

## Supporting information

### Employing **a** chelating agent as electrolyte additive with synergistic effects **yields** highly reversible zinc metal anodes

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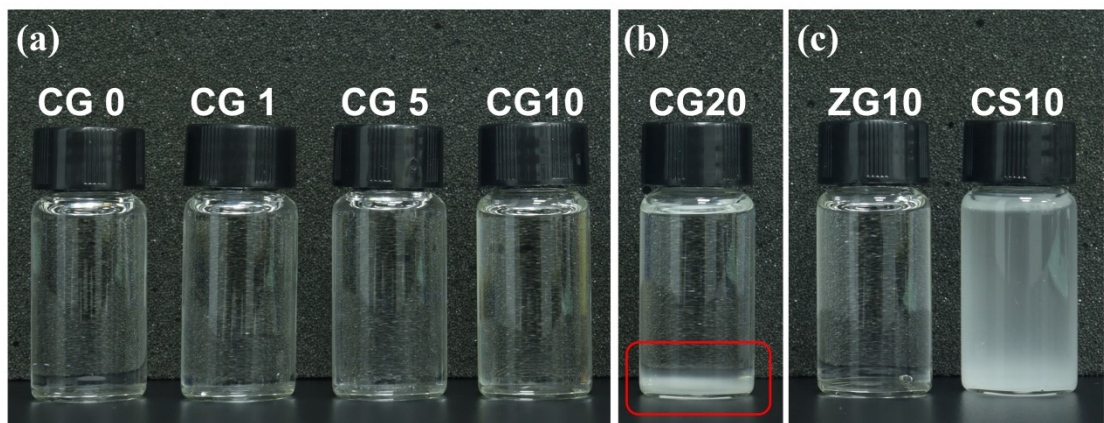


Figure S1. Digital photographs of electrolytes with different concentrations of CG additive (a) CG0, CG1, CG5, CG10; (b) CG20; (c) Digital photographs of electrolyte with 10 mM zinc gluconate (ZG10) additive and 10 mM calcium sulfate (ZS10) additive.

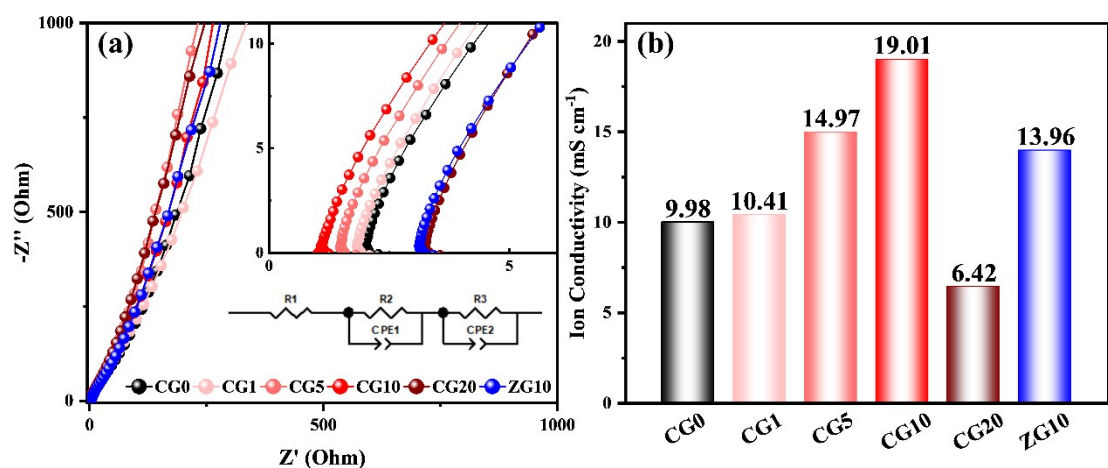


Figure S2. (a) Comparison of Nyquist plots (the equivalent circuit is inserted) and (b) the ion conductivity of SS//SS symmetric cells with different electrolyte systems.

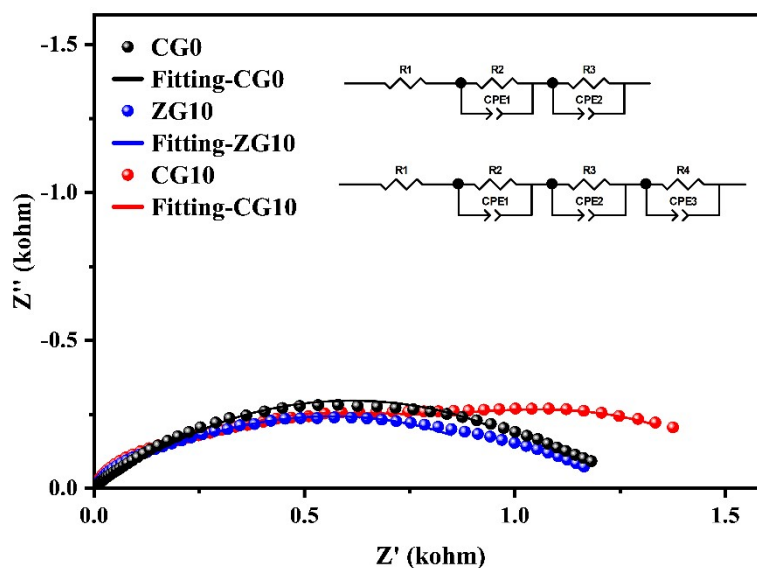


Figure S3. Comparison of Nyquist plots (the equivalent circuit is inserted) and the fitting results of Zn//Zn symmetric cells with different electrolyte systems.

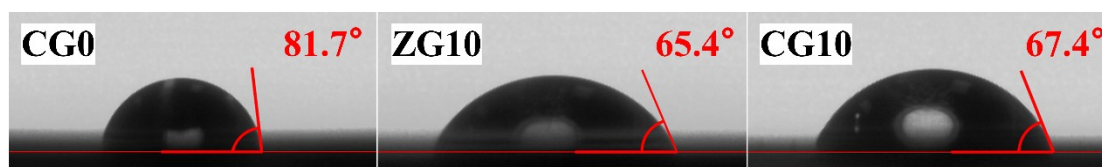


Figure S4. Comparison of contact angle results on polished Zn surface with different electrolytes.

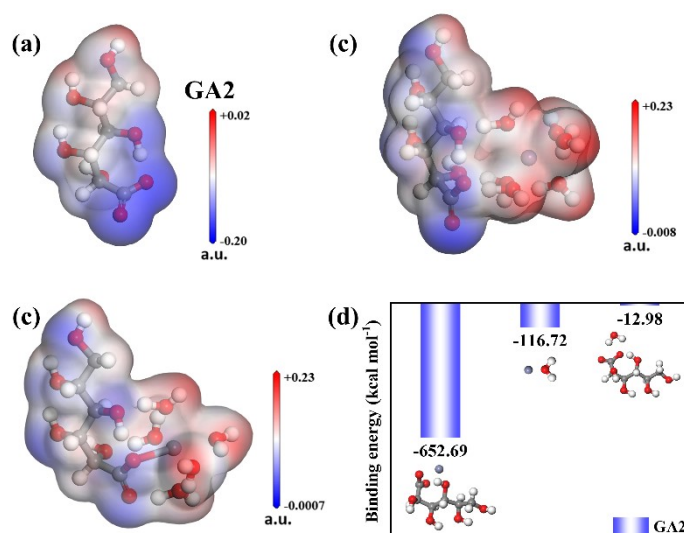


Figure S5. Electrostatic distribution mappings of (a) GA2, (b) GA2-Zn<sup>2+</sup>(H<sub>2</sub>O)<sub>6</sub> and (c) GA2-Zn<sup>2+</sup>(H<sub>2</sub>O)<sub>5</sub>; (d) the binding energy of GA2-Zn<sup>2+</sup>, H<sub>2</sub>O-Zn<sup>2+</sup> and GA2-H<sub>2</sub>O.

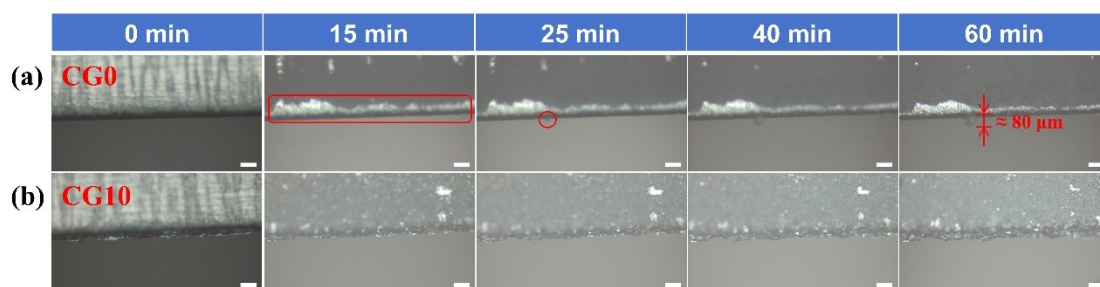


Figure S6. The optical microscope images of Zn electrode in (a) CG0 and (b) CG10 electrolytes at different zinc electrodeposition time at a current density of  $20.0 \text{ mA cm}^{-2}$ .

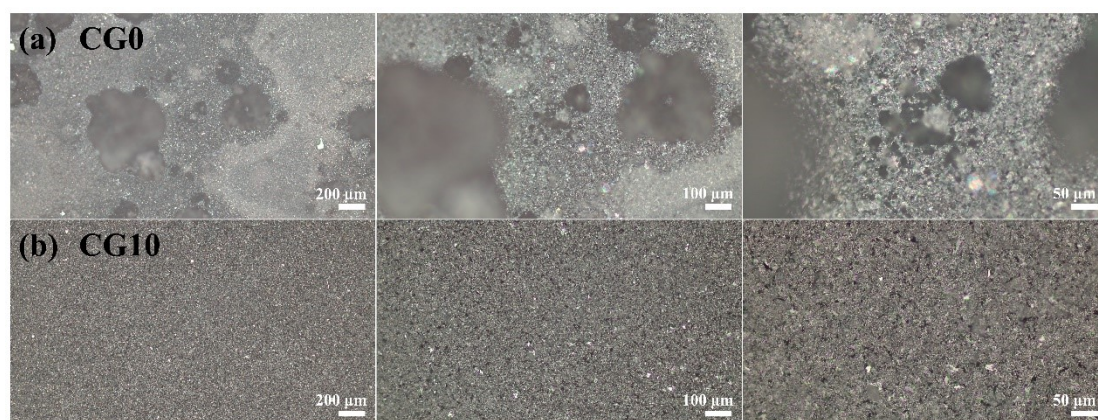


Figure S7. The optical microscope images of Zn electrode in CG0 and CG10 electrolytes after deposition for 1 h.

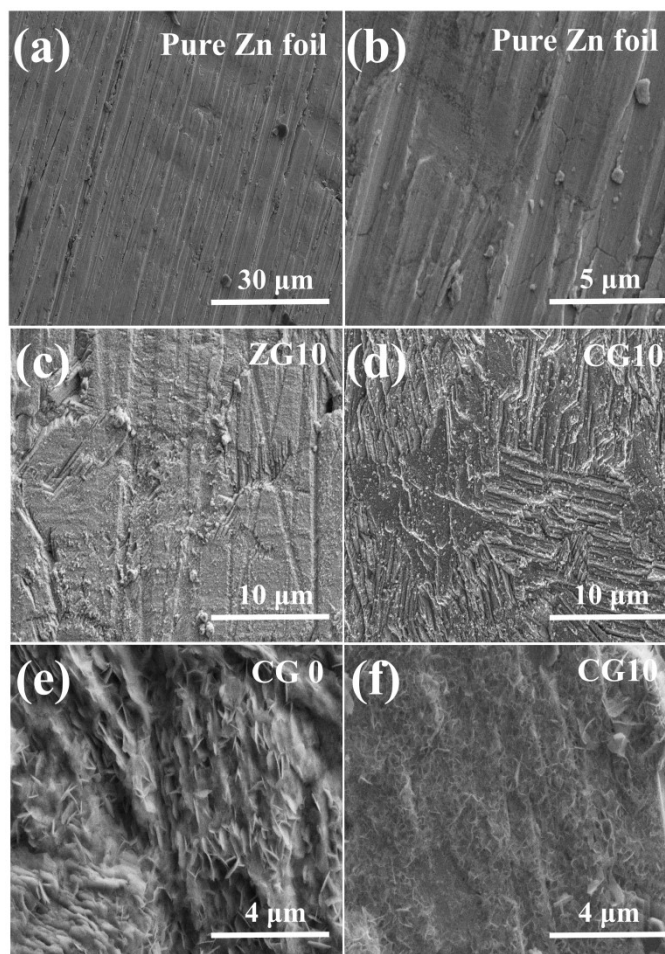


Figure S8. The SEM images of (a, b) pure Zn foil, Zn foils after the first deposition in (c) ZG10 and (d) CG10, and after stripping in (e) CG0 and (f) CG10 electrolyte.

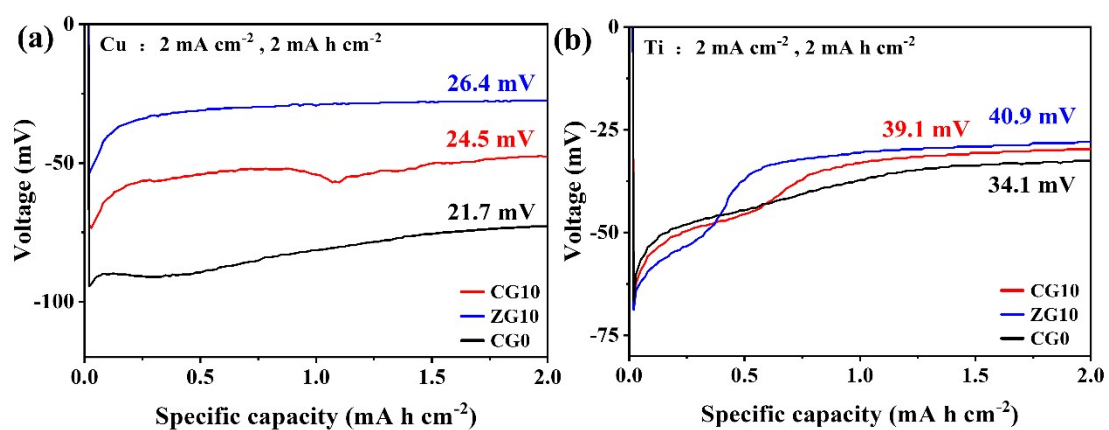


Figure S9. Comparative plots of nucleation overpotential of (a) Zn//Cu and (b) Zn//Ti half-cells in different electrolytes at  $2 \text{ mA cm}^{-2}$ ,  $2 \text{ mA h cm}^{-2}$ .

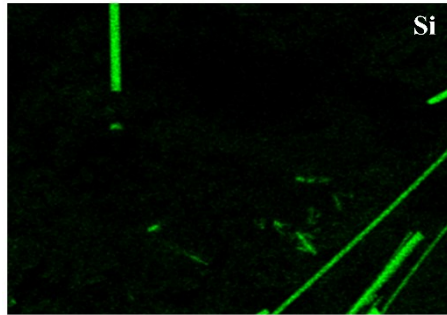


Figure S10. The EDS image of Zn anode in CG10 electrolyte after cycling for 100 cycles under 6.37 mA cm<sup>-2</sup>, 2.88 mA h cm<sup>-2</sup>.

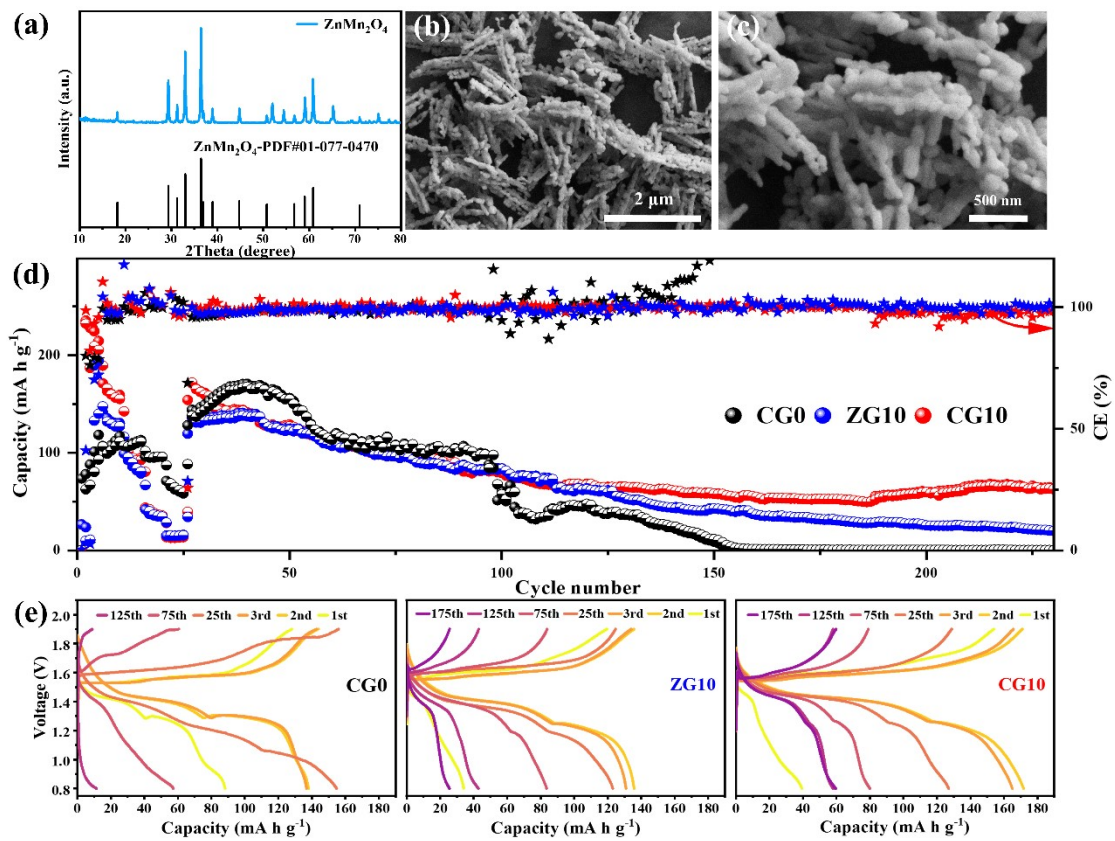


Figure S11. (a) XRD pattern and (b), (c) SEM images of ZnMn<sub>2</sub>O<sub>4</sub>. (d) The rate and cycling stability performance of Zn//ZnMn<sub>2</sub>O<sub>4</sub> full cells with different electrolyte; (e) The corresponding voltage profiles of cycling test.

Table S1. Fitting results of Zn//Zn symmetric cells based on CG0, ZG10 and CG10 electrolyte.

	R1 (ohm)	R2 (ohm)	R3 (ohm)	R4 (ohm)
CG0	5.22	44.95	990.9	
ZG10	4.704	111.0	859.9	
CG10	1.768	168.9	553.6	867.2