Supporting Information

Natural Polysaccharide Strengthened Hydrogel Electrolyte and Biopolymer Derived Carbon for Durable Aqueous Zinc Ion Storage

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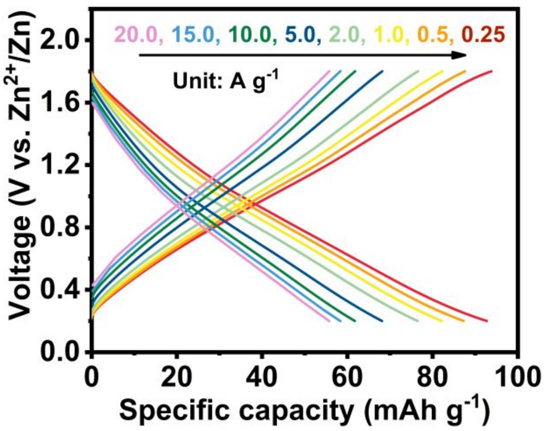

Figure S1. GCD curves of the aqueous ZHSC.

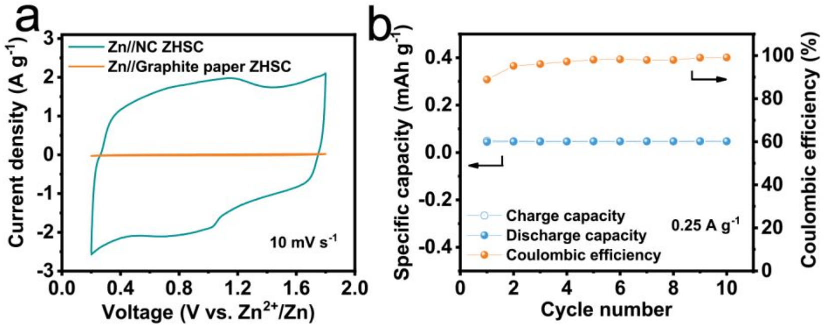

Figure S2. (a) CV curves of the aqueous Zn//NC and Zn//graphite paper ZHSCs. (b) Specific capacity and Coulombic efficiency of Zn//graphite paper ZHSC.

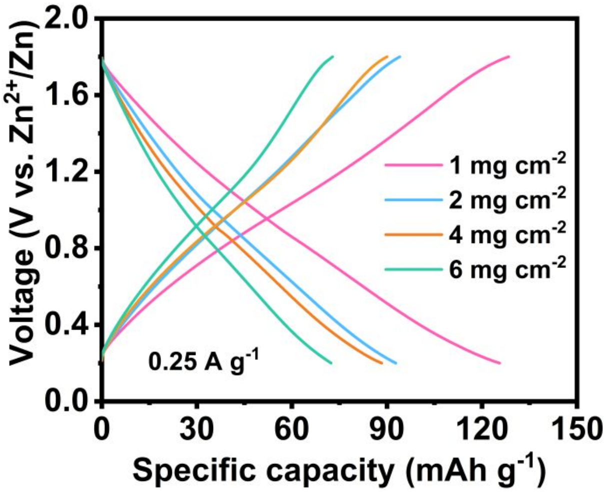

Figure S3. GCD curves of the ZHSCs under various NC mass loadings.

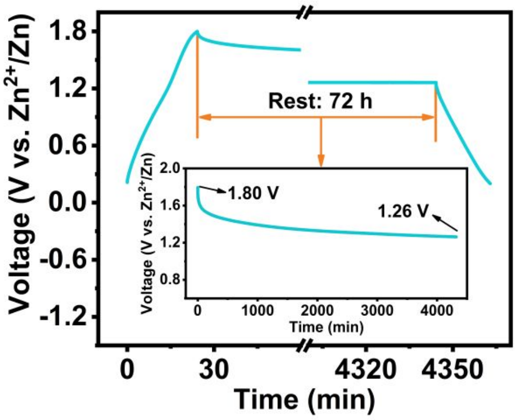

Figure S4. Self-discharge curve of the aqueous ZHSC.

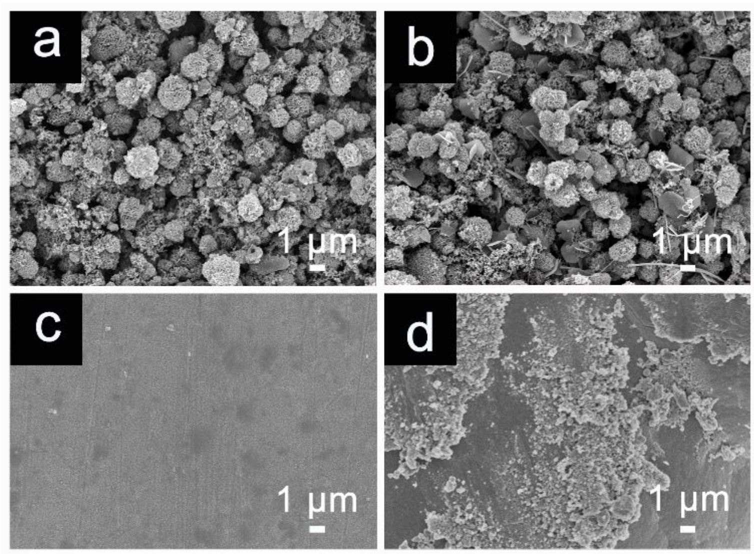

Figure S5. SEM images of NC cathode (a) before cycling and (b) after cycling, Zn anode (c) before cycling and (d) after cycling.

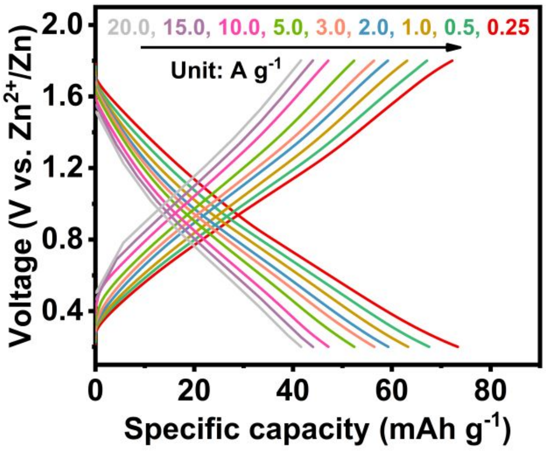

Figure S6. GCD curves of the quasi-solid-state ZHSC.

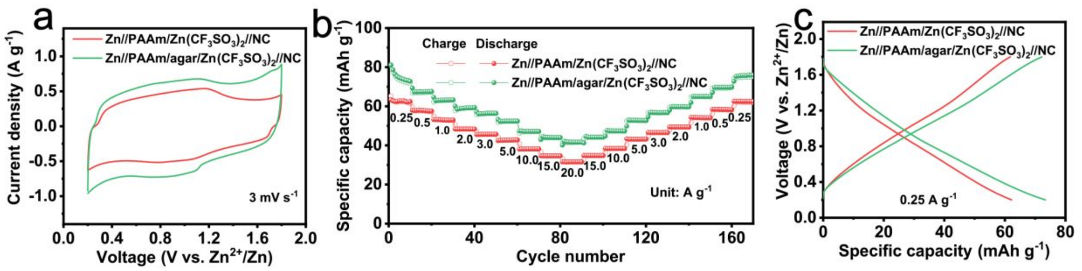

Figure S7. (a) CV curves of the quasi-solid-state Zn//PAAm/Zn(CF_3SO_3)$_2$//NC and Zn//PAAm/agar/Zn(CF_3SO_3)$_2$//NC ZHSCs. (b) Rate performance of the quasi-solid-state ZHSCs. (c) GCD curves of the quasi-solid-state ZHSCs in different hydrogel electrolytes.

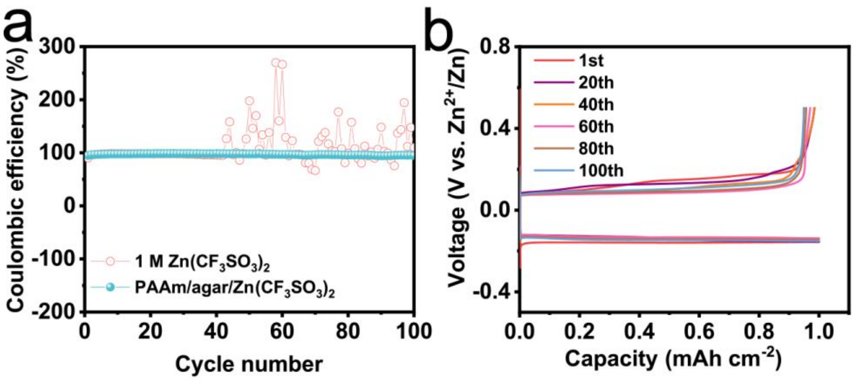

Figure S8. (a) Coulombic efficiencies of Zn//Cu cells in aqueous and hydrogel electrolytes. (b) Voltage curves of Zn//Cu cell in hydrogel electrolyte.

Table S1. Comparisons of the mechanical properties with recently reported hydrogel electrolytes.

Electrolyte	Tensile strength (kPa)	Compressive strength (kPa)	Ref.
PolySH/LiCl	5	42, 75%	1
$PVA/NFC/ZnSO_4$	23.1	26.2, 90%	2
κ-CG/PAAm/$Zn(CF_3SO_3)_2$	34.6	75.3, 75.0%	3
PAM-co-PAA/k-CG/$ZnSO_4$	42.5	~110, 60%	4
PAM with 7.5 M $ZnCl_2$	~40	-	5
SPMA-Zn3	58	70, 50%	6
$P(GMA_3\text{-}AAm_7)$-borate	17.7	-	7
PAAm/agar/$Zn(CF_3SO_3)_2$	78.9	118.0, 60.0%	This work

Table S2. Comparisons of the ionic conductivity with recently reported hydrogel electrolytes.

Electrolyte	ionic conductivity ($S\ m^{-1}$/$mS\ cm^{-1}$)	Ref.
PHE	6.33 $mS\ cm^{-1}$ (25 ℃)	8
P(AM-co-DMAEMA)-AMP/ gelatin	~1.35 $S\ m^{-1}$ (25 ℃) 0.43 $S\ m^{-1}$ (-40 °C)	9
PVA/glycerol/$CaCl_2$	1 $S\ m^{-1}$	10
$P(AMPS_{0.3}\text{-co-}AAM_{0.4})$	0.82 $S\ m^{-1}$ (-20 °C) 1.12 $S\ m^{-1}$ (100 °C)	11
HPAAN/PDA	0.32 $S\ m^{-1}$	12
AFHE	5.88 $mS\ cm^{-1}$ (20 ℃)	13
cross-linked lignin hydrogel	10.35 $mS\ cm^{-1}$ (25 ℃)	14
PAAm/agar/$Zn(CF_3SO_3)_2$	1.55 $S\ m^{-1}$	This work

Table S3. Comparisons of the obtained capacity with previously reported aqueous ZHSCs.

Materials	Electrolyte	Voltage range (V)	Specific capacity/ Capacitance	Ref.
MnO_2 nanorods	$ZnSO_4$	0-2	54.1 mA h g^{-1} (0.1 A g^{-1})	15
BC-CNa	$ZnSO_4$	0.2-1.8	51.4 mA h g^{-1} (0.2 A g^{-1})	16
EG/PANI	$ZnSO_4$	0.1-1.5	172 F g^{-1} (0.13 A g^{-1})	17
AC	$Zn(CF_3SO_3)_2$	0-1.8	170 F g^{-1} (0.1 A g^{-1})	18
MXene-rGO2	$ZnSO_4$	0.2-1.6	128.6 F g^{-1} (0.4 A g^{-1})	19
PC	$ZnSO_4$	0.3–1.9	75.2 mA h g^{-1} (0.22 A g^{-1})	20
NMXC	$ZnSO_4$	0.2-1.8	83.9 mA h g^{-1} (0.1 A g^{-1})	4
NC	$Zn(CF_3SO_3)_2$	0.2-1.8	92.8 mAh g^{-1} (0.25 A g^{-1})	This work

Table S4. Comparisons of the cycling stability with the ZHSCs in different electrolytes.

Materials	Electrolyte	Cycling stability	Ref.
ACNS	κ-CG/PAAm/$Zn(CF_3SO_3)_2$	102.7% after 10000 cycles	3
NMXC	PAM-coPAA/k-CG/$ZnSO_4$	96.4% after 10000 cycles	4
AC	SPMA-Zn hydrogel electrolyte	95.3% after 5000 cycles	6
AC	SA-Zn double network hydrogel electrolyte	95.4% after 2000 cycles	21
HPC-600	gelatin/$Zn(CF_3SO_3)_2$	102.1% after 10000 cycles	22
WC-6ZnN-12U@CC	PAM-$ZnSO_4$	81.4% after 2000 cycles	23
$VOPO_4{\cdot}2H_2O$	UV-crosslinked ZIP with 0.65 M $Zn(OTf)_2$ salt	63% after 50 cycles	24
AC	Redox SA-Zn-Br double network hydrogel electrolyte	87.7% after 5000 cycles	25
OPCNF-20	gelatin/$ZnSO_4$	92.1% after 1000 cycles	26

NC	PAAm/agar/$Zn(CF_3SO_3)_2$ hydrogel electrolyte	112.4% after 10000 cycles	This work

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