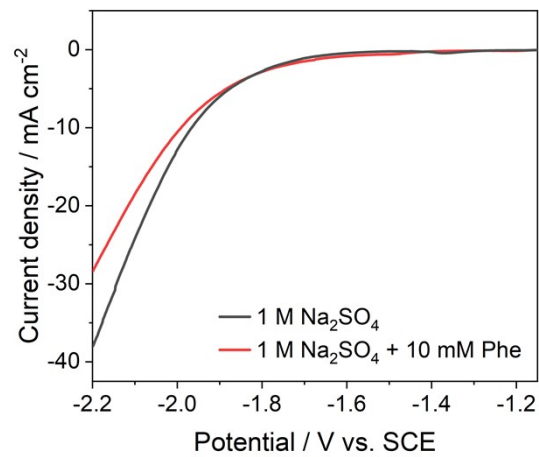


Figure S7. The linear polarization curves of Zn electrodes in 1 M Na<sub>2</sub>SO<sub>4</sub> solution with the absence and presence of 10 mM Phe

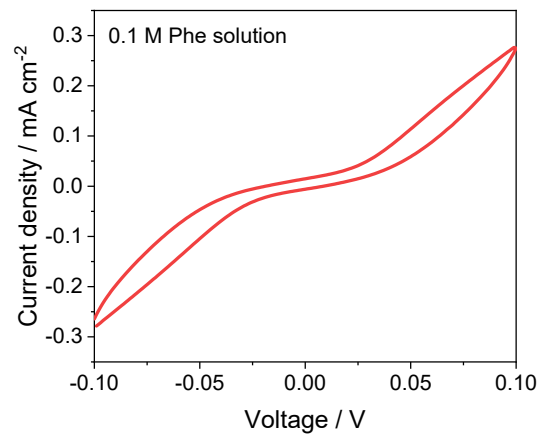


Figure S8. CV curve of pure Phe electrolyte in Zn/Zn symmetric battery

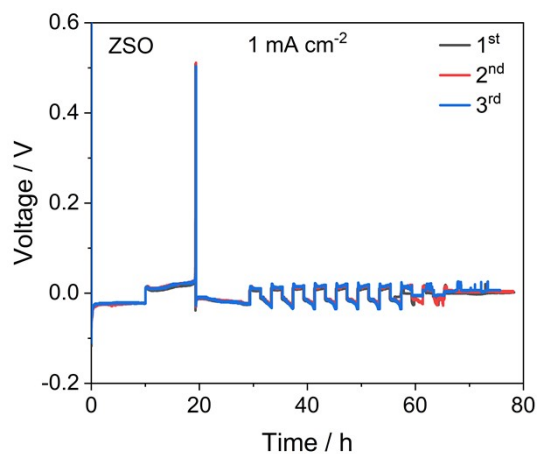


Figure S9. Galvanostatic measurements of Cu/Zn cell with the ZSO electrolyte

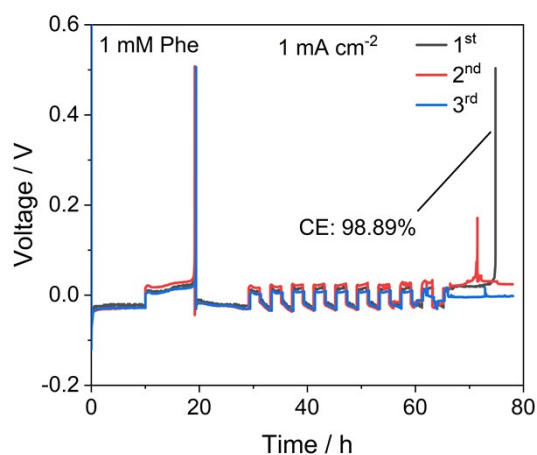


Figure S10. Galvanostatic measurements of Cu/Zn cell with the 1 mM Phe electrolyte

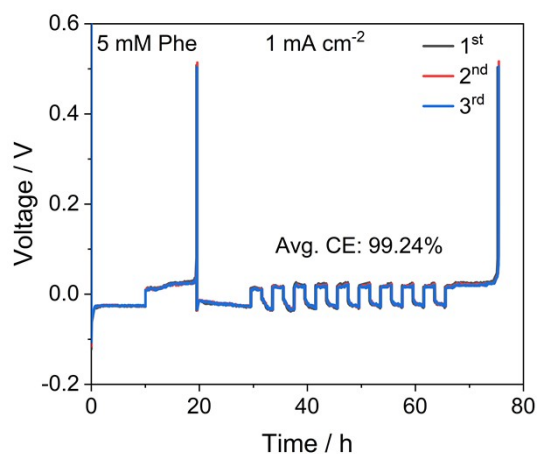


Figure S11. Galvanostatic measurements of Cu/Zn cell with the 5 mM Phe electrolyte

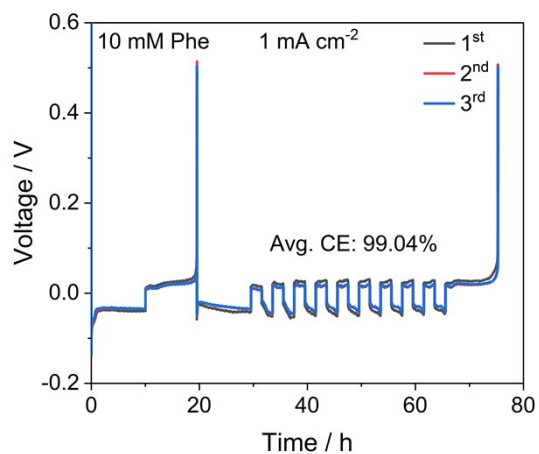


Figure S12. Galvanostatic measurements of Cu/Zn cell with the 10 mM Phe electrolyte

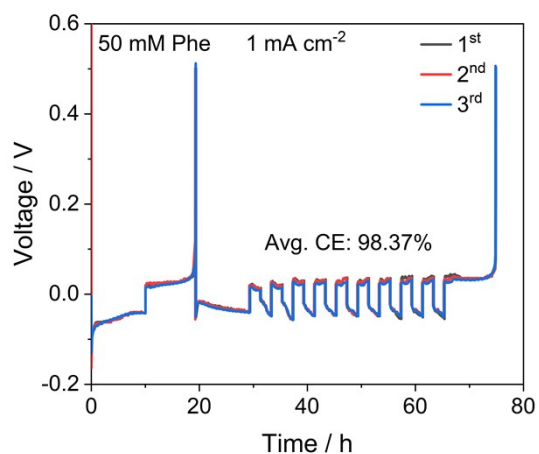


Figure S13. Galvanostatic measurements of Cu/Zn cell with the 50 mM Phe electrolyte

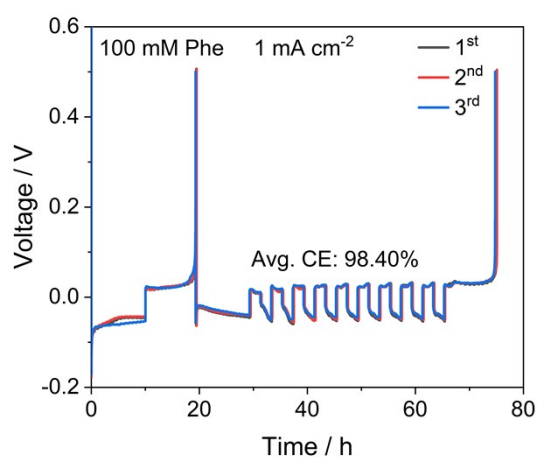


Figure S14. Galvanostatic measurements of Cu/Zn cell with the 100 mM Phe electrolyte

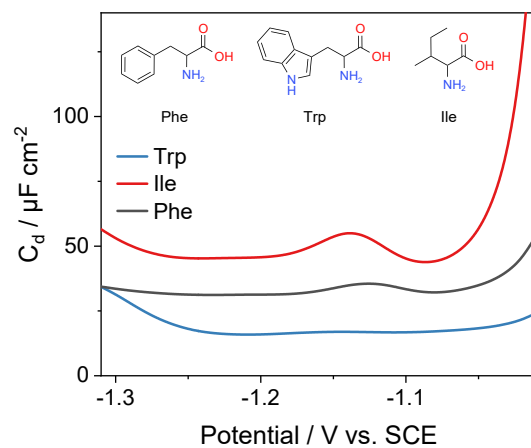


Figure S15. Differential capacitance of Zn anode in  $\text{Na}_2\text{SO}_4$  electrolyte with 10 mM different additives

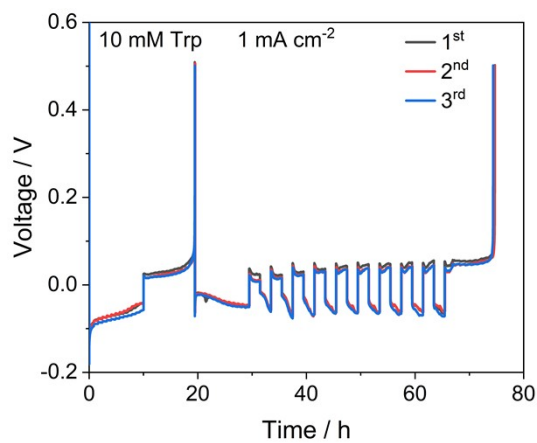


Figure S16. Galvanostatic measurements of Cu/Zn cell with the 10 mM Trp electrolyte

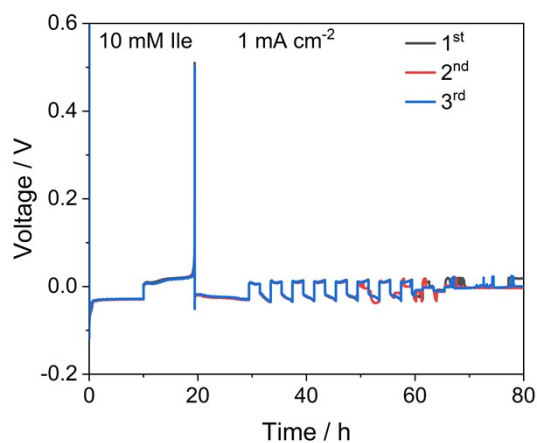


Figure S17. Galvanostatic measurements of Cu/Zn cell with the 10 mM Ile electrolyte

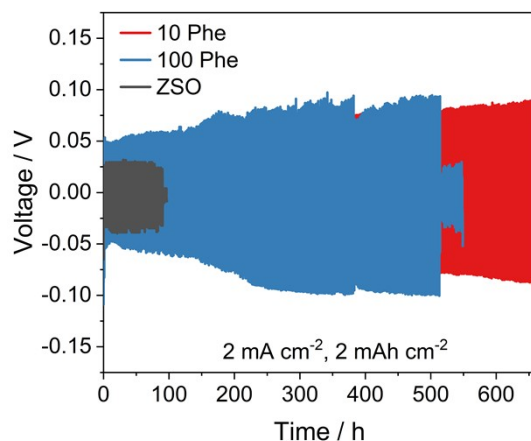


Figure S18. Galvanostatic cycling of Zn/Zn cell with different electrolytes at  $2 \text{ mA} \cdot \text{cm}^{-2}$  and  $2 \text{ mAh} \cdot \text{cm}^{-2}$

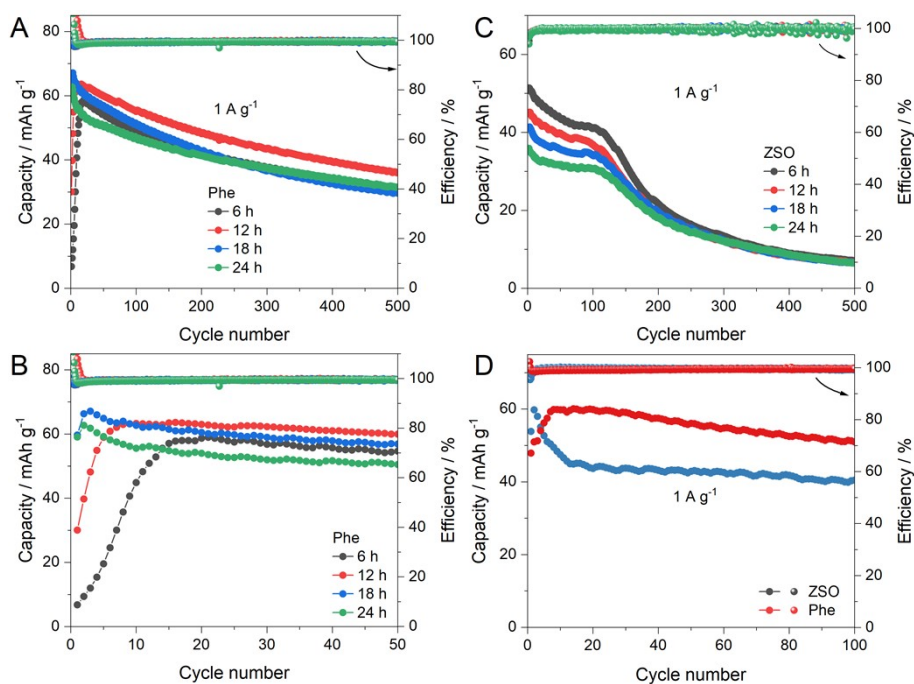


Figure S19. (A-C) Cycle performance of the ZnHCF/Zn full cells with (A-B) Phe and (C) ZSO electrolytes after different relax timescale; (B) the enlarged view of (A); (D) cycle performance of full cells using commercial separators (NKK, MPF-30AC)