

Supporting information for

**High-performance anion exchange membrane water
electrolyzers with a current density of 7.68 A cm⁻² and
durability of 1000 h**

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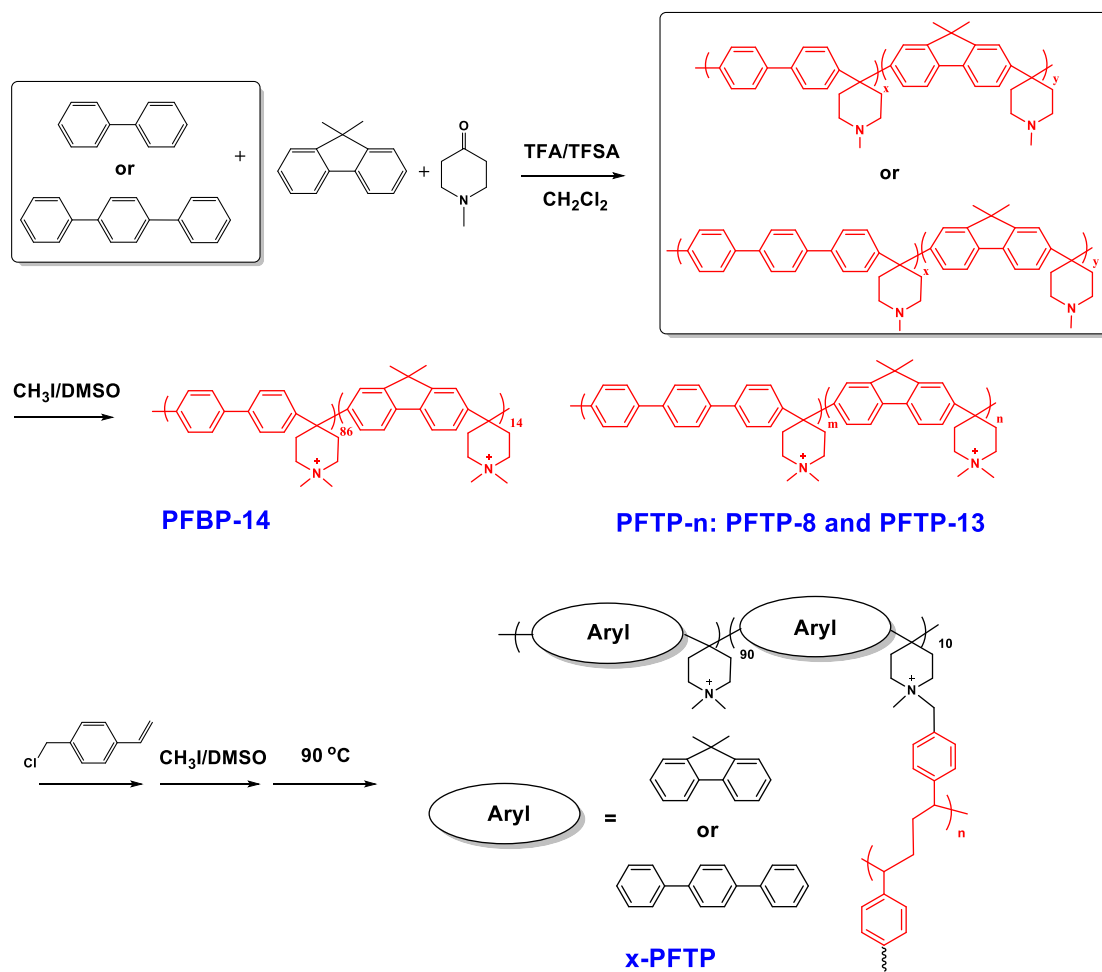


Fig. S1 Synthesis route to PFAP copolymers.

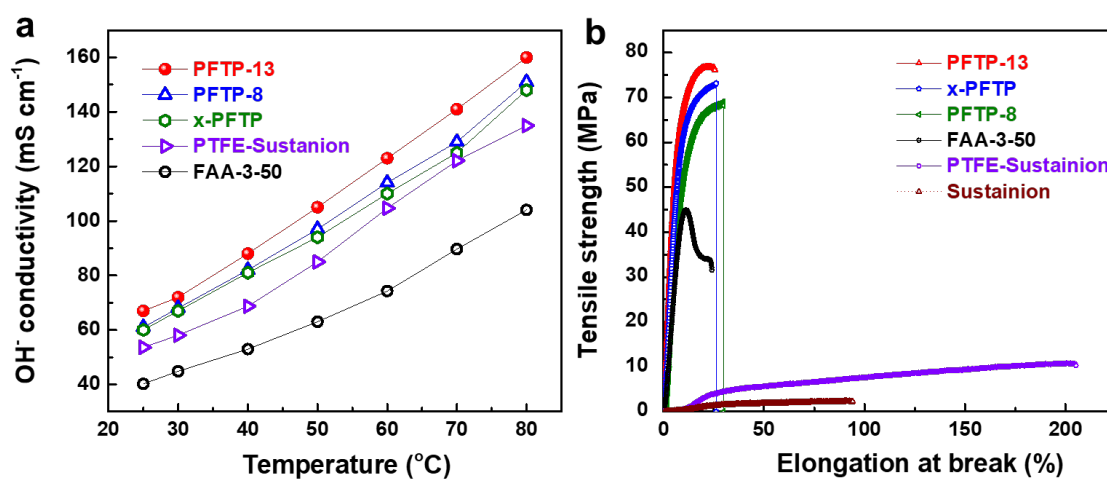


Fig. S2 Ion conductivity and mechanical properties of AEMs. a, OH⁻ conductivity of PFAP and commercial AEMs as a function of temperature. b, Mechanical properties of PFAP and commercial AEMs.

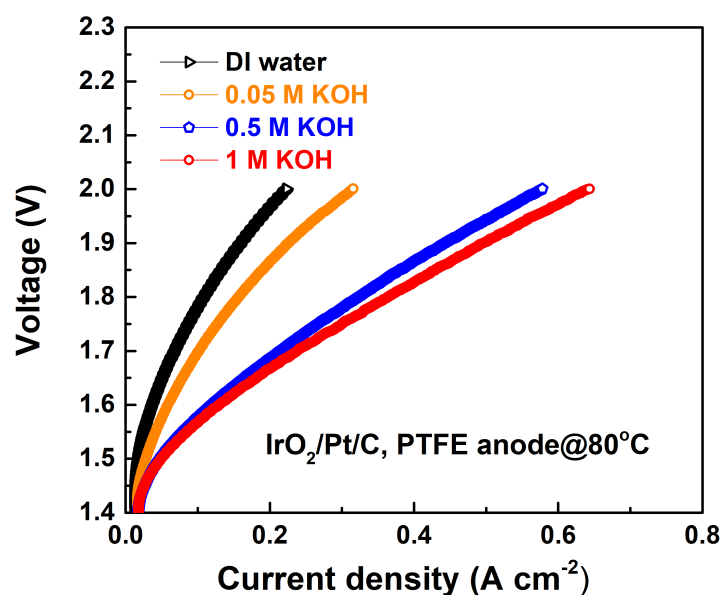


Fig. S3 AEMWE performance in different KOH concentrations at 80 °C. PFTP-8 AEMs (~40 μm), non-ionic PTFE anode binder, and PFBP-14 cathode ionomers.

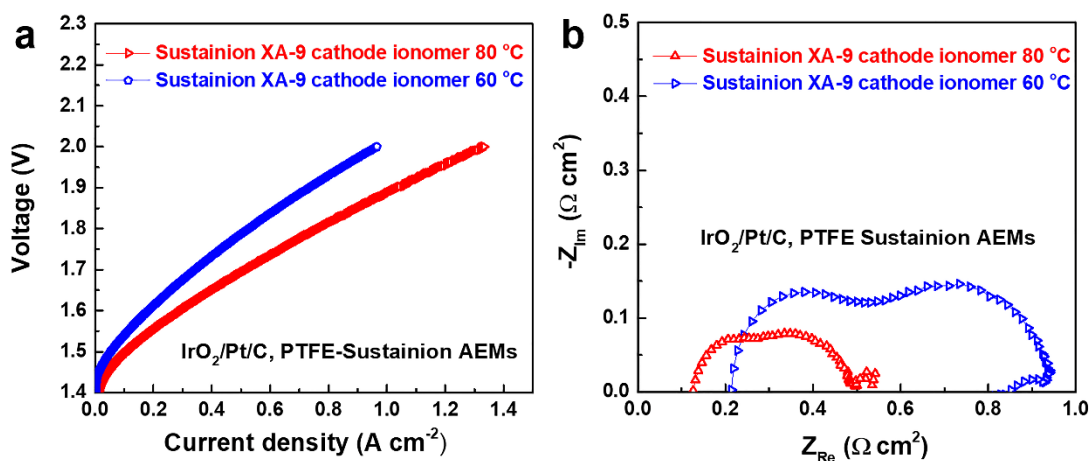


Fig. S4 AEMWE performance based on PTFE-Sustainion[®] AEMs. **a**, PTFE-reinforced Sustainion[®] AEM-based AEMWEs with 10% Sustainion[®] XA-9 cathode ionomers and 10% PTFE anode ionomers at different temperatures. **b**, EIS spectra of cells.

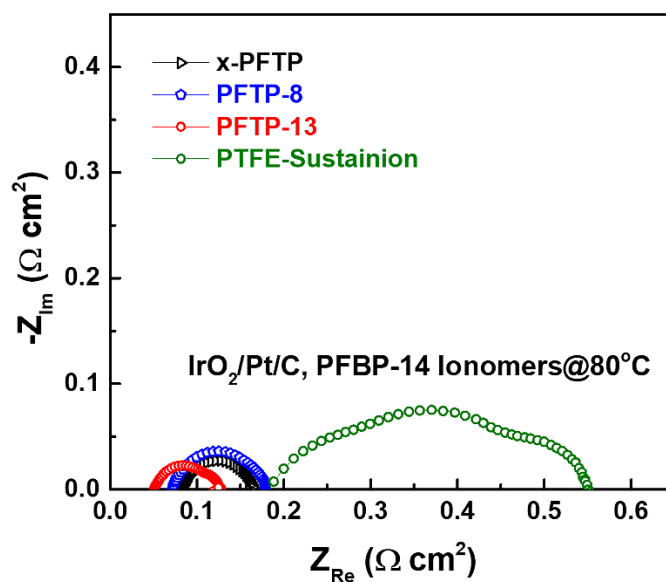


Fig. S5 EIS analysis. EIS spectra of AEMWEs based on different AEMs with 25% PFBP cathode ionomers, PFTP-8 anode ionomers, 2 mg cm⁻² IrO₂ anode, and 0.5 mg cm⁻² Pt/C cathode.

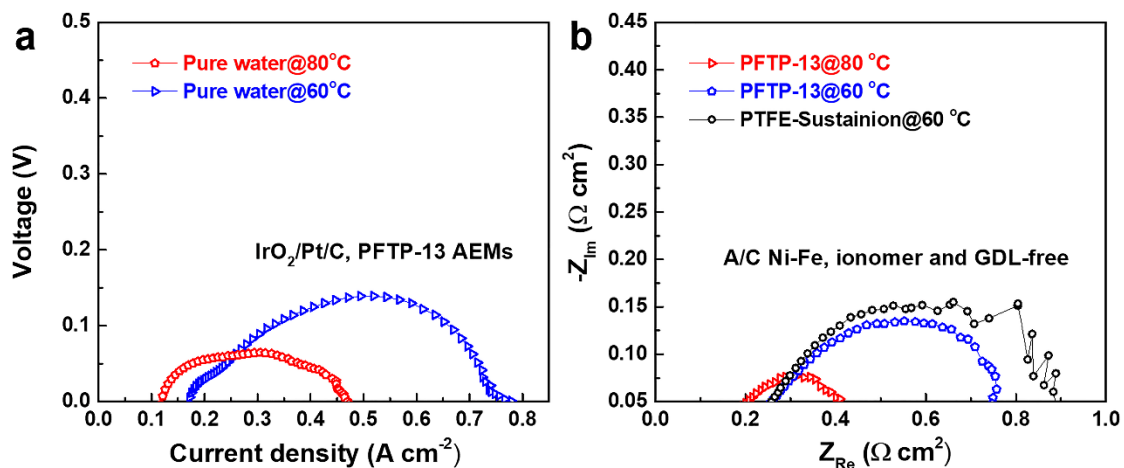


Fig. S6 EIS analysis. EIS spectra of AEMWEs based on PFTP-13 AEMs with 25% PFBP cathode ionomers and PFTP-8 anode ionomers. **a**, Pure water condition with 2 mg cm⁻² IrO₂ anode and 0.5 mg cm⁻² Pt/C cathode. **b**, A/C Ni-Fe catalysts without ionomers or GDLs.

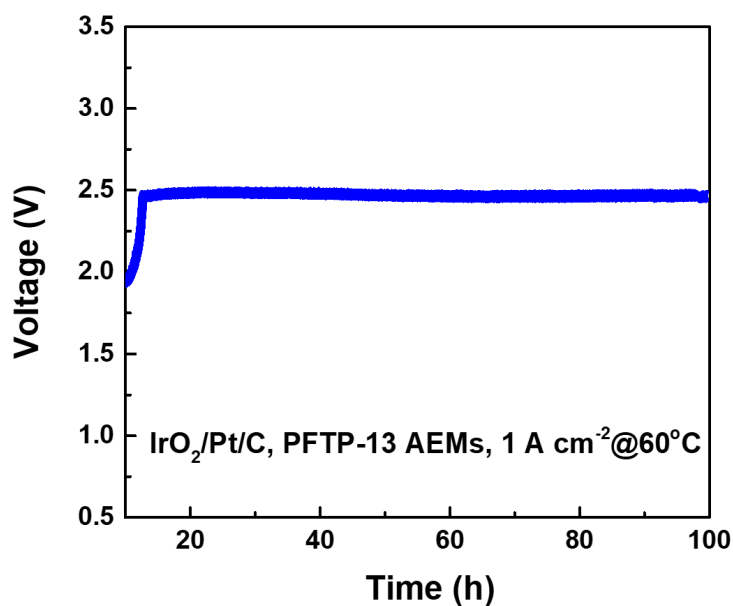


Fig. S7 In situ durability. Durability of AEMWEs based on PFTP-13 AEMs with 25% PFBP cathode ionomers and PFTP-8 anode ionomers at 1 A cm⁻² and 60 °C with 2 mg cm⁻² IrO₂ anode and 0.5 mg cm⁻² Pt/C cathode.

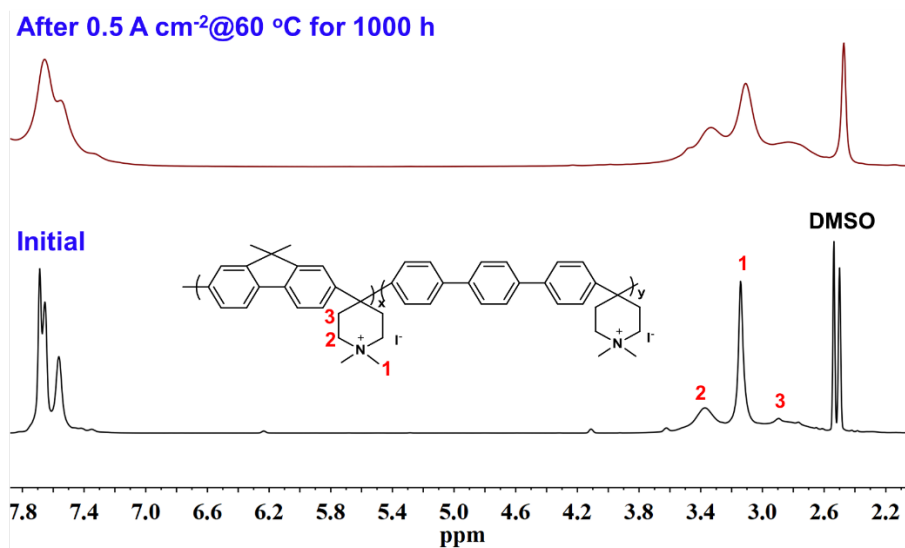


Fig. S8 ¹H NMR spectra of PFTP and PFBP-based CCM after *in situ* durability testing under 0.5 A cm⁻² at 60 °C for 1,000 h. DMSO-d₆ was used as solvent, and 10% TFA was added to remove the water effect.

Table S1. The ECSA of cathode and anode electrodes			
Catalyst	Ionomer	ECSA ($\text{m}^2 \text{g}_{\text{Pt}}^{-1}$)	Ref
Pt/C	PFBP-14	52.2 $\text{m}^2 \text{g}_{\text{Pt}}^{-1}$	This work
Pt/C	FAA-3-SOLUT-10	49.9 $\text{m}^2 \text{g}_{\text{Pt}}^{-1}$	[1]
Pt/C	QPC-TMA	54.3 $\text{m}^2 \text{g}_{\text{Pt}}^{-1}$	[1]

Reference

- [1] M. S. Cha, J. E. Park, S. Kim, S. H. Han, S. H. Shin, S. H. Yang, T. H. Kim, D. M. Yu, S. Y. So, Y. T. Hong, S. J. Yoon, S. G. Oh, S. Y. Kang, O. H. Kim, H. S. Park, B. Bae, Y. E. Sung, Y. H. Cho and J. Y. Lee, *Energy & Environmental Science*, 2020, **13**, 3633-3645.