Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

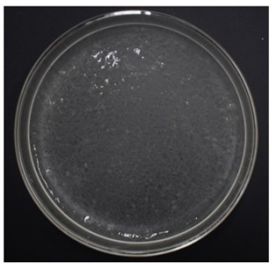

Fig. S1 Optical picture of LBG electrolyte before heat treatment.

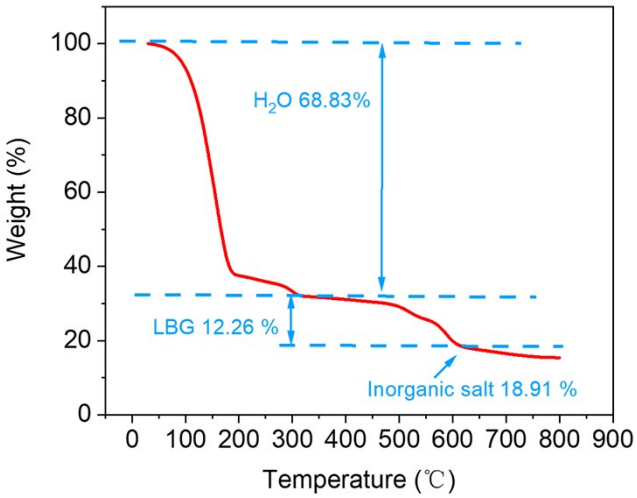

Fig. S2 TGA analysis of LBG electrolyte

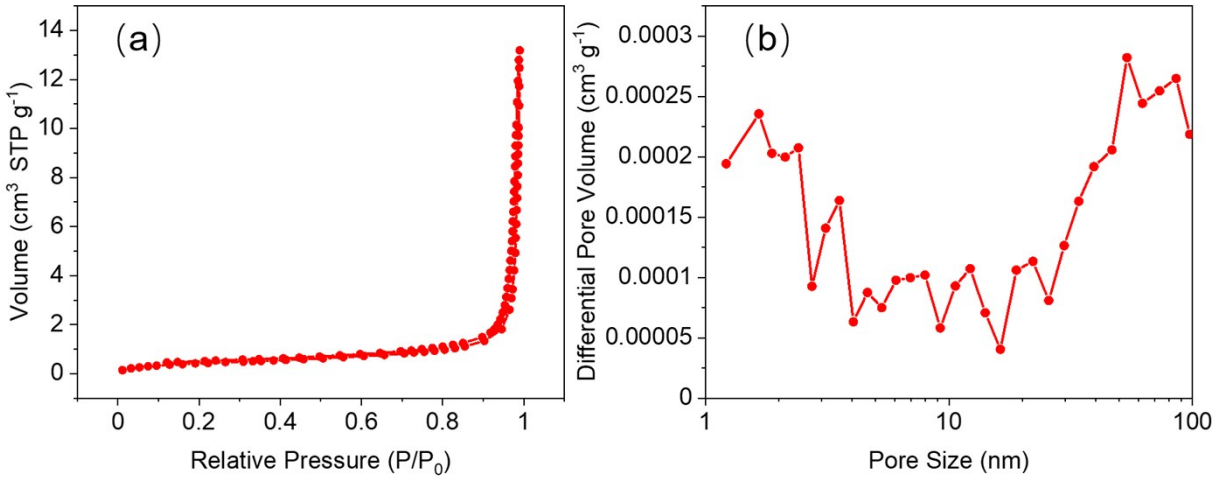

Fig. S3 (a) Nitrogen adsorption/desorption isotherms of LBG electrolyte after vacuum drying. (b) Pore size distributions of LBG electrolyte after vacuum drying.

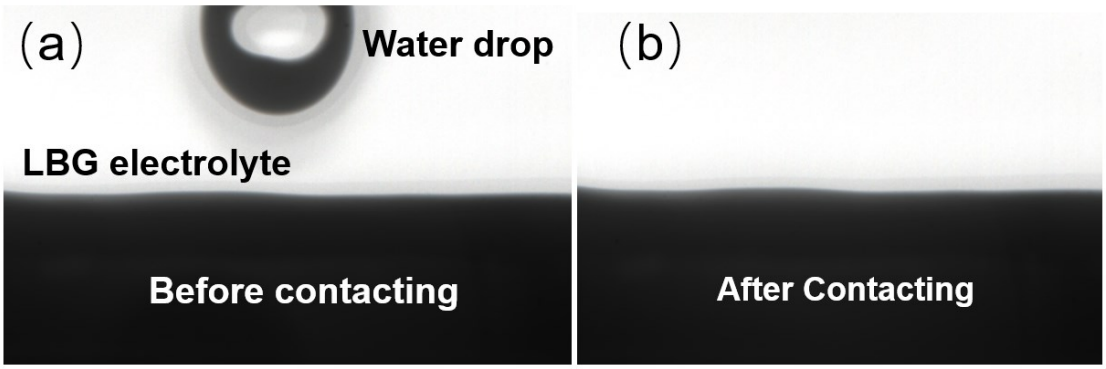

Fig. S4 The wettability of the LBG electrolyte.

Table S1 Conductivity values for different concentrations of LBG hydrogels electrolyte

Concentration	Ionic conductivity [mS cm^{-1}]
1 M $ZnSO_4$ and 0.1 M $MnSO_4$	24.88
2 M $ZnSO_4$ and 0.1 M $MnSO_4$	33.57
2 M $ZnSO_4$ and 0.2 M $MnSO_4$	33.80
2 M $ZnSO_4$ and 0.3 M $MnSO_4$	34.78

First, the LBG hydrogels were prepared by dispersing the LBG in aqueous solution containing different $ZnSO_4$ ratios (1, 2, and 3 M) and 0.1 M $MnSO_4$. We found that dispersing the LBG in aqueous solution containing 3 M $ZnSO_4$ and 0.1 M $MnSO_4$ cannot be converted into a hydrogel. Additionally, the LBG electrolyte with 2 M $ZnSO_4$ and 0.1 M $MnSO_4$ mixture shows a higher ionic conductivity (33.57 mS cm^{-1}) than that with 1 M $ZnSO_4$ and 0.1 M $MnSO_4$ (24.88 mS cm^{-1}). Second, the LBG hydrogels were prepared by dispersing the LBG in aqueous solution containing 2 M $ZnSO_4$ and different $MnSO_4$ ratios (0.1, 0.2 and 0.3 M). As show in, very similar ionic conductivity is observed for the LBG hydrogels with 2 M $ZnSO_4$ and different $MnSO_4$ ratios.

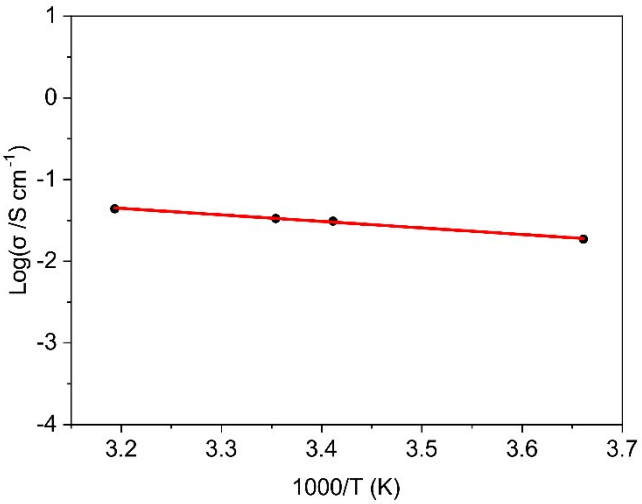

Fig. S5 Arrhenius plot for the LBG electrolyte.

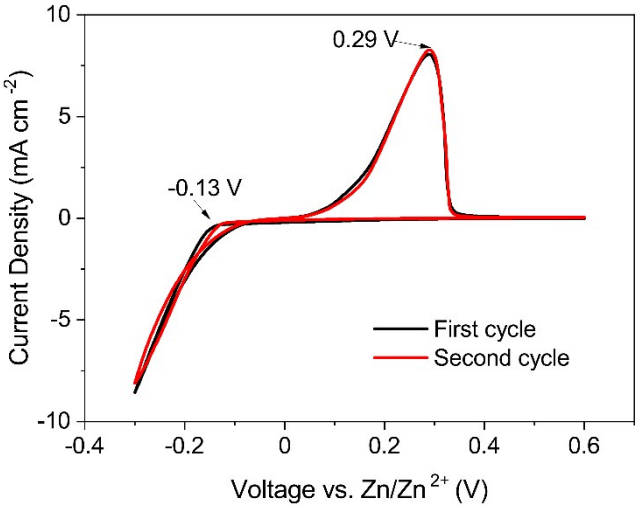

Fig. S6 The first two cycles CV curves of Zn plating/stripping in the LBG electrolyte.

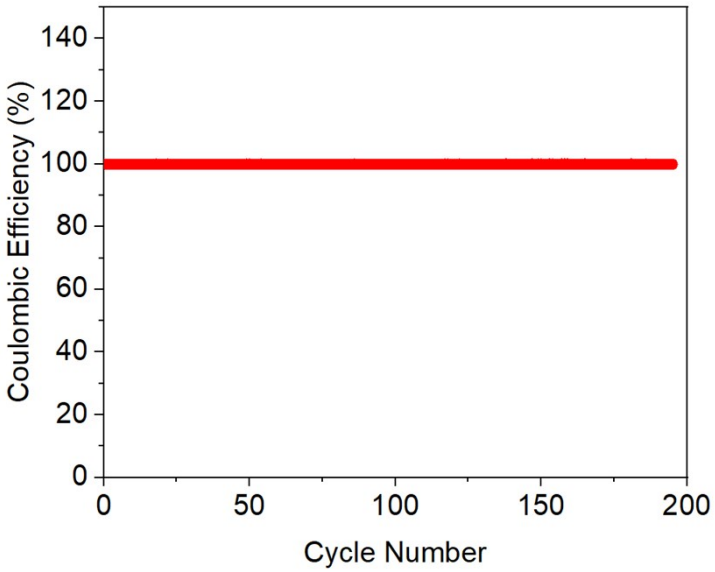

Fig. S7 The coulombic efficiency during Zn^{2+} stripping/plating process with LBG electrolyte

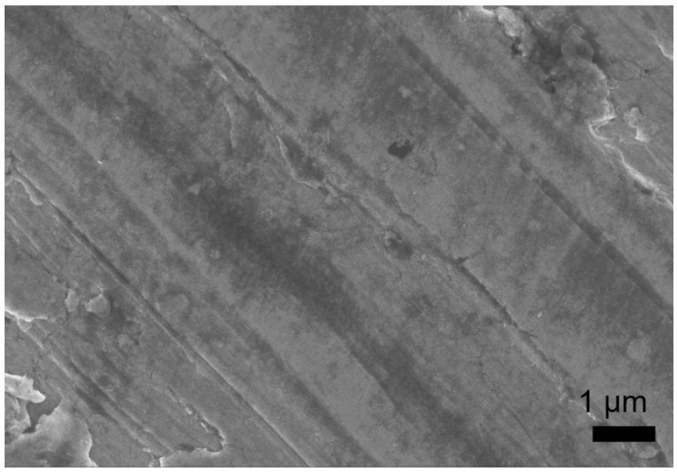

Fig. S8 SEM image of pristine Zn foil.

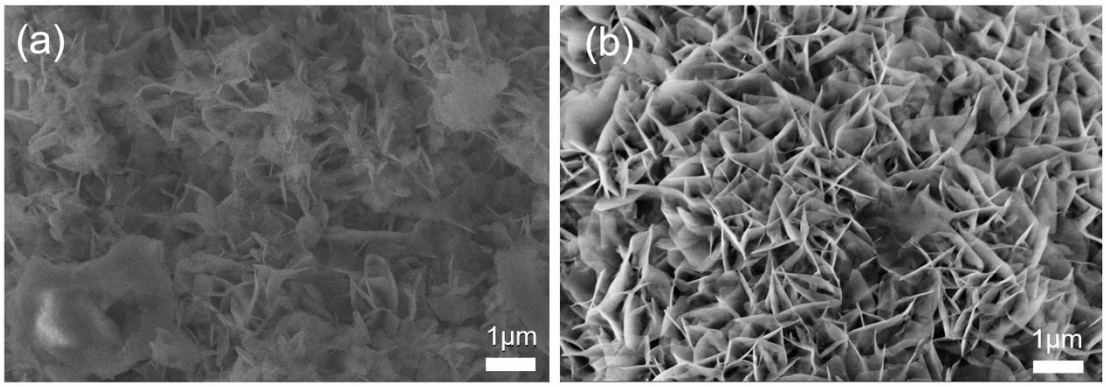

Fig. S9 SEM images of MnO_2 cathode (a) and (b) electro-deposited Zn anode.

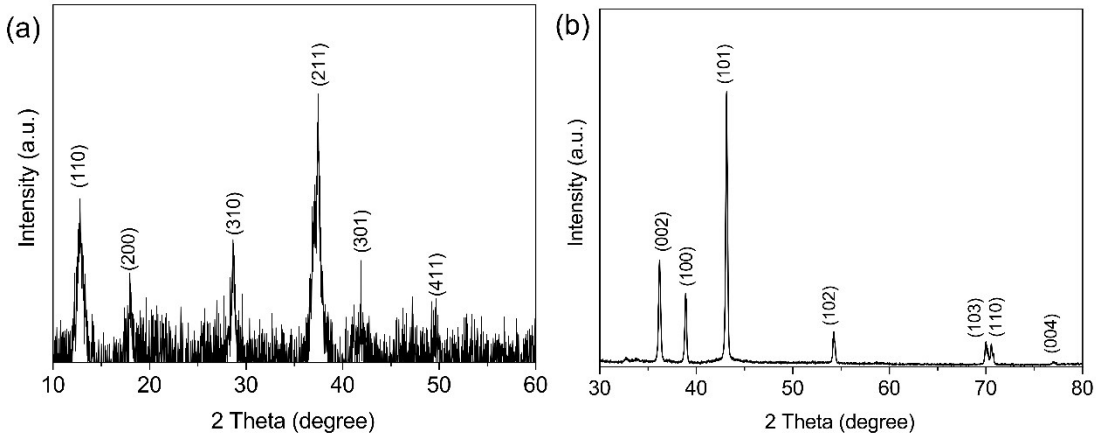

Fig. S10 XRD patterns of (a) MnO_2 powder and (b)electro-deposited Zn anode.

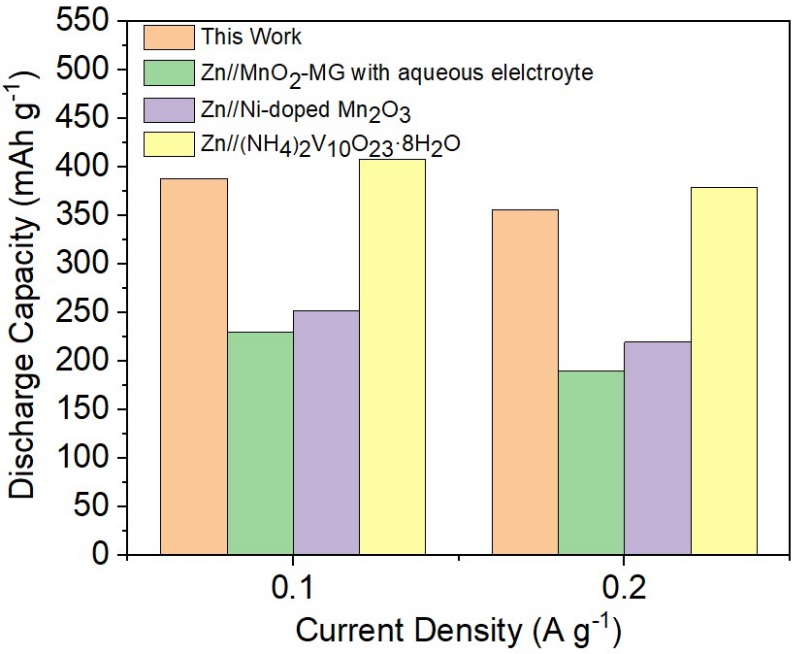

Fig. S11 Discharge capacity compared to references[1-3] at low current densities

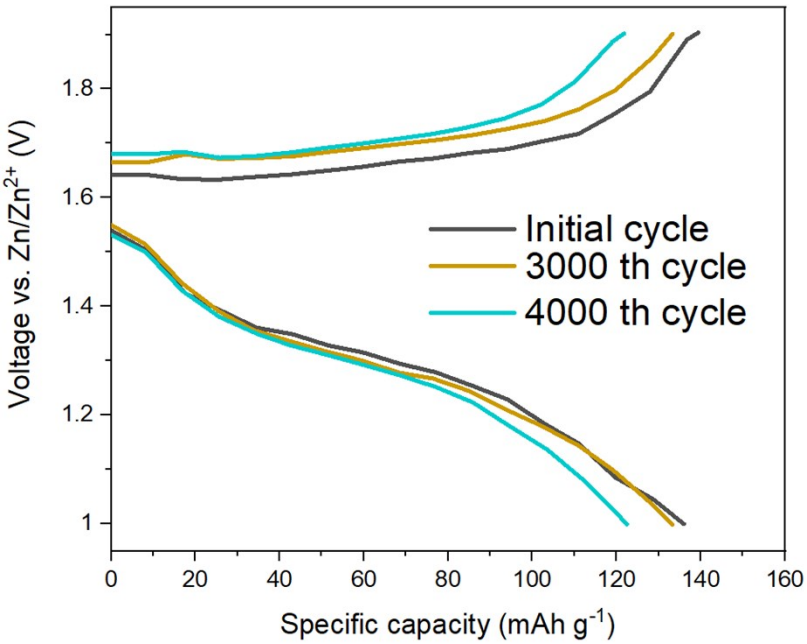

Fig. S12 The 1st, 3000th and 4000th charging/discharging profiles of the ZIBs with the LBG electrolyte at 6 A g^{-1}.

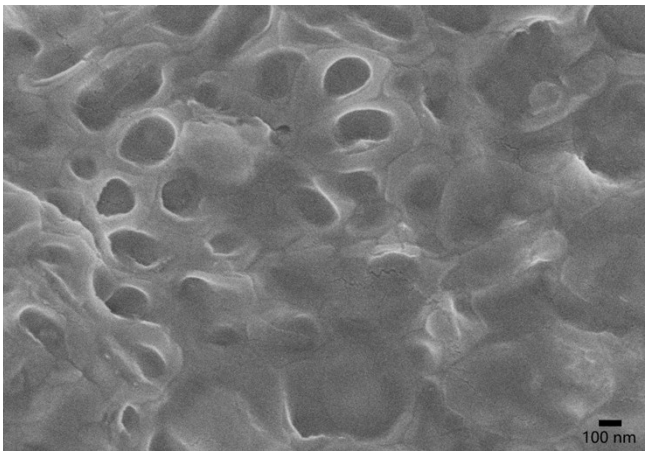

Figure S13 SEM image of LBG electrolyte after 100 charging/discharging cycles.

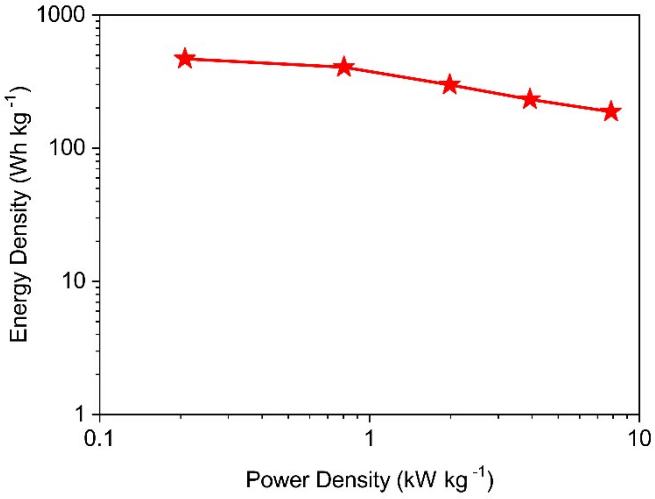

Fig. S14 Ragone plot of the ZIBs with LBG electrolyte.

Fig. S15 Thickness of the flexible ZIBs with LBG electrolyte.

Reference

1. D. Zhang, J. Cao, X. Zhang, N. Insin, S. Wang, J. Han, Y. Zhao, J. Qin and Y. Huang, *Advanced Functional Materials*, 2021, **31**, 2009412.
2. J. Cao, D. Zhang, X. Zhang, S. Wang, J. Han, Y. Zhao, Y. Huang and J. Qin, *Applied Surface Science*, 2020, **534**, 147630.
3. J. Cao, D. Zhang, Y. Yue, X. Wang, T. Pakornchote, T. Bovornratanaraks, X. Zhang, Z.-S. Wu and J. Qin, *Nano Energy*, 2021, **84**, 105876.