Supporting information for

Synergistic Modulation of Desolvation Kinetics and Zn^{2+} Flux in Dual-Biopolymer Interface for Stable Zinc Anode

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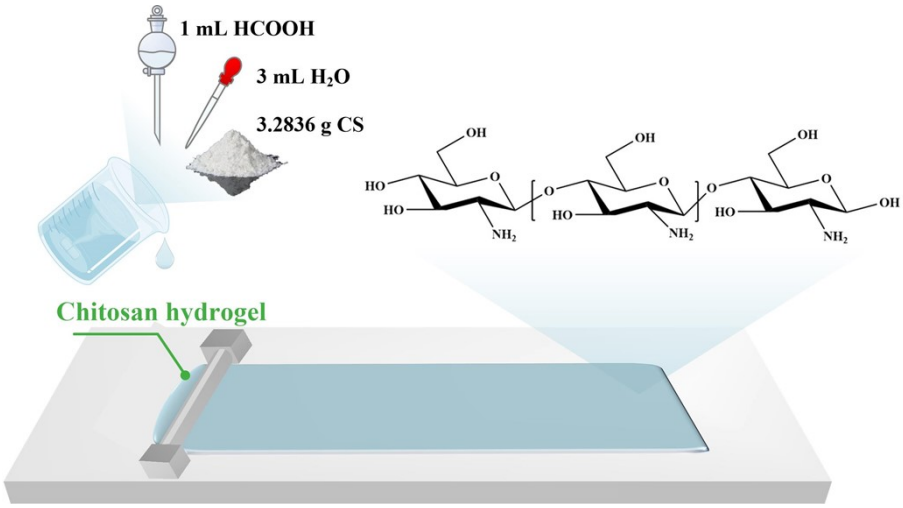

Fig. S1 Preparation diagram of Zn@CS.

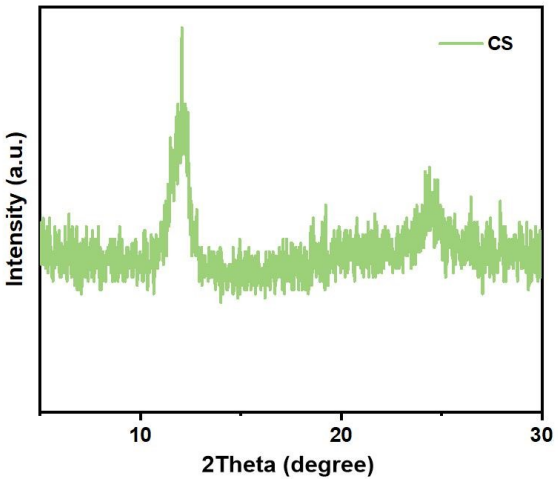

Fig. S2 XRD of chitosan powder.

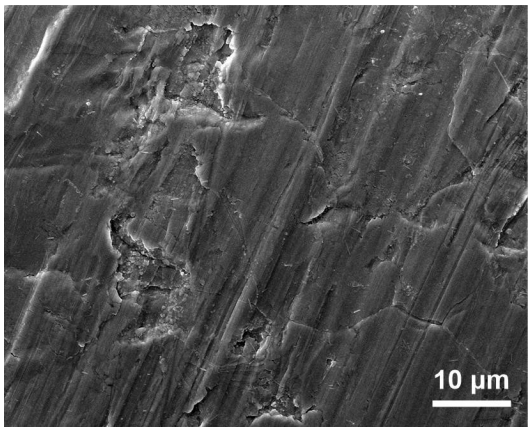

Fig. S3 SEM image of bare Zn.

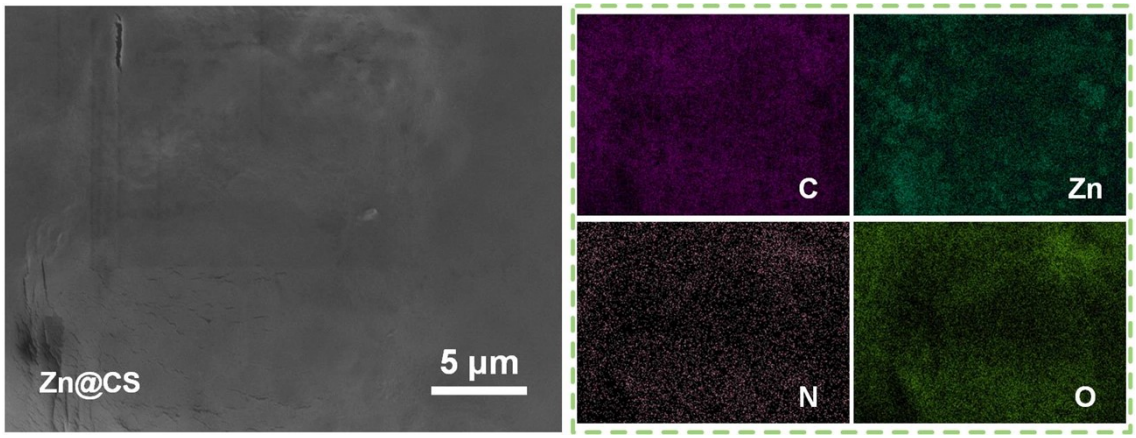

Fig. S4 SEM and EDS spectra of Zn@CS.

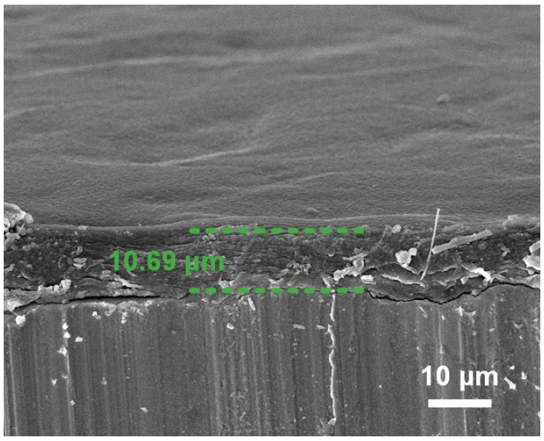

Fig. S5 Cross-sectional SEM image of Zn@CS anode.

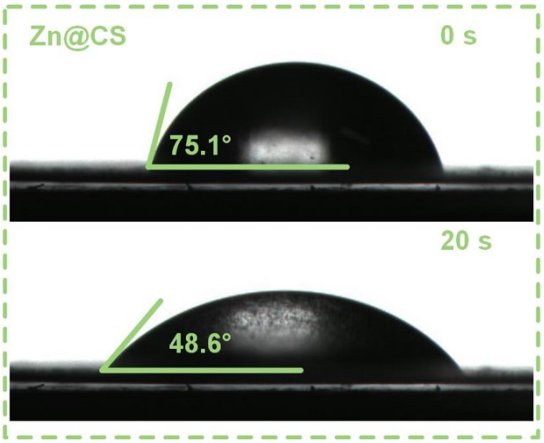

Fig. S6 Contact angle images of Zn@CS (0 s and 20 s).

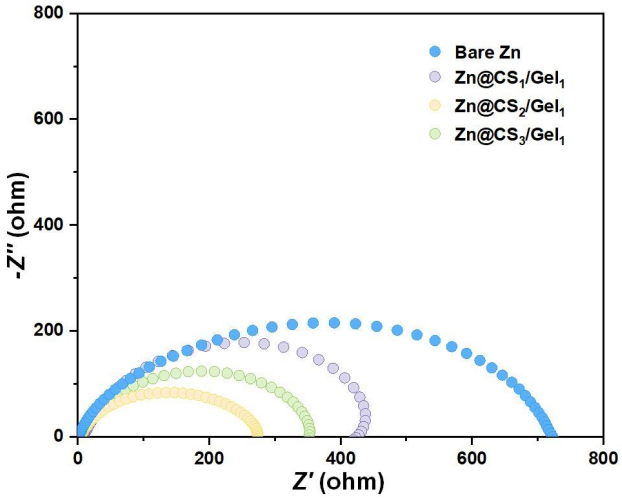

Fig. S7 EIS curves of symmetric cells with $Zn@CS_1/Gel_1$, $Zn@CS_2/Gel_1$, and $Zn@CS_3/Gel_1$.

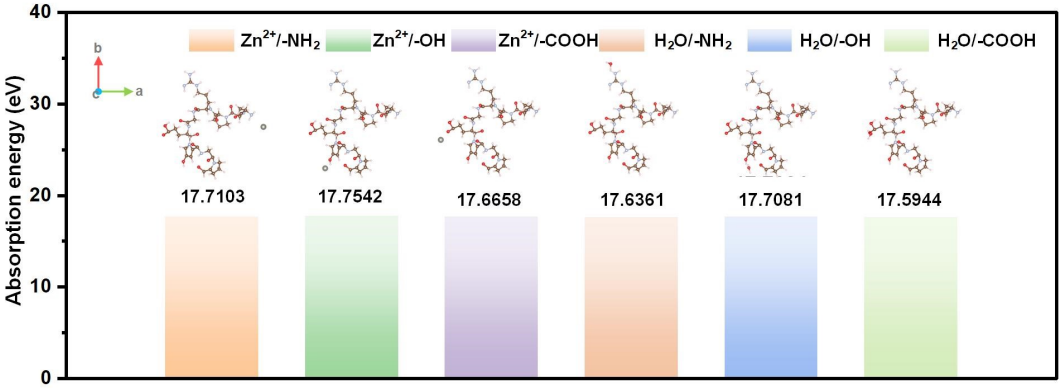

Fig. S8 Binding energy of Zn^{2+} and H_2O with $–NH_2$, –OH and –COOH in gelatin.

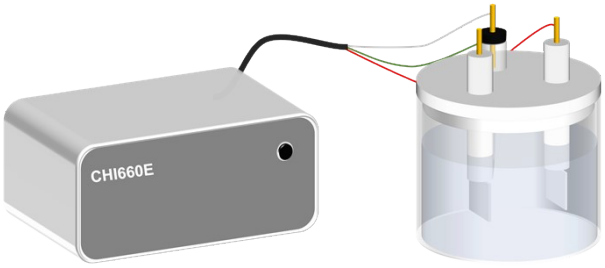

Fig. S9 Schematic representation of the three-electrode system. Different anode materials (bare Zn, Zn@CS, or Zn@CS/Gel) served as working electrodes, with Pt foil as the counter electrode and saturated calomel electrode as the reference electrode.

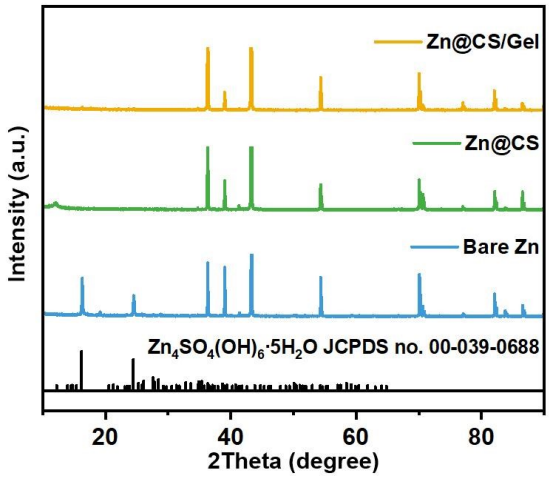

Fig. S10 XRD spectra of three electrodes soaked for 5 days.

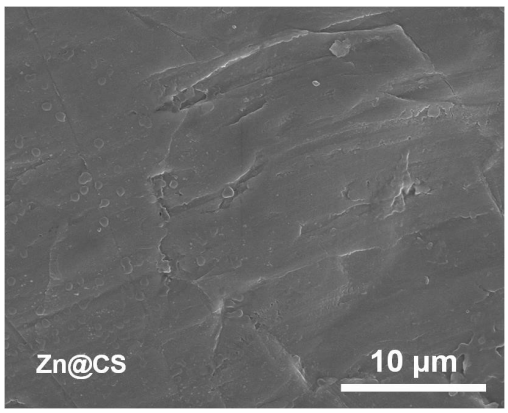

Fig. S11 The SEM of Zn@CS soaked for 7 days.

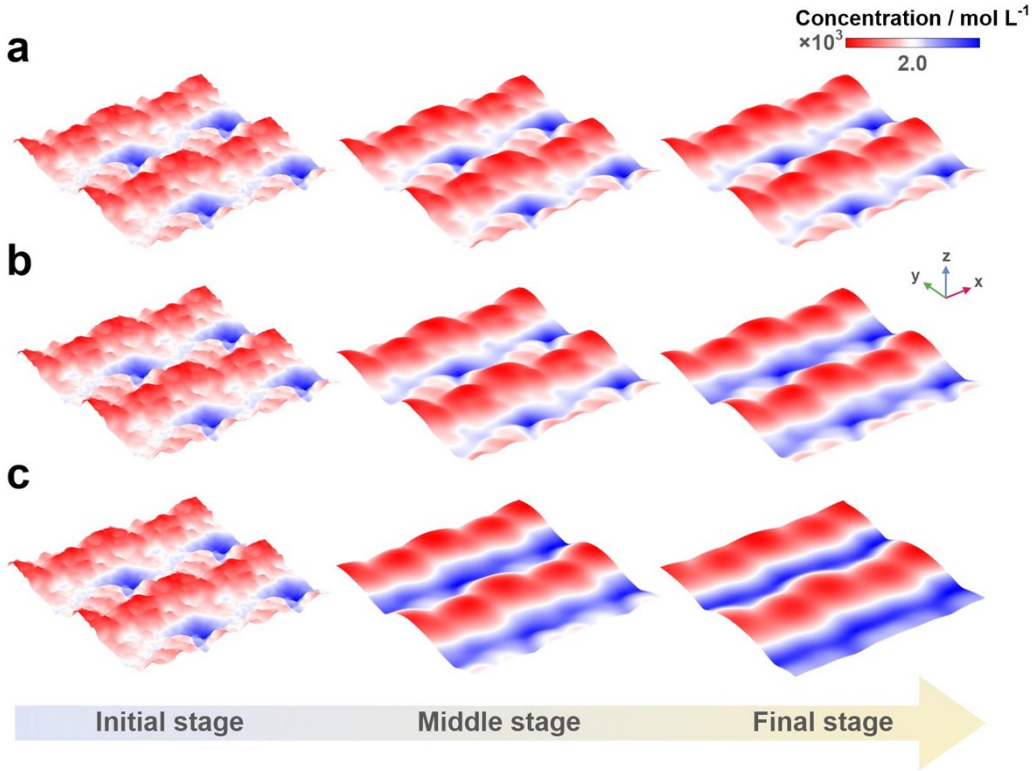

Fig. S12 Distribution of Zn-ion concentration on the surface of (a) bare Zn, (b) Zn@CS, and (c) Zn@CS/Gel at different stage.

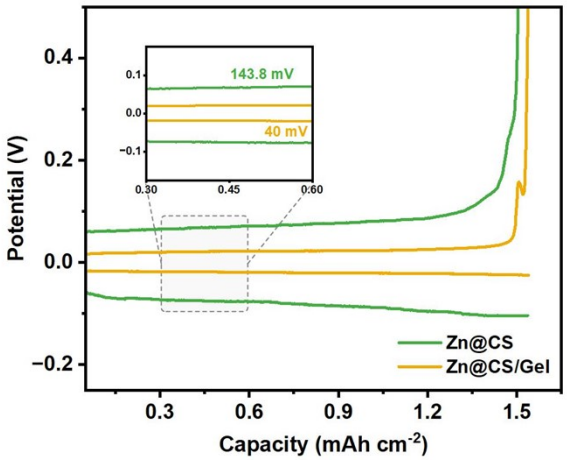

Fig. S13 Corresponding plating/stripping profiles of Zn@CS||Cu and Zn@CS/Gel||Cu cells at the 100th cycle.

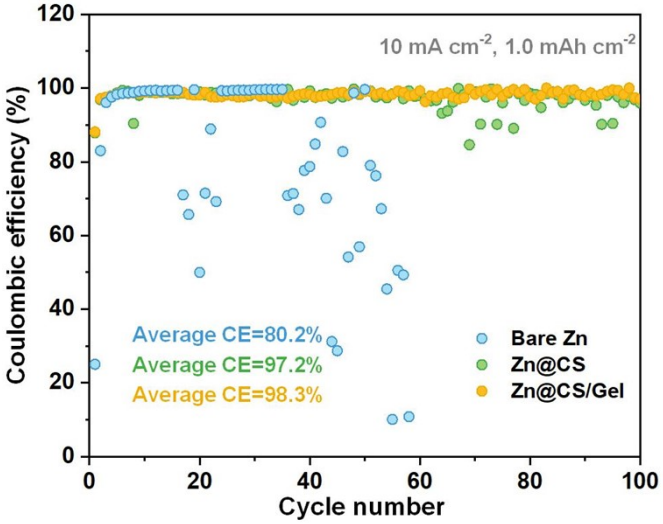

Fig. S14 The CE performance of Zn||Cu batteries at high current density.

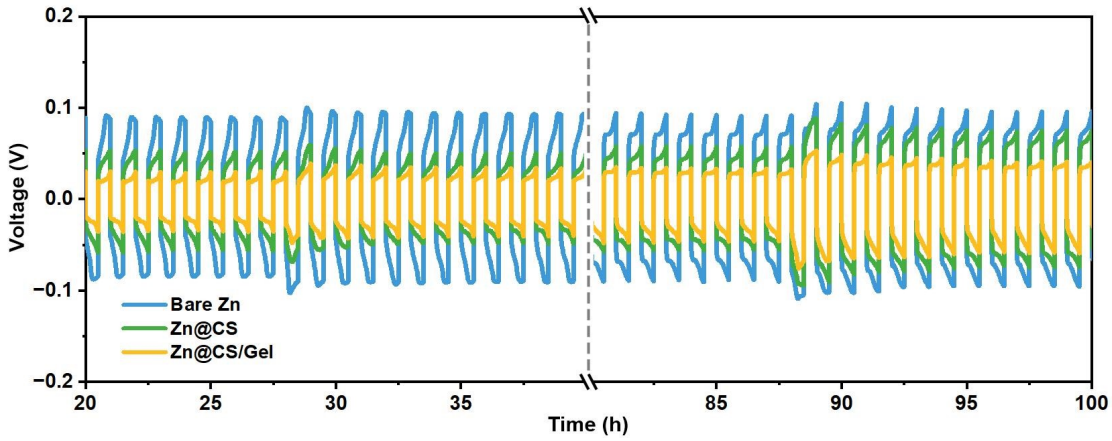

Fig. S15 The enlarged voltage curves of three symmetric cells' rate performances at different cycles.

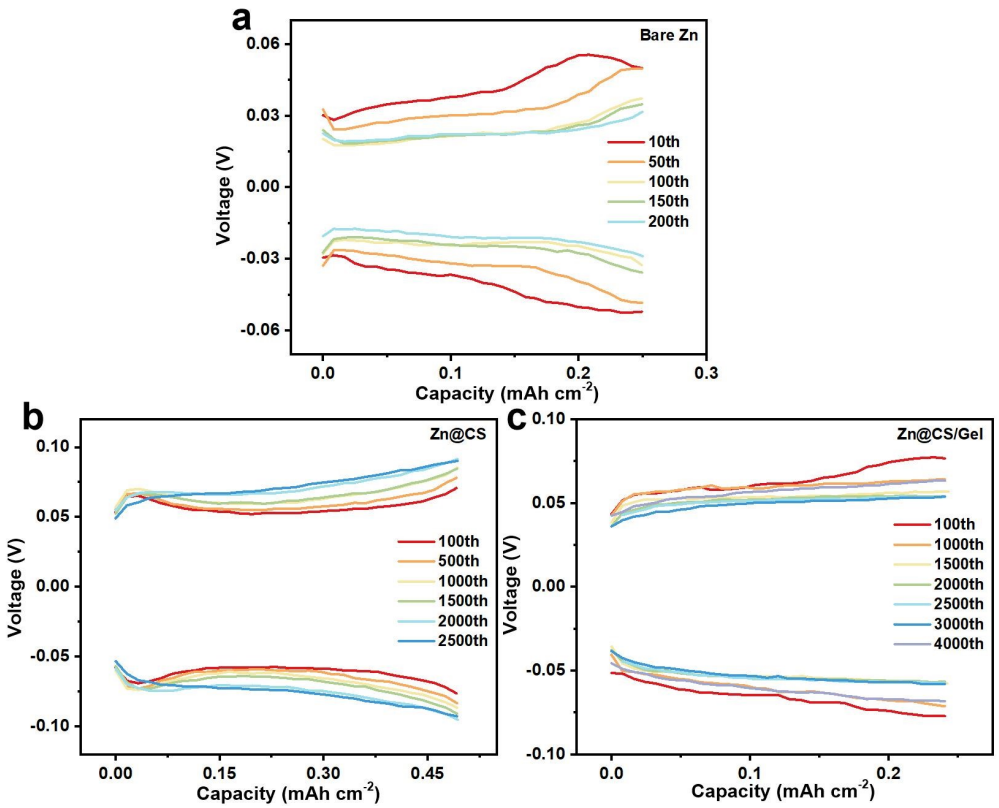

Fig. S16 Voltage gap of (a) Bare Zn||Bare Zn, (b) Zn@CS||Zn@CS, and (c) Zn@CS/Gel||Zn@CS/Gel symmetric cells at 0.5 mA cm^{-2} for 0.25 mAh cm^{-2}.

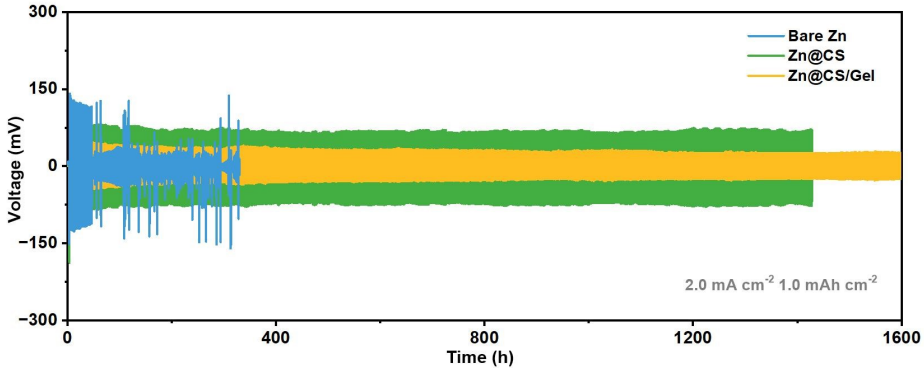

Fig. S17 Cycling performance of symmetric cells at 2.0 mA cm^{-2} and 1.0 mAh cm^{-2}.

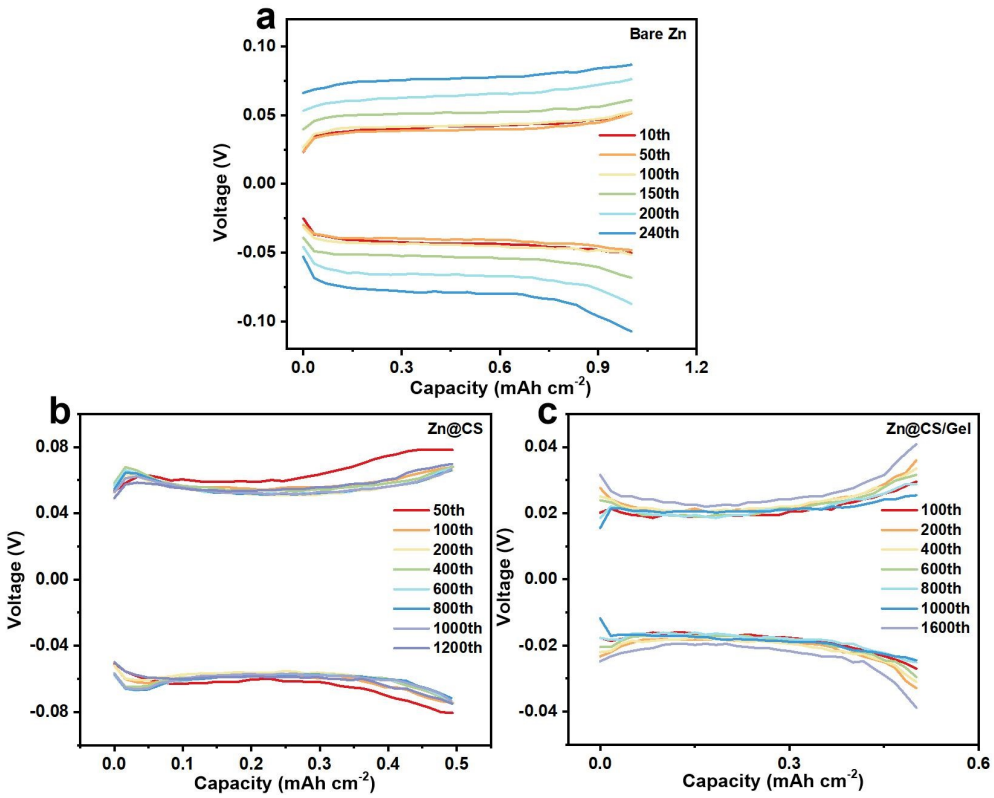

Fig. S18 Voltage gap of (a) Bare Zn||Bare Zn, (b) Zn@CS||Zn@CS, and (c) Zn@CS/Gel||Zn@CS/Gel symmetric cells at 2.0 mA cm^{-2} for 1.0 mAh cm^{-2}.

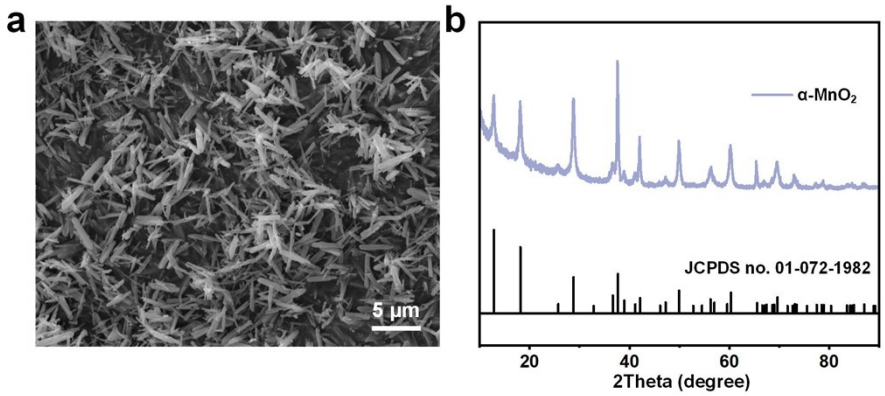

Fig. S19 XRD pattern for α-MnO_2.

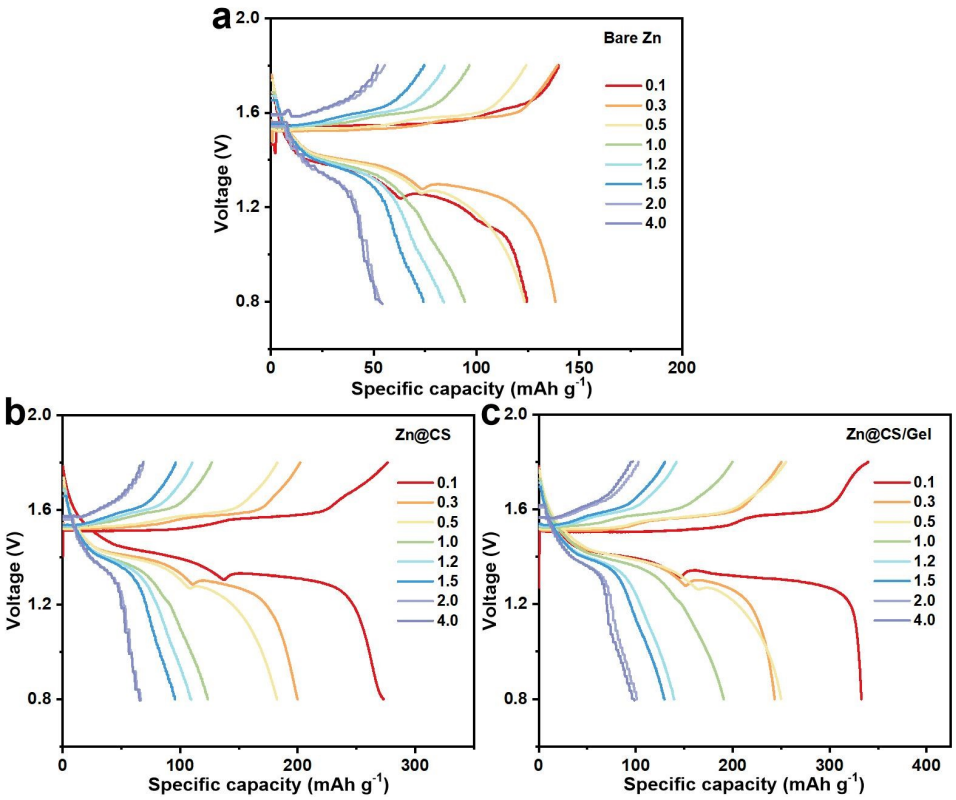

Fig. S20 Charge/discharge profiles of (a) Bare Zn||MnO_2, (b) Zn@CS||MnO_2, and (c) Zn@CS/Gel||MnO_2 full cells ranging from 0.1 to 4 A g^{-1}

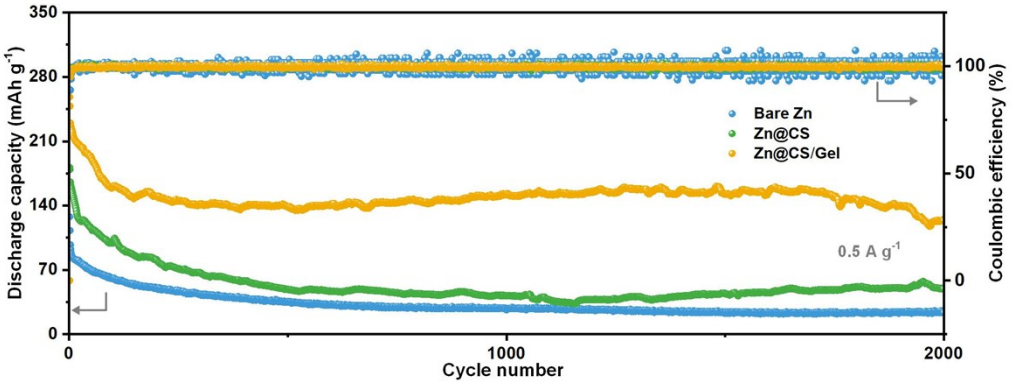

Fig. S21 Cycle performance of full cells with three anodes at 0.5 A g^{-1}.

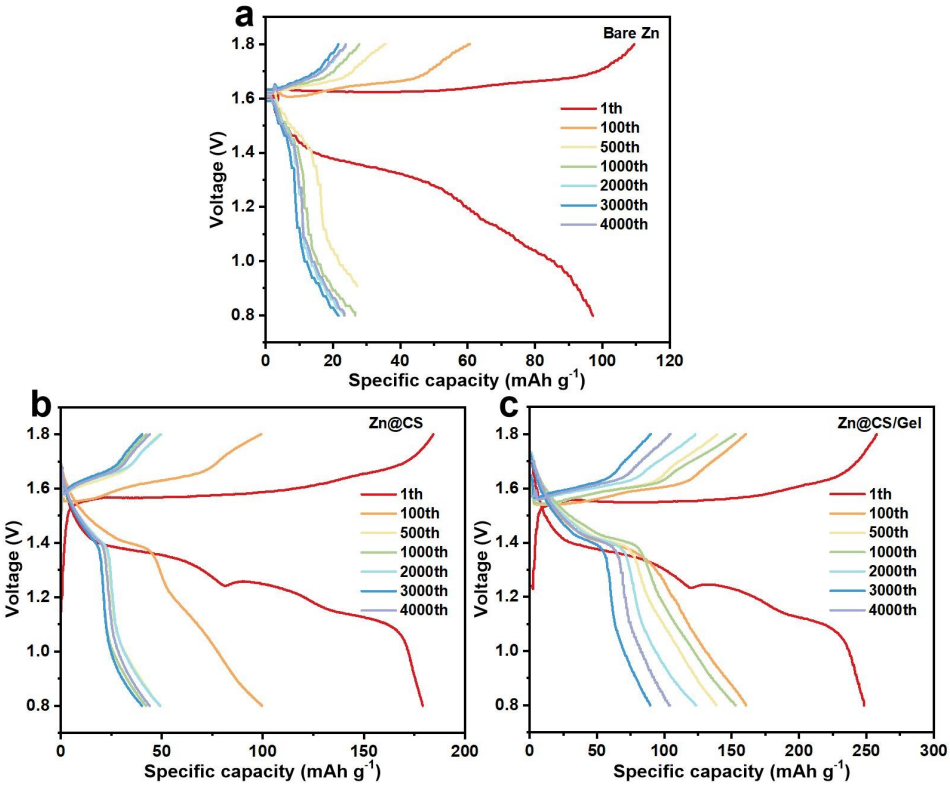

Fig. S22 Charge-discharge profiles of (a) Bare Zn||MnO_2, (b) Zn@CS||MnO_2, and (c) Zn@CS/Gel||MnO_2 full cells at 0.5 A g^{-1} of different cycles.

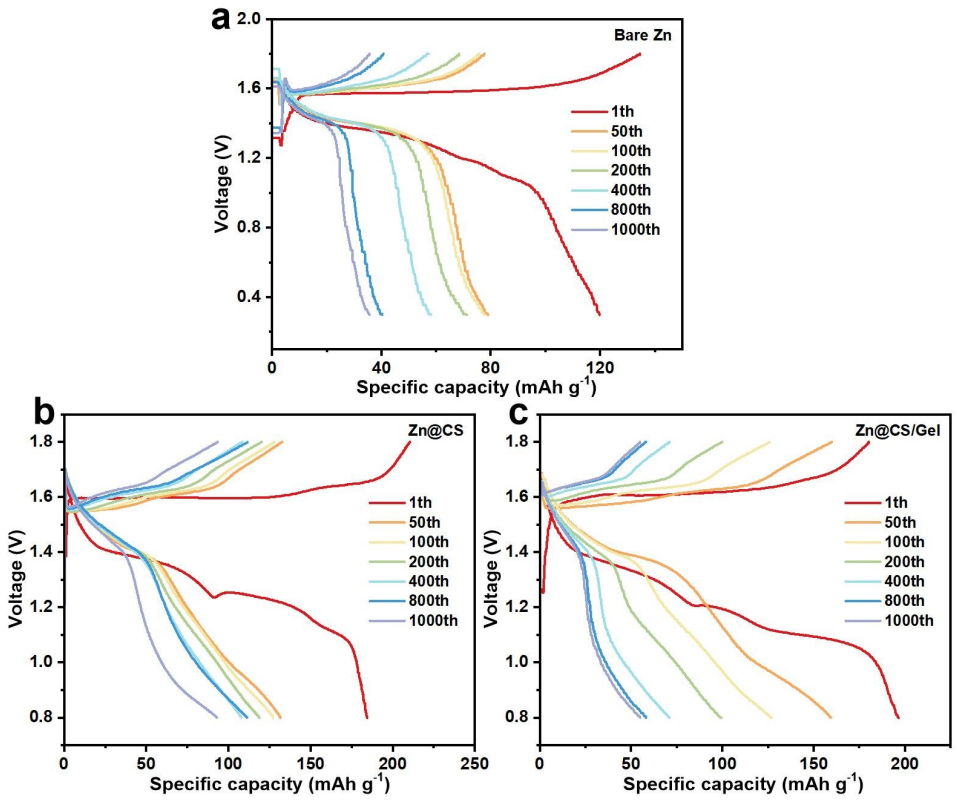

Fig. S23 Charge-discharge profiles of (a) Bare Zn||MnO_2, (b) Zn@CS||MnO_2, and (c) Zn@CS/Gel||MnO_2 full cells at 1.0 A g^{-1} of different cycles.

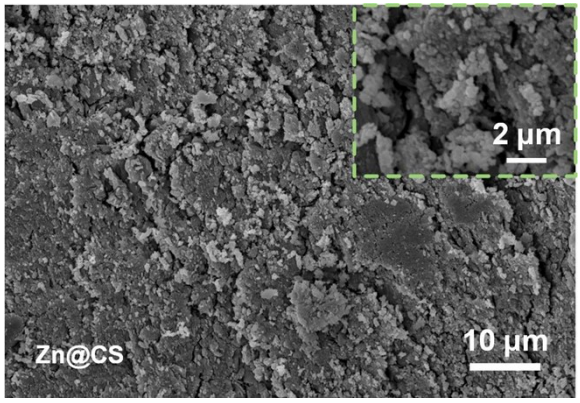

Fig. S24 SEM images of Zn@CS||MnO_2 full cells after cycling of anode at different magnifications.

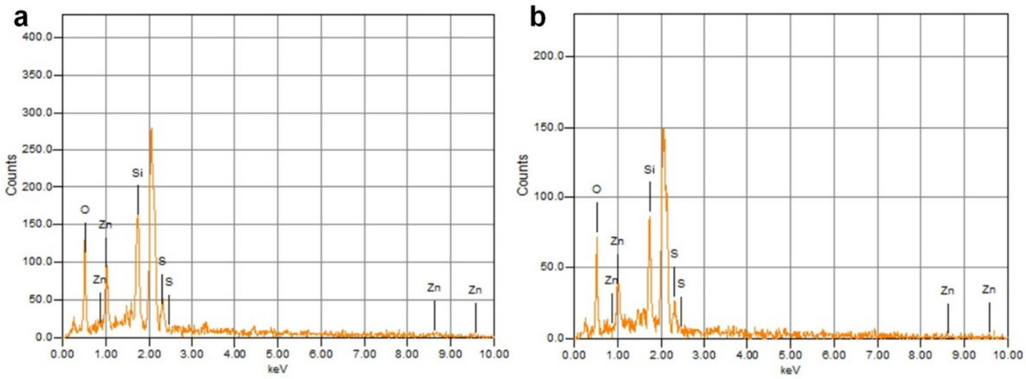

Fig. S25 EDS spectra of the separators near the anode side after cycling for (a) Zn@CS||MnO_2 and (b) Zn@CS/Gel||MnO_2 batteries.

Table S1 Contact angles of bare Zn, Zn@CS and Zn@CS/Gel at 0 and 20 s (n=3).

Electrode	Test time	Angle $_{\text{bare Zn}}$ Mean±SD	RSD $_{\text{bare Zn}}$
Bare Zn	0 s	106.7±0.20	0.19%
	20 s	103.8±0.15	0.14%
Zn@CS	0 s	76.0±0.19	0.25%
	20 s	47.2±0.15	0.32%
Zn@CS/Gel	0 s	61.0±0.23	0.38%
	20 s	35.0±0.14	0.40%

Table S2 Comparison of typical parameters for our work with recently reported Zn-based cells.

Anode	Electrolyte	Symmetric cell performance			Ref.
		Current density (mA cm^{-2})	Capacity (mAh cm^{-2})	Life (h)	
Zn@PPH-CN	2 M $ZnSO_4$	1.0	1.0	1800	1
ZIF-8@MXene-Zn	2 M $ZnSO_4$	1.0	1.0	1000	2
Zn-PDPTT	3 M $Zn(CF_3SO_3)_2$	1.0 2.0	1.0 2.0	4300 1300	3
MoS_2@Zn	2 M $ZnSO_4$	1.0 5.0	1.0 5.0	1000 800	4
C-ZSL@Zn	2 M $ZnSO_4$	1.0 3.0	1.0 3.0	1600 1100	5
KI-CHOP@Zn	2 M $ZnSO_4$	1.0 2.0	1.0 2.0	2200 980	6
Zn@PAN-TS-1	2 M $ZnSO_4$	1.2 0.2	0.6 0.1	1000 500	7
ZnTAPP-NTCDA-POP@Zn	3 M $ZnSO_4$	0.5	0.5	1200	8
PH-ZFF-coated electrode	2 M $ZnSO_4$	0.5 1.0	0.5 1.0	1200 2000	9
Zn-PPy-CNT	2 M $ZnSO_4$	2.0		500	10
Zn@CS/Gel	2 M $ZnSO_4$	0.5 2.0	0.25 1.0	4400 1600	This work

Table S3 Testing information and corresponding parameters of the full battery.

Testing information	Specific parameters
Test temperature	25 ℃ (Constant temperature and humidity room)
Cathode	α-MnO_2/Super P/PVDF (7:2:1, wt%) on steel mesh; Φ = 14 mm; α-MnO_2 mass loading ~1.2 mg
Electrolyte	2 M $ZnSO_4$ + 0.1 M $MnSO_4$
Separator	Whatman 1823-047 (Φ = 18 mm)
Anode	Bare Zn, Zn@CS, Zn@CS/Gel, Φ = 14 mm, mass loading ~12.4 mg (CS), 15.0 mg (CS/Gel), Coating thickness ~10.69 μm (CS), 13.55 μm (CS/Gel)
N/P ratio	~416
Coin-type	CR2032

Notes and references

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