Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Supporting Information

High-rate and non-toxic $Na_7Fe_{4.5}(P_2O_7)_4$@C for quasi-solid-state sodium-ion battery

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Supplementary Figures

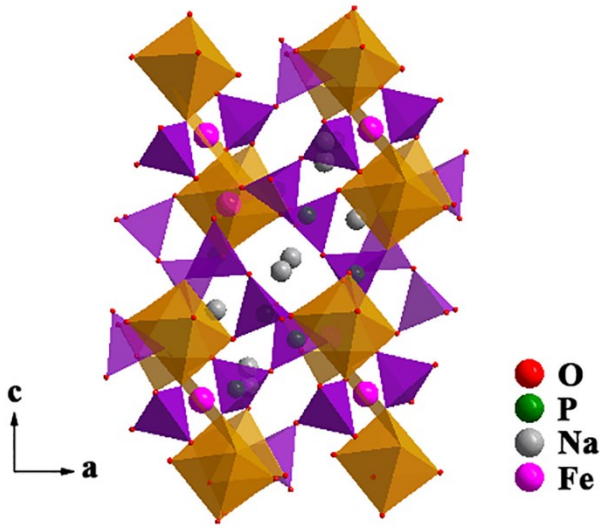


Fig. S1. Crystal structure projected down the b-axis.

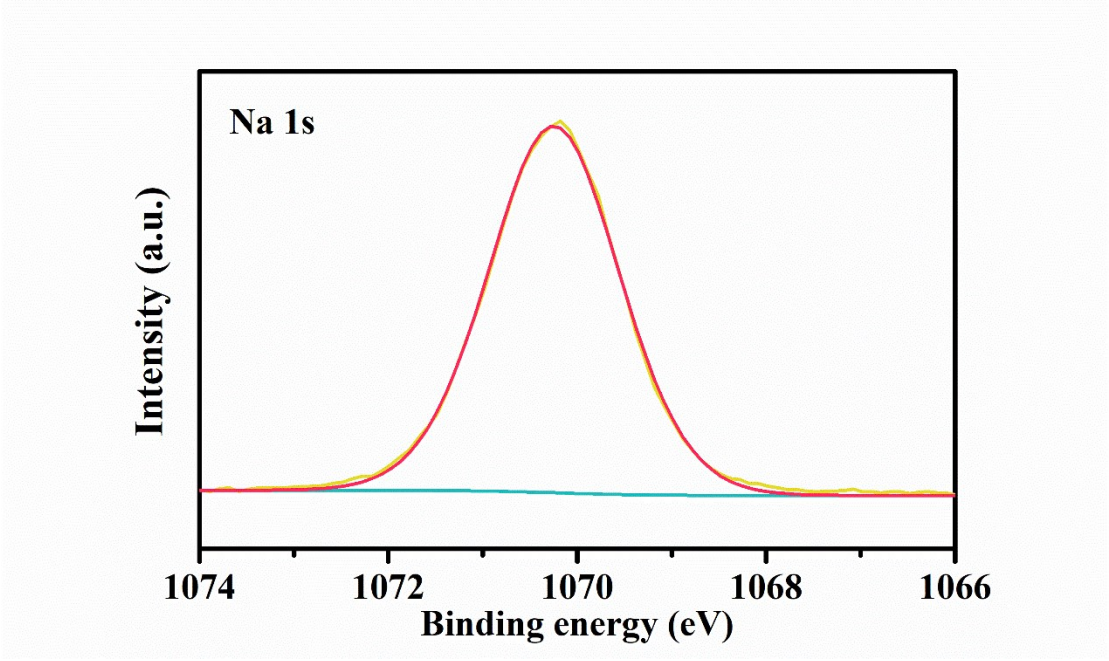


Fig. S2. XPS narrow spectra of Na 1s.

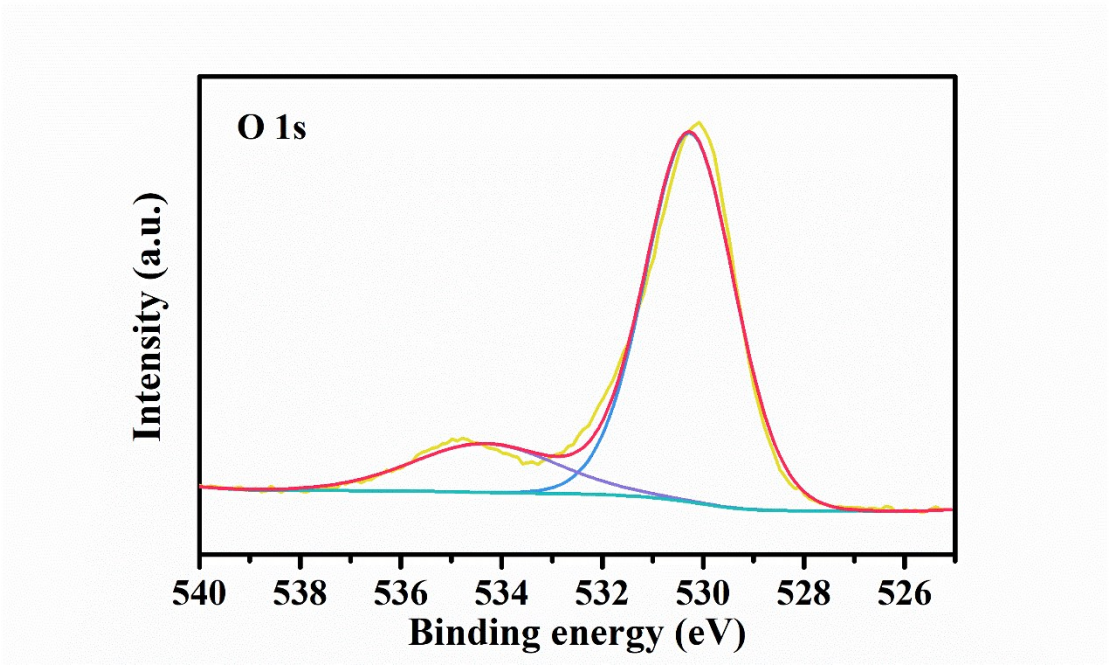


Fig. S3. XPS narrow spectra of O 1s.

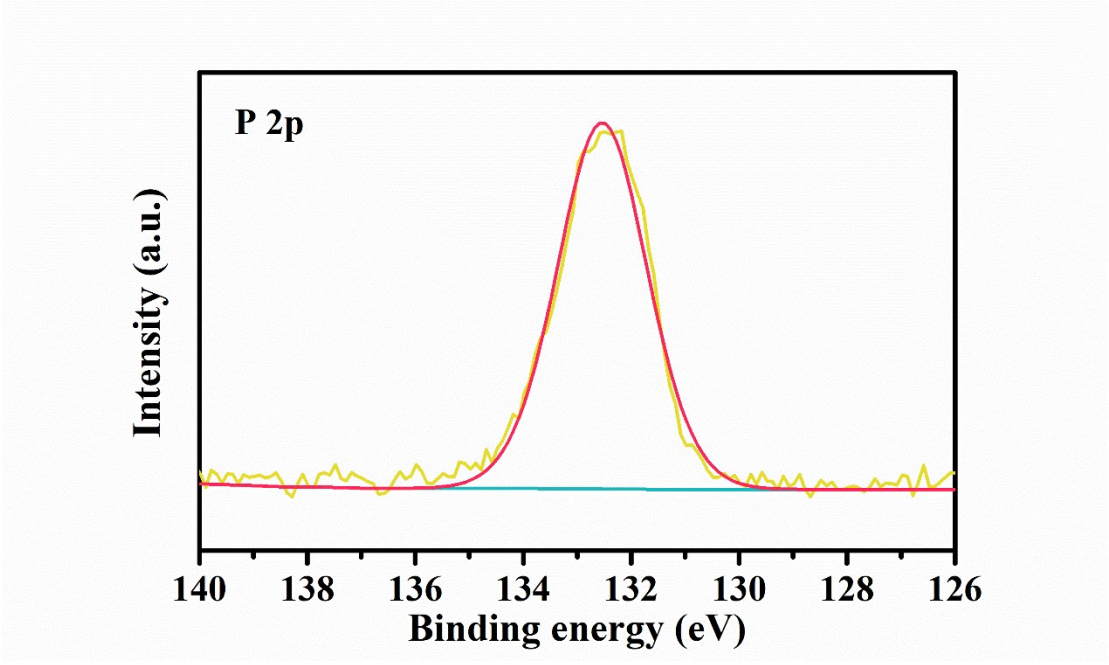


Fig. S4. XPS narrow spectra of P 2p.

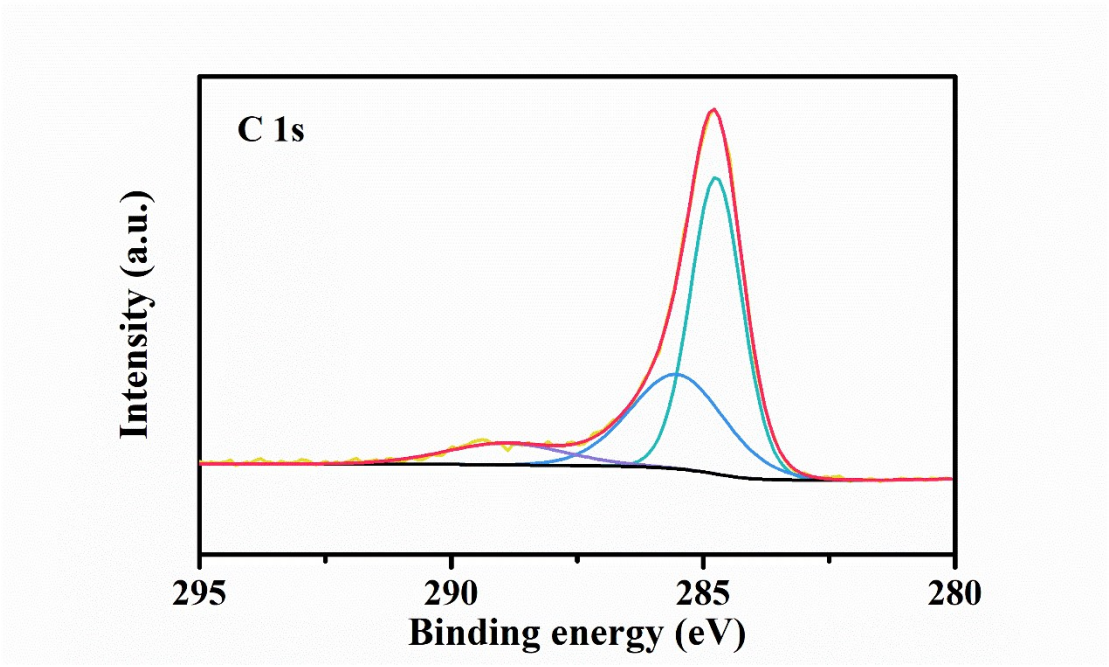
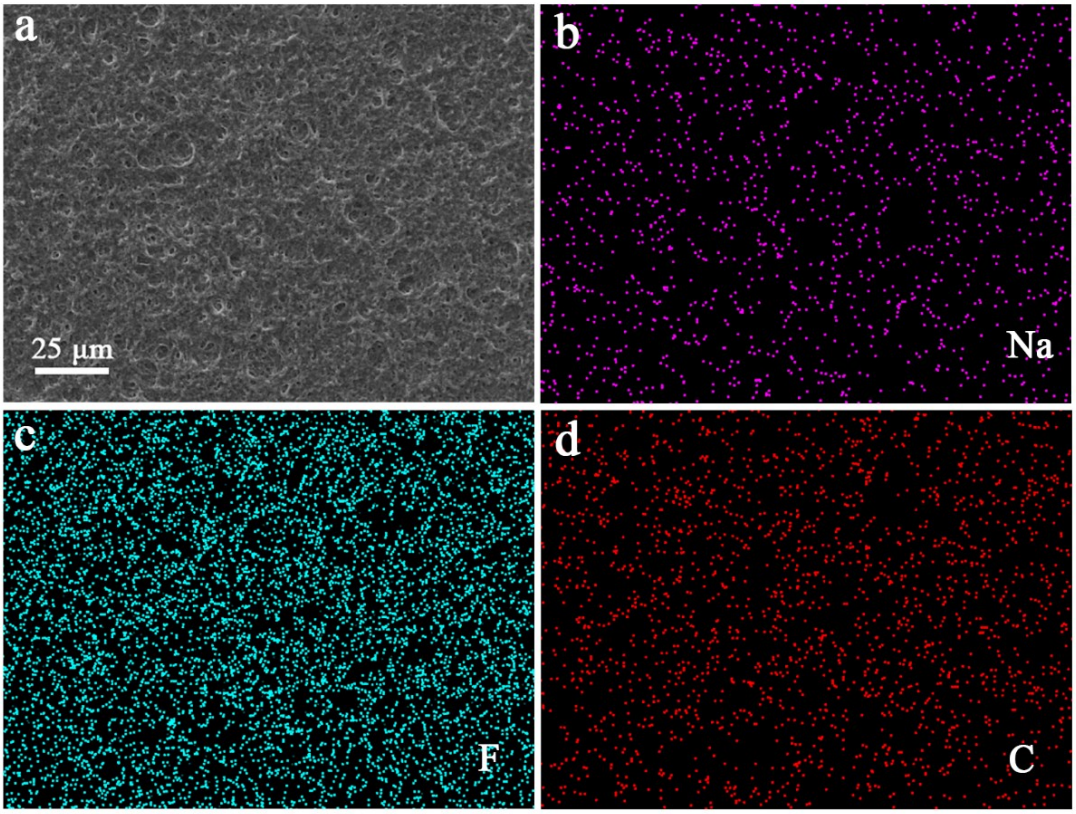


Fig. S5. XPS narrow spectra of C 1s.



F

ig. S6. FESEM image and corresponding elemental distribution of the PFSA-Na membrane. (a) FESEM image. (b) Na. (c) F. (d) C.

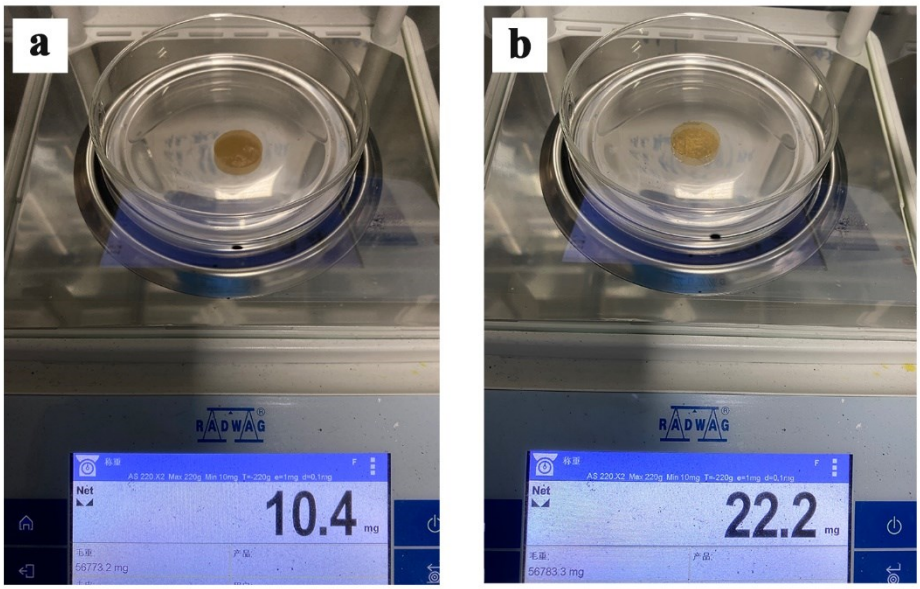


Fig. S7. Digital images of the (a) pristine and (b) treated PFSA-Na membrane.

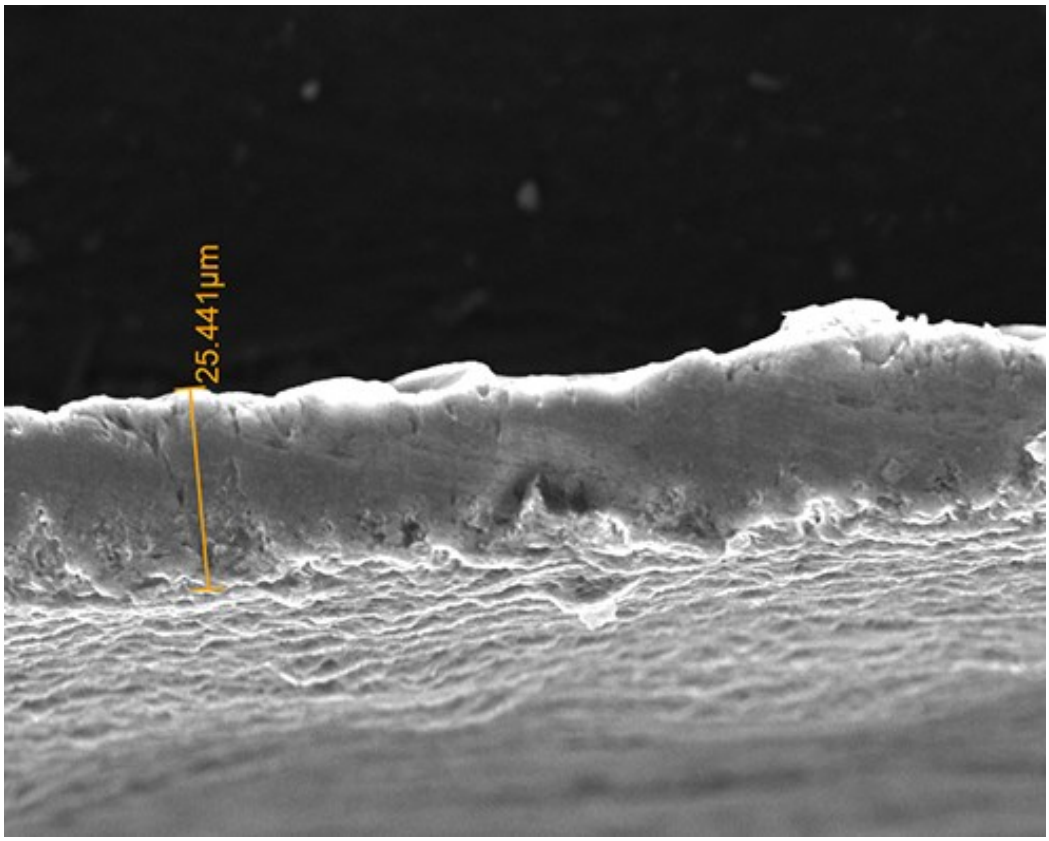


Fig. S8. Thickness of the PFSA-Na membrane.

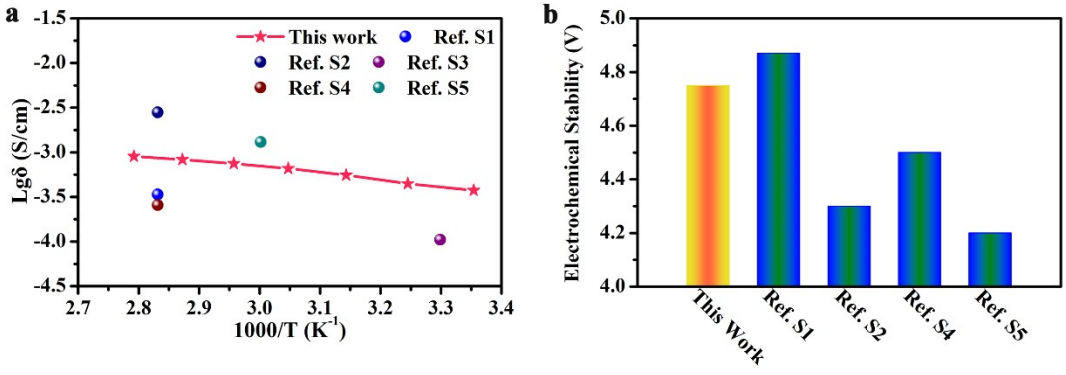


Fig. S9. The comparison of ionic conductivity (a)and electrochemical stability (b) between PFSA-Na membranes and previous literatures.[1-5]

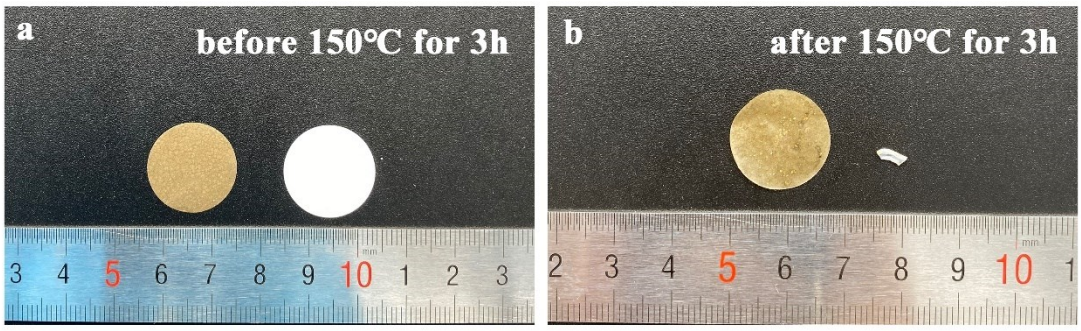


Fig. S10. The comparison of thermal stability between the PFSA-Na membrane and the traditional Celgard-2400 separator.

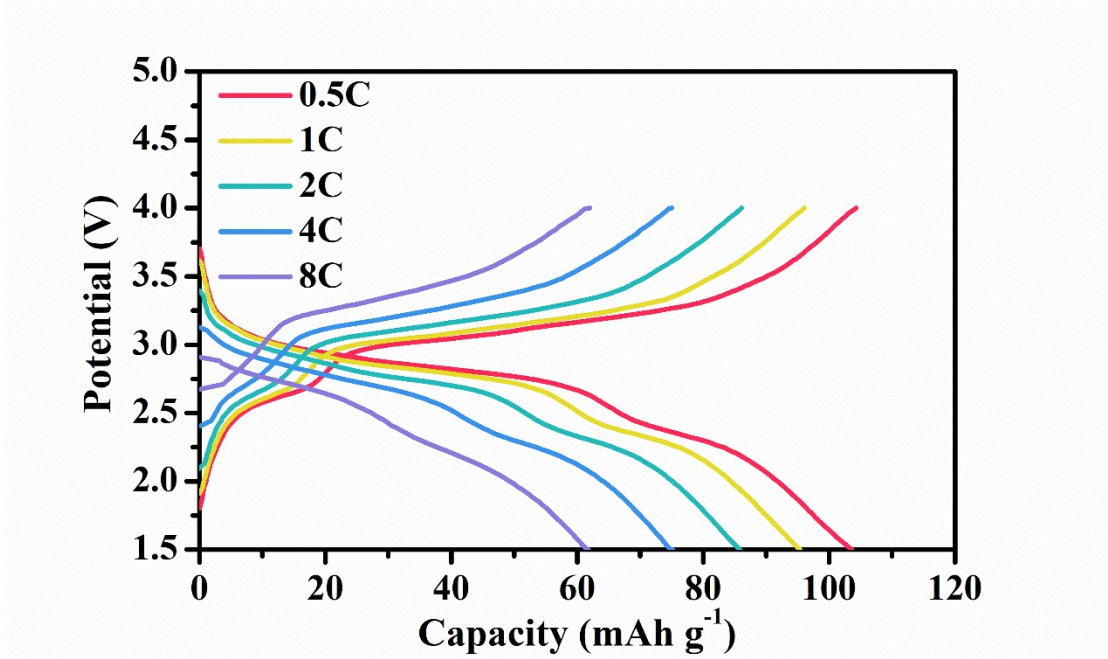


Fig. S11. Charge-discharge curves of the half QSSIB at different current rates of 0.5C, 1C, 2C, 4C and 8C.

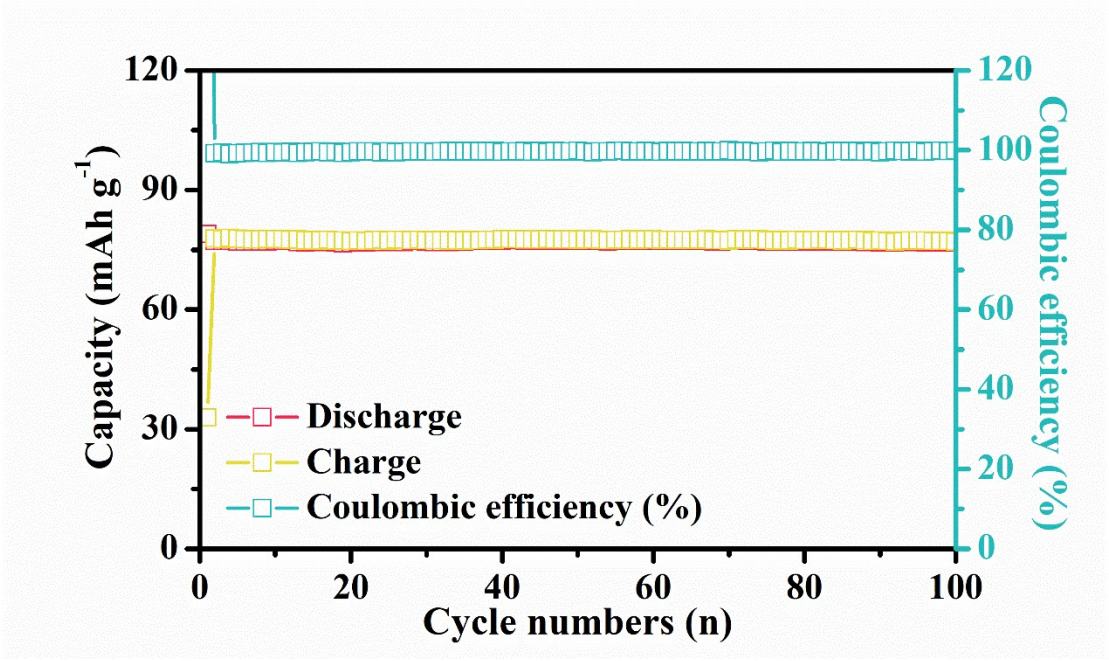


Fig. S12. Cyclic performance of the half QSSIB at a current rate of 0.5C at -10 °C.

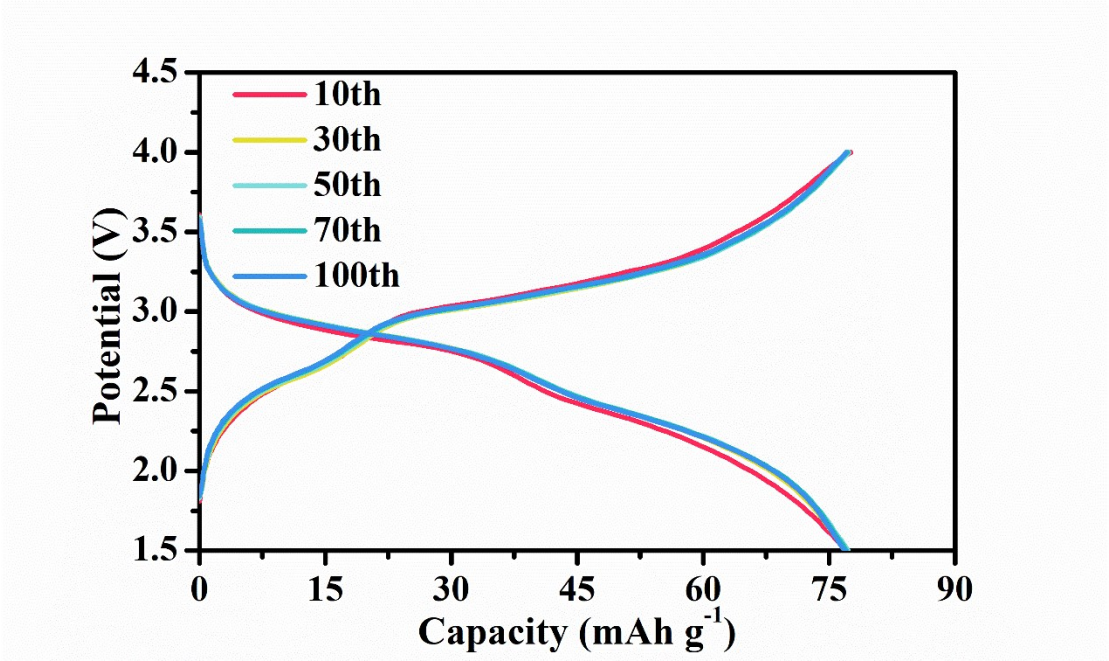


Fig. S13. Charge-discharge curves of the half QSSIB at -10 °C.

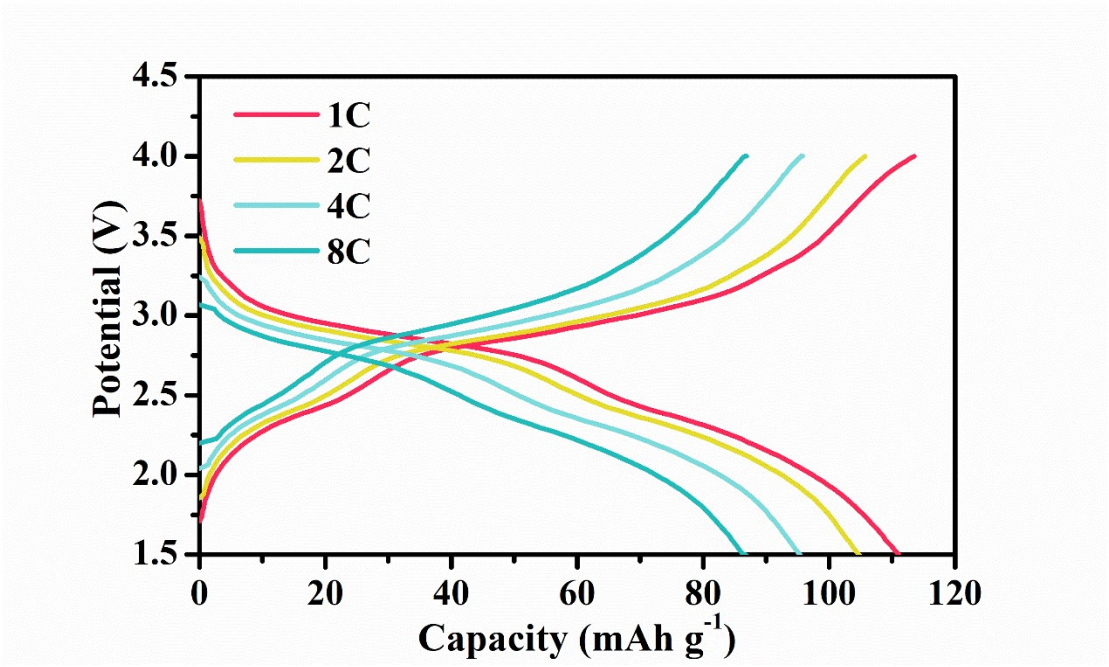


Fig. S14. Charge-discharge curves of the full QSSIB at different current rates of 1C, 2C, 4C and 8C.

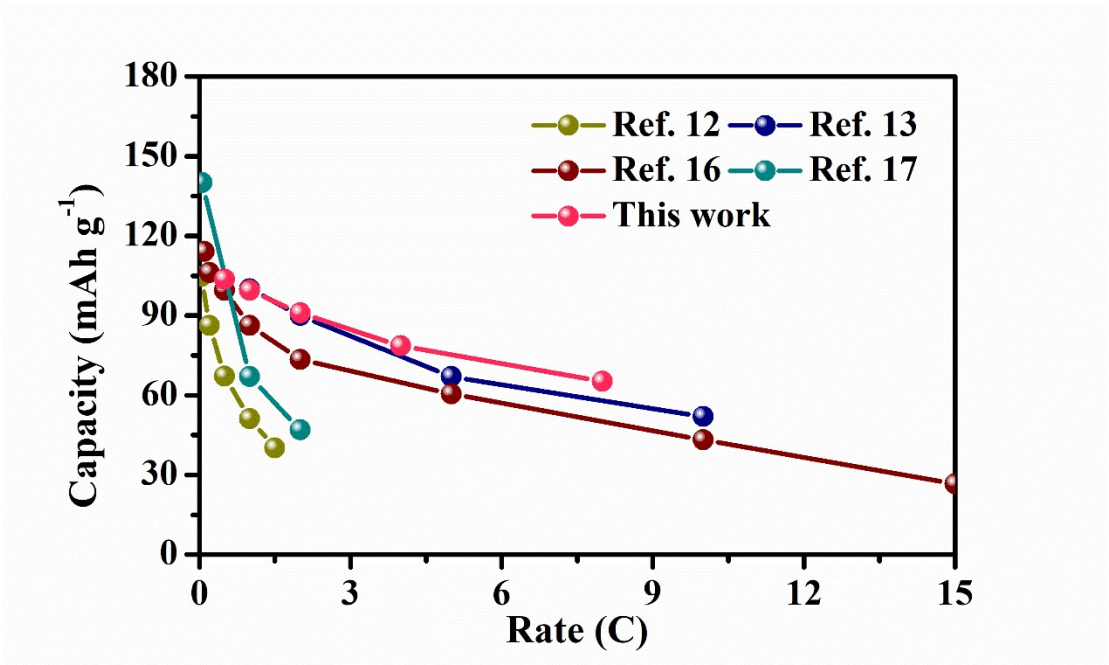


Fig. S15. The comparison of rate capability in full cells with previous literatures.

References:

1 Q. Ma, J. Liu, X. Qi, X. Rong, Y. Shao, W. Feng, J. Nie, Y.-S. Hu, H. Li, X. Huang, L. Chen, Z. Zhou, A new Na[(FSO_2)(n-$C_4F_9SO_2$)N]-based polymer electrolyte for solid-state sodium batteries, *J. Mater. Chem. A*, 2017, **5**, 7738-7743.

2 Z. Zhang, K. Xu, X. Rong, Y.-S. Hu, H. Li, X. Huang, L. Chen, $Na_{3.4}Zr_{1.8}Mg_{0.2}Si_2PO_{12}$ filled poly(ethylene oxide)/Na(CF_3SO_2)$_2$N as flexible composite polymer electrolyte for solid-state sodium batteries, *J. Power Sources*, 2017, **372**, 270-275.

3 V. K. Singh, S. Shalu, S. K. Chaurasia, R. K. Singh, Development of ionic liquid mediated novel polymer electrolyte membranes for application in Na-ion batteries, *RSC Adv.*, 2016, **6**, 40199-40210.

4 Y. Zheng, Q. Pan, M. Clites, B. W. Byles, E. Pomerantseva, C. Y. Li, High-Capacity All-Solid-State Sodium Metal Battery with Hybrid Polymer Electrolytes, *Adv. Energy Mater.*, 2018, **8**, 1801885.

5 S. Song, M. Kotobuki, F. Zheng, C. Xu, S. V. Savilov, N. Hu, L. Lu, Y. Wang, W. D. Z. Li, A hybrid polymer/oxide/ionic-liquid solid electrolyte for Na-metal batteries, *J. Mater. Chem. A*, 2017, **5**, 6424-6431.