

Supporting Information

Accelerating the ionic transport properties in zwitterionic PAM-based hydrogel for direct liquid fuel cells

Jianmeng Pang^{a,b}, Chenxi Liu^{a,b}, Minyue Yan^{a,b}, Yang Yang^{a,b}, Dingding Ye^{a,b}, Jun Li^{a,b}, Xun Zhu^{a,b,*}, Qiang Liao^{a,b}

^aKey Laboratory of Low-grade Energy Utilization Technologies and Systems (Chongqing University), Ministry of Education, Chongqing, 400030, China

^bInstitute of Engineering Thermophysics, School of Energy and Power Engineering, Chongqing University, Chongqing, 400030, China

*Corresponding author: zhuxun@cqu.edu.cn (Xun Zhu).

Supplementary Figures

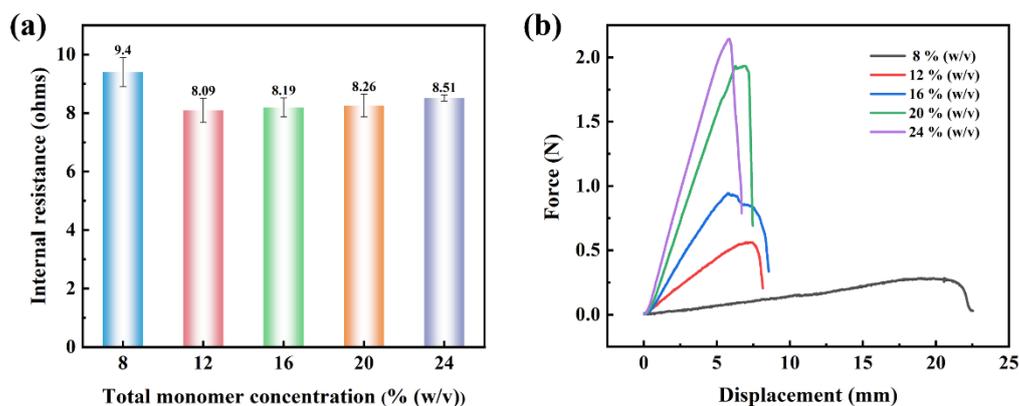


Figure S1. Structure-property relationships in P(AM-MAPTAC-SA) hydrogels as a function of monomer concentration. **(a)** Ohmic resistance and **(b)** adhesive interface performance represented by shear force-displacement profiles.

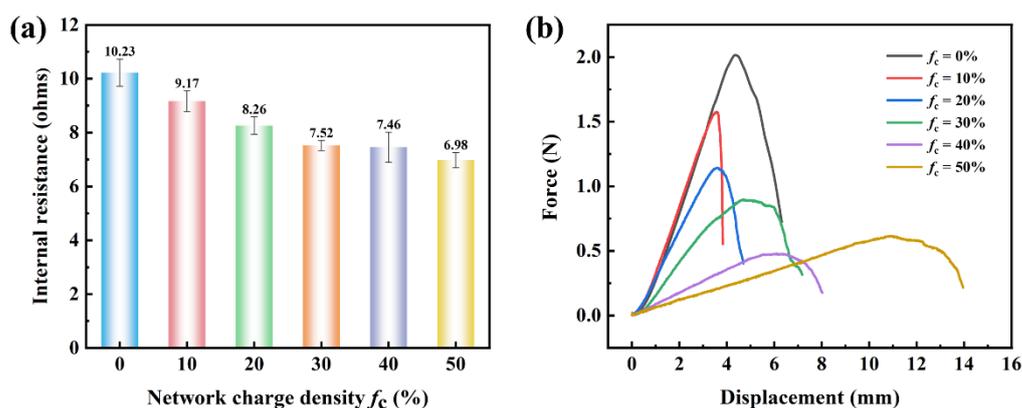


Figure S2. Structure-property relationships of P(AM-MAPTAC-SA) hydrogels tuned by network charge density. **(a)** Ohmic resistance and **(b)** shear adhesion force-displacement curves.



Figure S3. Optical images of P(AM-MAPTAC-SA) hydrogel with 50% network charge density

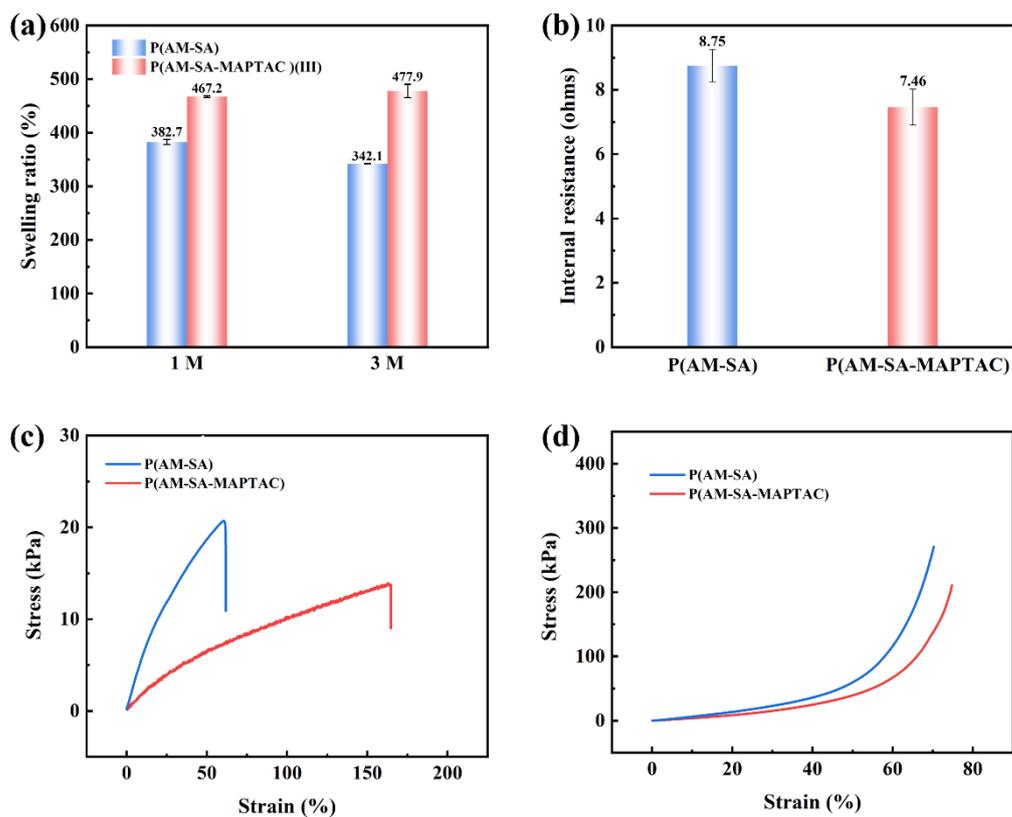


Figure S4. Zwitterionic modification enhances multifunctional performance of P(AM-SA) hydrogels. Comparative analysis of (a) swelling capacity, (b) charge transfer resistance, (c) tensile mechanical behavior, and (d) compressive mechanical response.

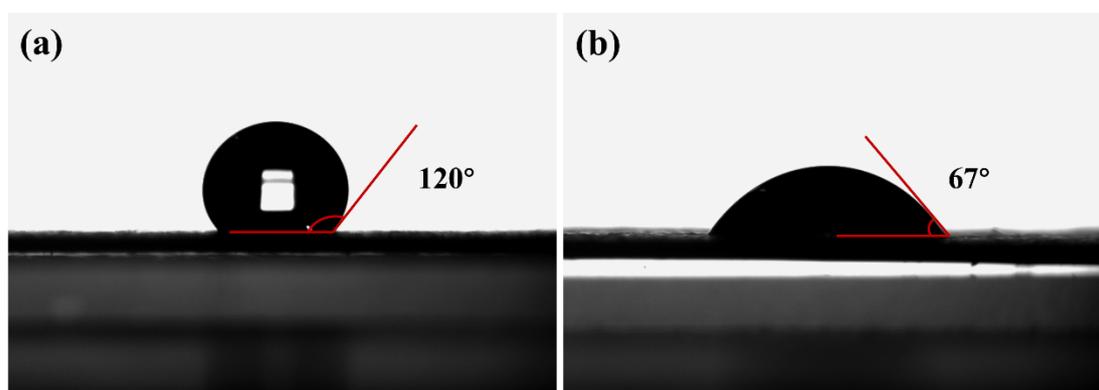


Figure. S5. Surface wettability engineering of carbon paper electrodes. Static water contact angle measurements (a) before and (b) after hydrophilic treatment.

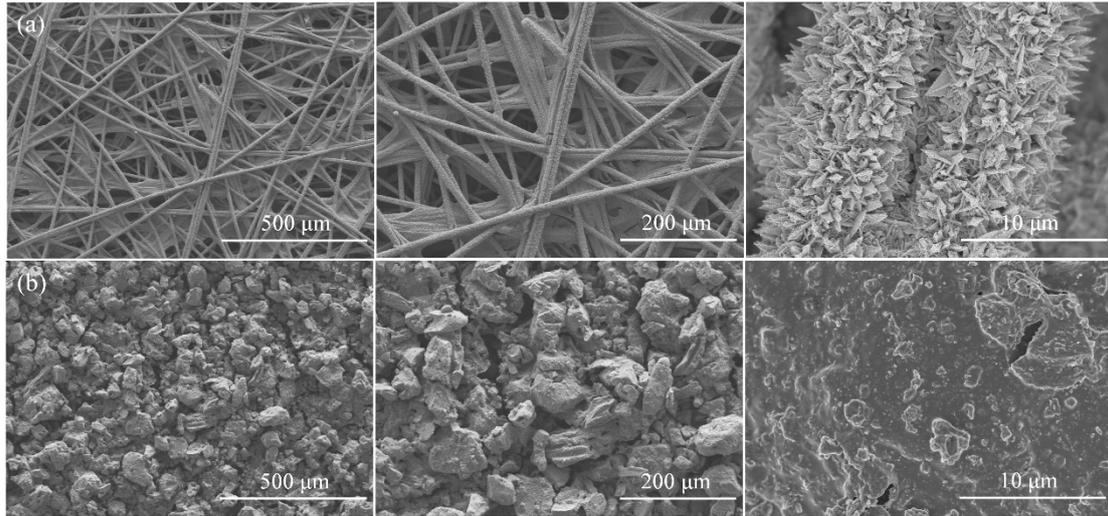


Figure S6. Microstructural landscape of fuel cell electrodes. Representative scanning electron microscopy (SEM) images of the **(a)** anode and **(b)** cathode surfaces.

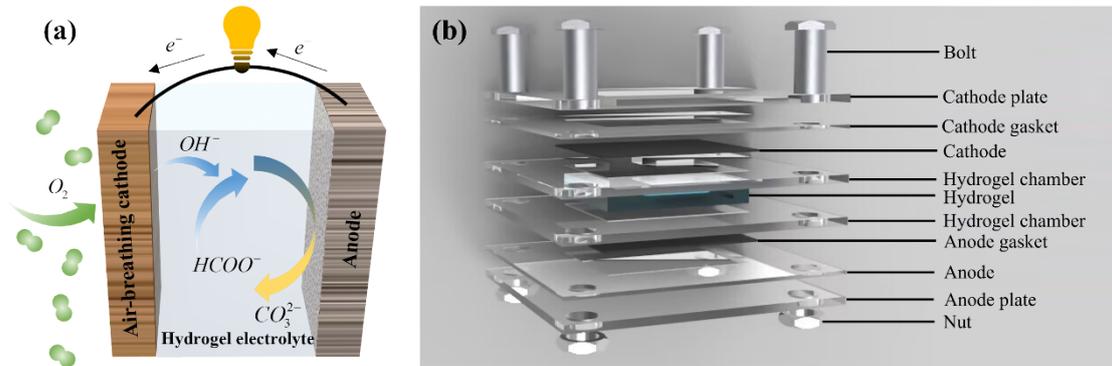


Figure S7. Conceptual and structural blueprint of the hydrogel fuel cell. **(a)** Operational mechanism illustrating ion transport pathways and **(b)** engineered assembly configuration with multilayer integration.

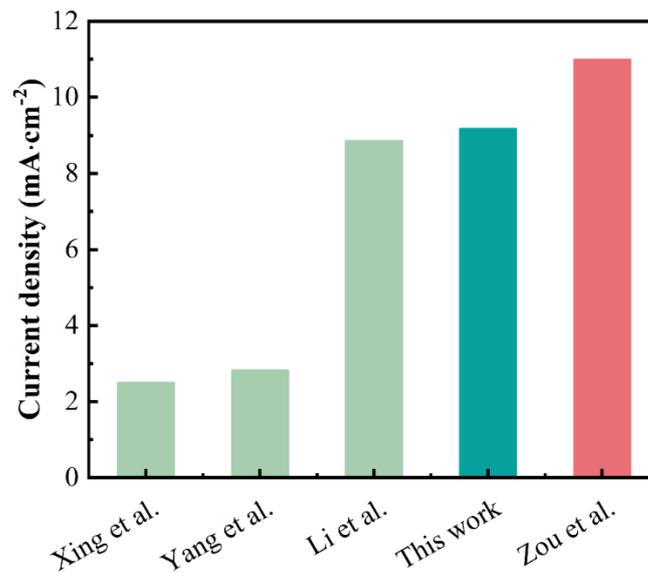


Figure S8. Power density comparison with previous studies [1-4].

Supplementary Reference

- [1] Y. Yang, K. Xing, M. Yan, X. Zhu, D. Ye, R. Chen, Q. Liao, *Energy* 2023, 265.
- [2] K. Xing, Y. Yang, X. Zhu, D. Ye, R. Chen, Q. Liao, *Chinese Science Bulletin* 2022, 67 28-29.
- [3] S. Zou, Y. Li, H. Jin, F. Ning, P. Xu, Q. Wen, S. Pan, X. Dan, W. Li, X. Zhou, *Advanced Energy Materials* 2021, 12(6).
- [4] X. Li, T. Chao, Y.-e. Duan, Y. Qu, Y. Liu, Q. Tan, *ACS Sustainable Chemistry & Engineering* 2021, 9(45) 15138-15146.