Electronic Supplementary Information (ESI)

Four-arm star-shaped high-performance poly (aryl piperidine) anion exchange membranes for fuel cells

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1. Synthesis of qPTTP-0.

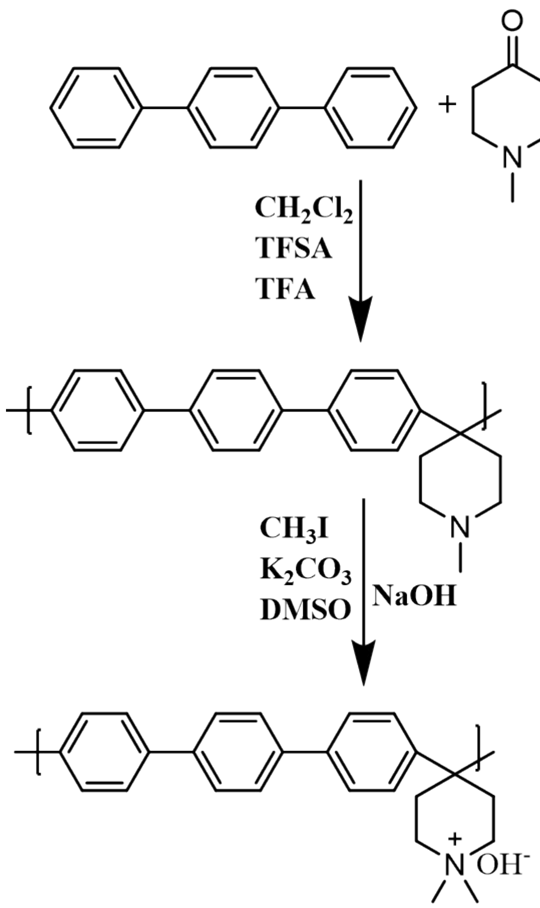


Figure S1. Synthesis route of qPTTP-0.

2. Synthesis and performance of PBP

For synthesis of poly (biphenyl piperidinium) or PBP, biphenyl (1.902 g, 10 mmol) and N-methyl-4-piperidone (1.37 mL, 12 mmol) were dissolved in 4 mL dichloromethane; then TFA (1 mL, 13.5 mmol) and TFSA (7.2 mL, 90 mmol) were added dropwise under an ice bath and reacted for 3 h. The viscous polymer solution was precipitated in deionized water, washed to neutral and vacuum dried at 60 ºC to get white solid. The above solid (1 g) was dissolved in 20 mL DMSO, to which 0.8 mL iodomethane and 0.8 g K_2CO_3 were added, and the mixture was stirred at 40 ºC for 24 h. The solution was then precipitated in ethyl acetate and washed repeatedly with deionized water. The product was vacuum dried at 60 ºC to obtain PBP.

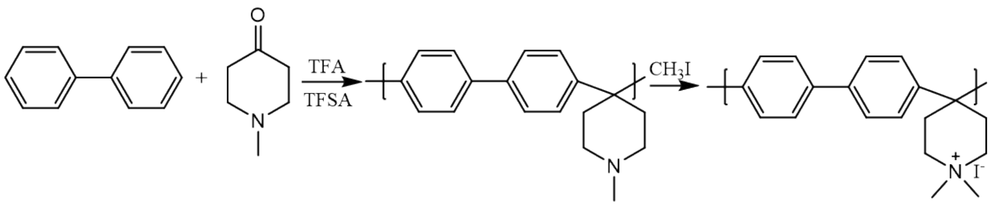
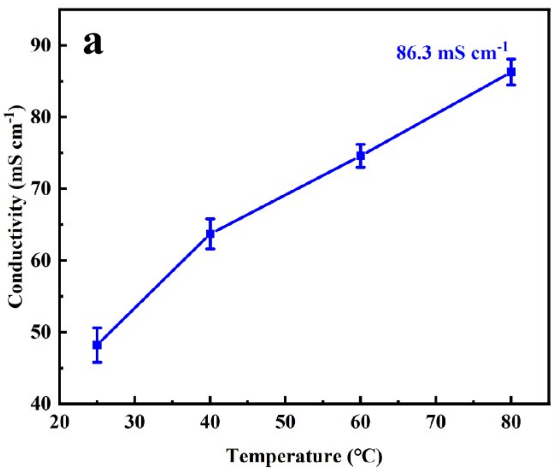


Figure S2 Synthesis route of PBP



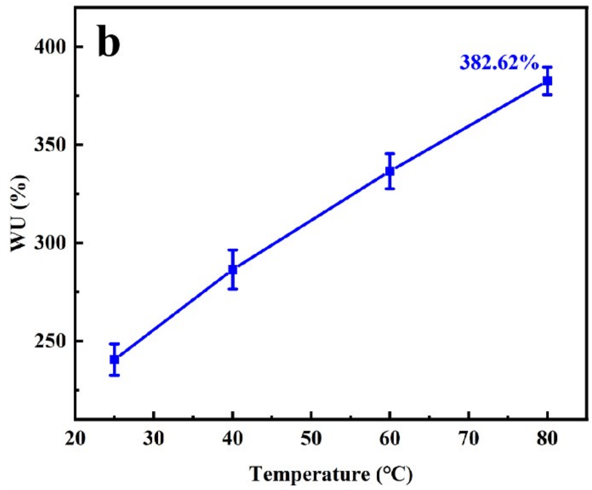


Figure S3 The (a) conductivity and (b) WU of PBP

3. SAXS spectra of qPTTP-0 and qPTTP-7

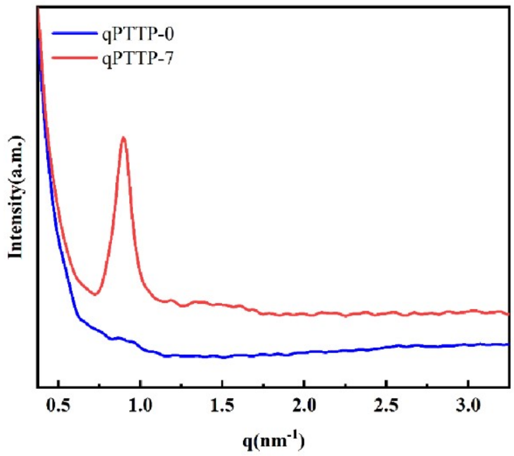


Figure S4 SAXS spectra of qPTTP-0 and qPTTP-7

4. Mechanical properties and thermal stability.

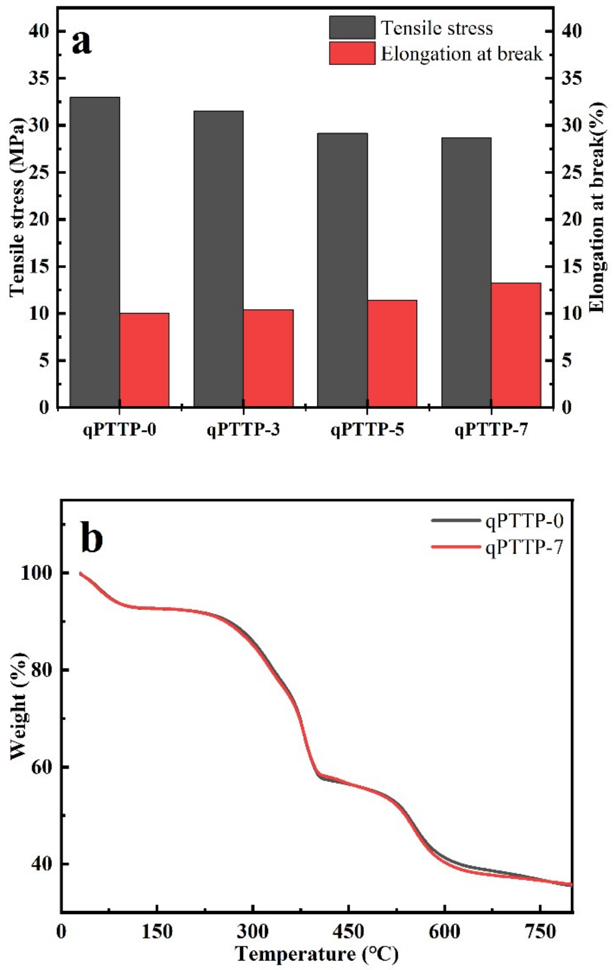


Figure S5 (a) Tensile strength and elongation at break of qPTTP-x and (b) TGA curves of qPTTP-0 and qPTTP-7.

5. Comparison of alkali stability.

Table S1. Comparison of alkali stability.

Membranes	Test time (h)	Alkali concentration (M)	Conductivity retention (%)	References
qPTTP-7	3000	1	86.5	This work
PTP-DPC/C10-50%	1100	2	92.2	[1]
PPTDF-QA-2.5	1900	3	83.8	[2]

QAPCE-16C	960	1	95.8	[3]
QABNP	1080	2	90.0	[4]
PTF6-QAPTP	1200	2	93.5	[5]
TPTP-Pip-OH-20%	1500	2	87.4	[6]
QPPTTP-75	1080	2	91.5	[7]
PPO-O-40	864	1	56.0	[8]
B-PBFB-DMP	2250	1	91.9	[9]
PDTP-10	1500	1	81.0	[10]
QABP-2	1000	1	88.0	[11]
QPEPTpi-35	2000	1	85.0	[12]

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