Supporting Information

For

An Ultra-stable Na-Zn Solid-state Hybrid Battery Enabled by A Robust Dual-crosslinked Polymer Electrolyte

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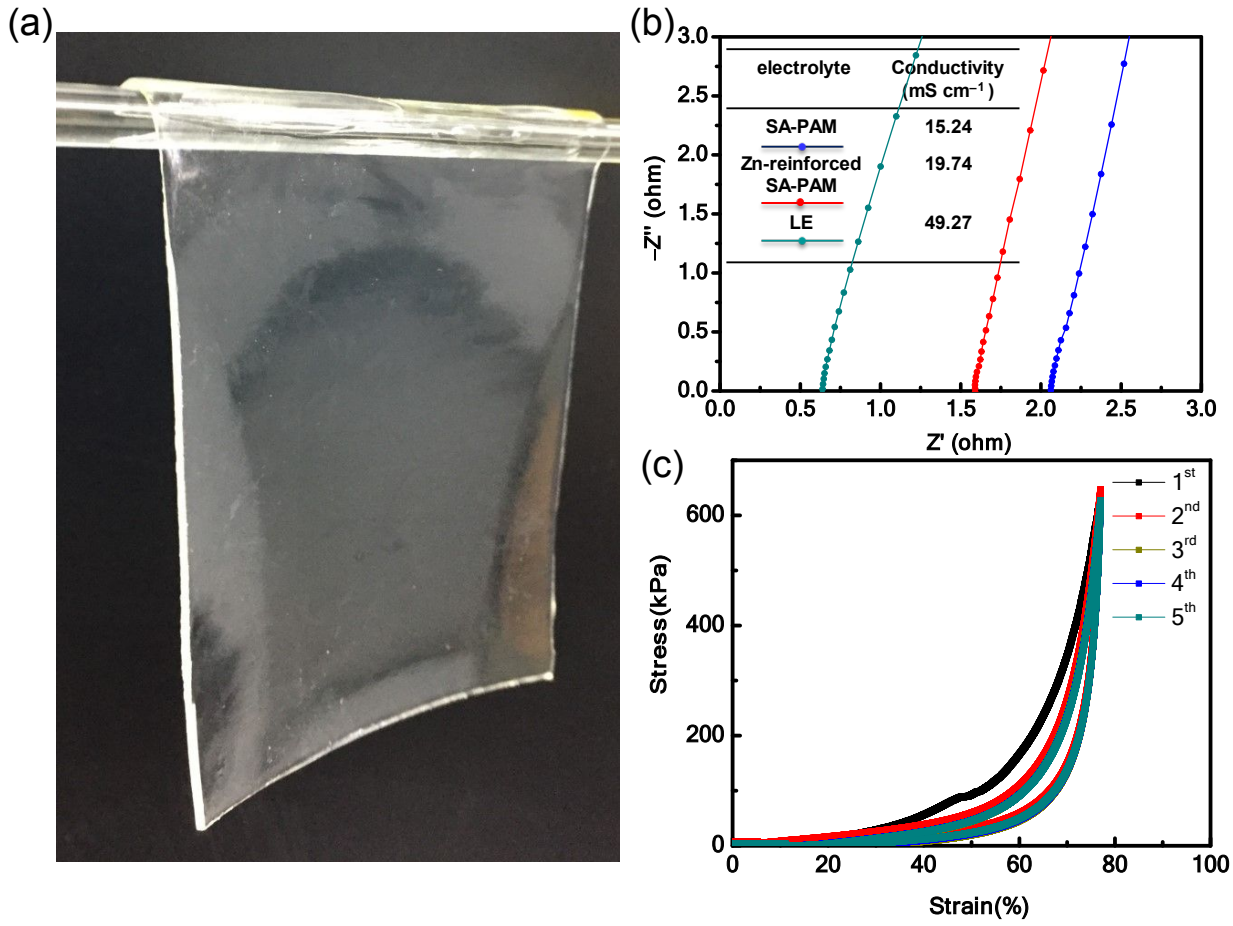

Figure S1. (a) Digital photograph of Zn-reinforced SA-PAM SE; (b) EIS plots of the solid electrolytes and liquid electrolyte; (c) Five cyclic compressive curves for hydrogel under maximum strain of 80% indicate good capability of recovering its initial shape.

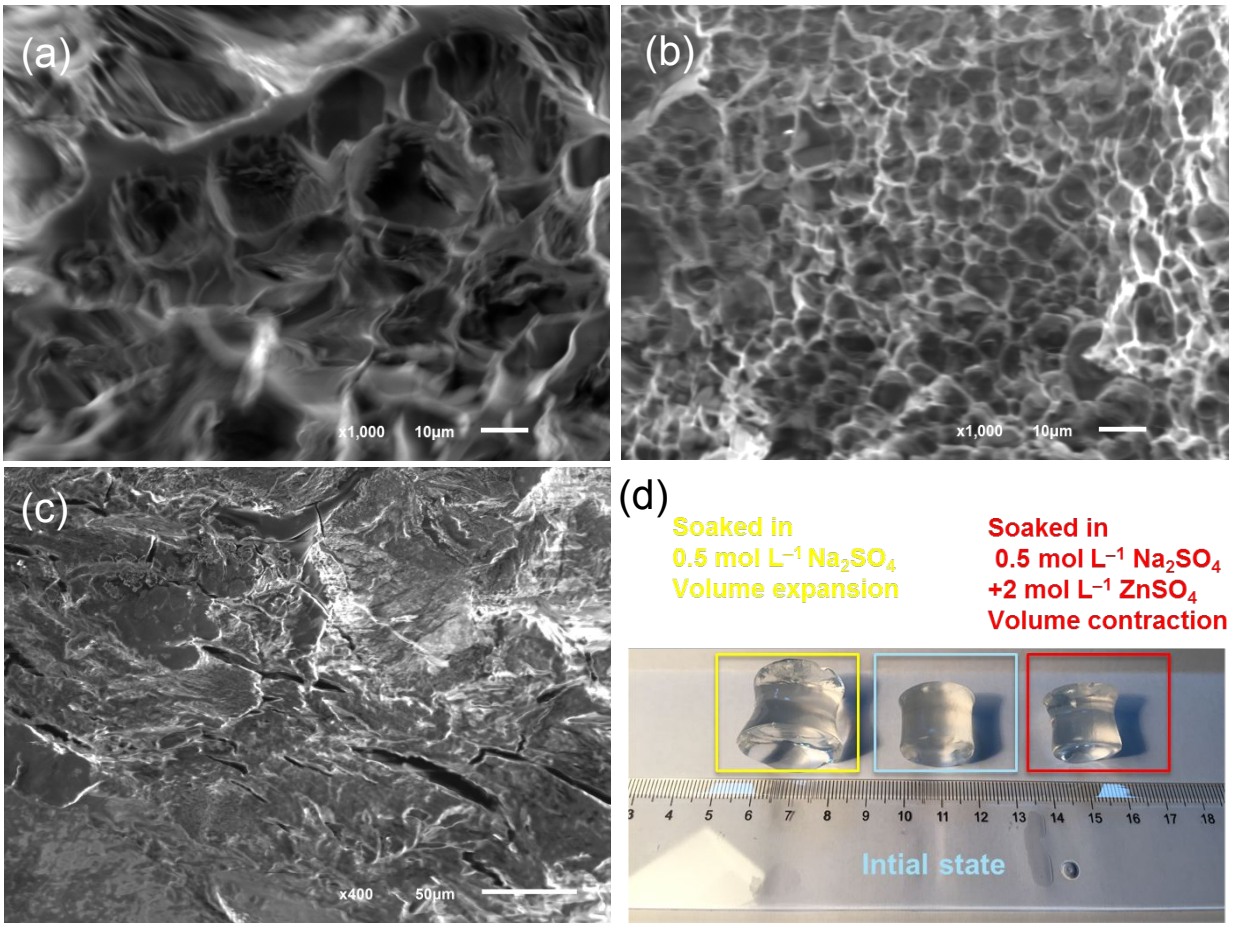

Figure S2. SEM images of the hydrogel (a) PAM, (b) SA-PAM SE, (c) Zn-reinforced SA-PAM SE; (d) Digital photograph of the SA-PAM SEs soaked in solution with or without Zn^{2+}.

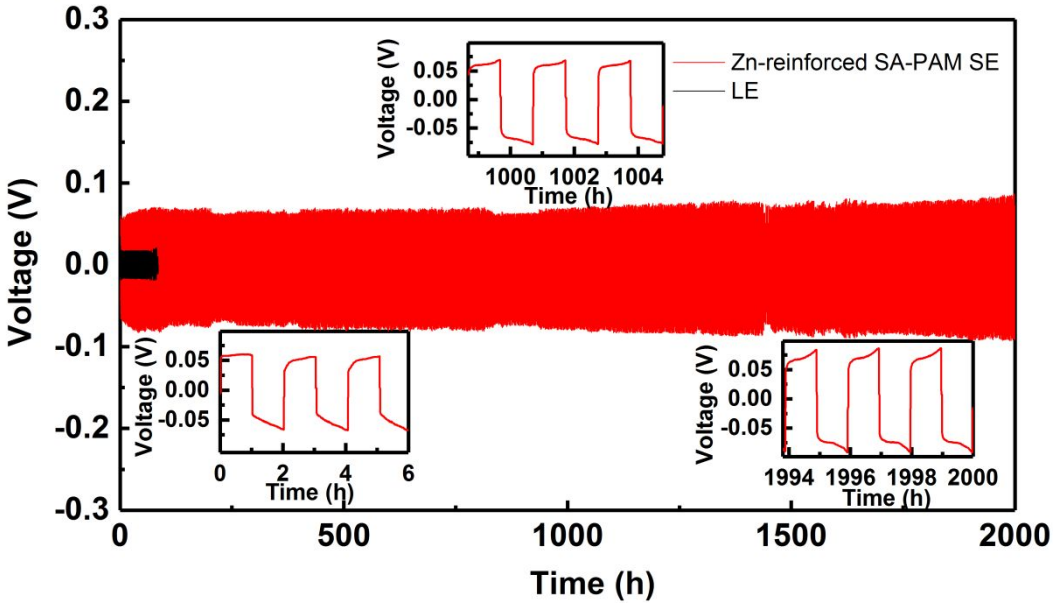

Figure S3. Galvanostatic Zn plating/stripping in Zn/Zn symmetric cells with Zn-reinforced SA-PAM SE and LE at a current density of 2 mA cm^{-2}, stripping/plating capacity is fixed at 2 mAh cm^{-2}. The insets represent magnified voltage curves for cells with zinc-reinforced SA-PAM SE over different time ranges.

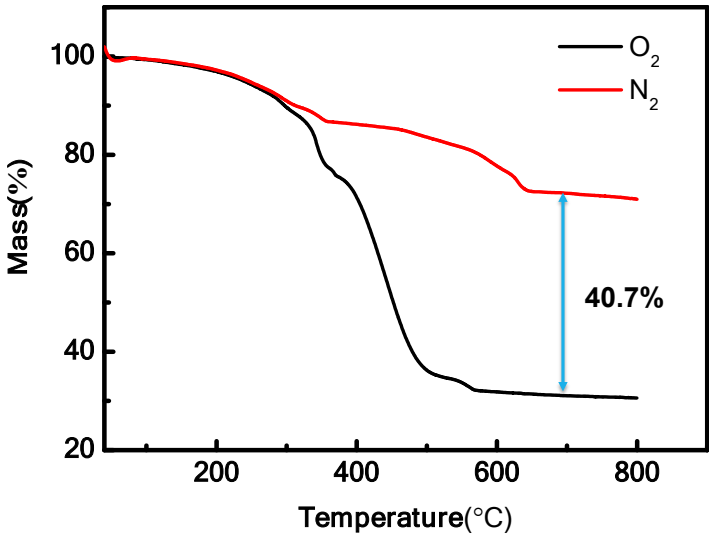

Figure S4. TGA profiles of PB@CNT measured at a heating rate of 5 ˚C min^{-1} in O_2 and N_2.

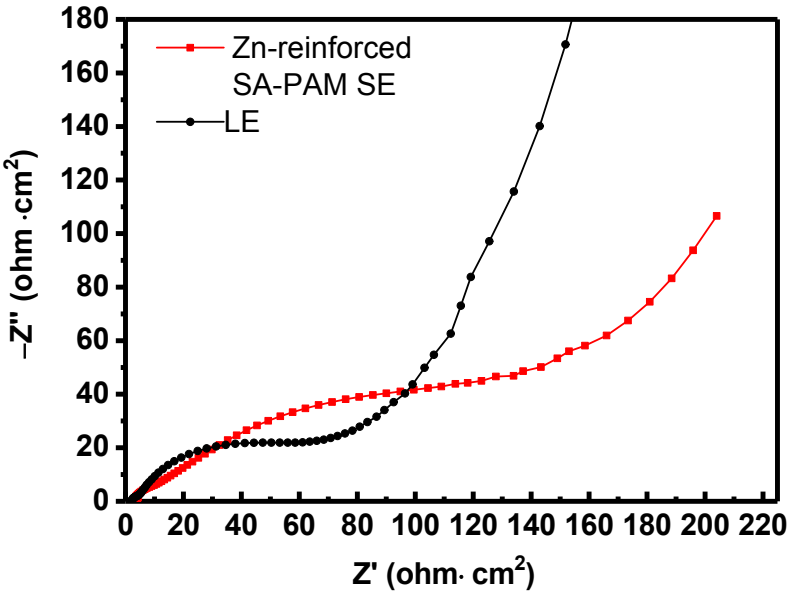

Figure S5. The EIS spectra of the batteries with Zn reinforced SA-PAM SE and LE

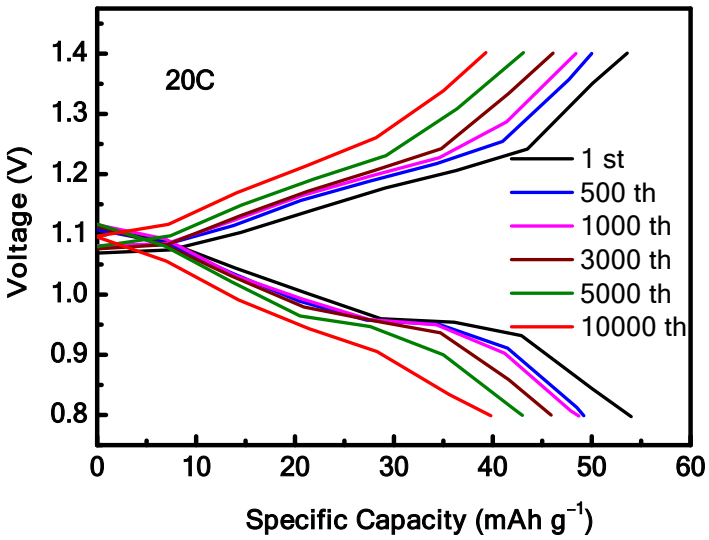

Figure S6. The charge/discharge curves of PB@CNT|Zn hybrid cell with Zn-reinforced SA-PAM SE over different cycling stages (20 C).

Figure S7. Digital photograph of the flexible Na-Zn hybrid battery using Zn-reinforced SA-PAM SE.

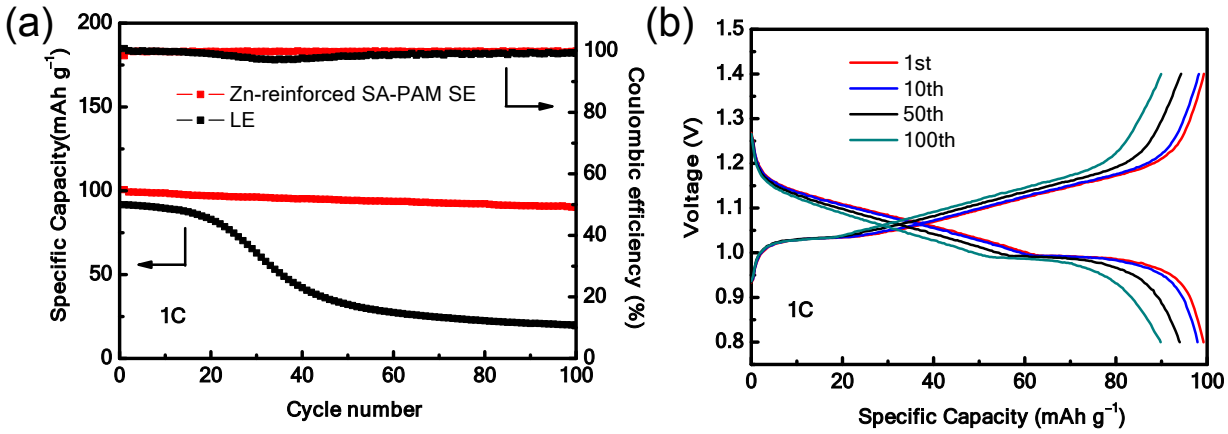

Figure S8. (a) Cycling performance at 1C; (b) The charge/discharge curves of PB@CNT|Zn hybrid cell with Zn-reinforced SA-PAM SE over different cycling stages, without no apparent capacity loss after 100 charge/discharge cycles.

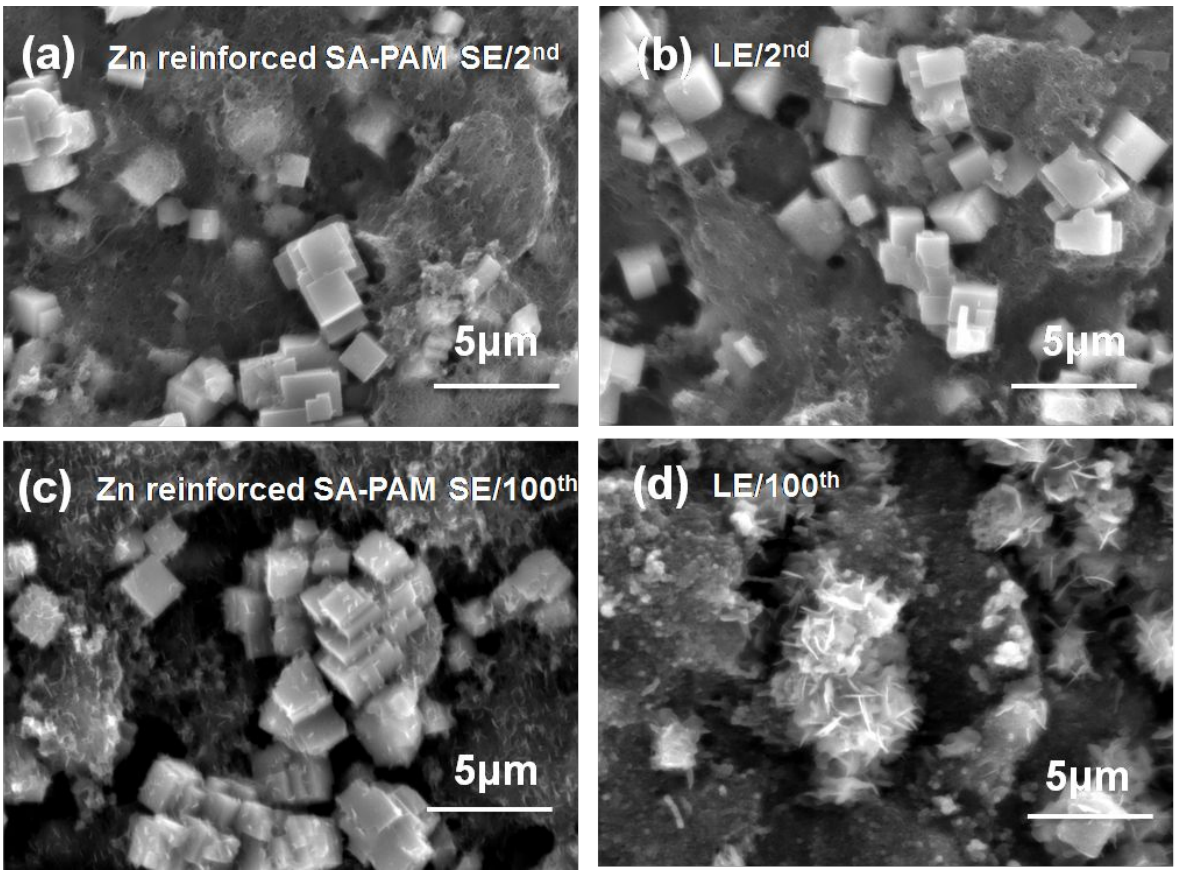

Figure S9. SEM images of the PBA cathode cycled in Zn-reinforced SA-PAM SE and LE.

Table S1. Comparison of the conductivity of polymer electrolytes

Gel electrolyte matrix	State of the electrolyte	Conductivity ($mS\ cm^{-1}$)	reference
Xanthan gum	Quasi-solid	14.60	32
guar gum	Quasi-solid	10.70	34
PVA	Solid	8.97	33
HPE	Solid	17.60	35
PHE	Solid	1.70	36
Gelatin	Solid	6.10	26
PAM+aligate	Solid	19.74	This work

Table S2. Summary of the characteristic groups in the FTIR spectra.

Characteristic group	Vibration type	Wavenumber (cm^{-1})
−OH	stretching vibration	3430 ~ 3720
N−H	stretching vibration	3179
–COOH	asymmetric vibration	1658
–COOH	symmetric vibration	1417
C−H	stretching vibration	2930
$-CH_2$	in-plane scissoring	1450
$-NH_2$	in-plane rocking	1100
SO_4^{2-}	doubly degenerate vibrations	617
SO_4^{2-}	non-degenerate mode	981
SO_4^{2-}	triply degenerate vibrations	1150