Electronic Supporting Information(ESI) for

Development of highly conductive anion exchange membranes

based on crosslinked PIM-SEBS with high free volume

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Experimental Section

Materials. Aluminum chloride (99%), 6-bromohexanoyl chloride, *N*-methyl-*4*-piperidone (97%), trimethylamine solution (45 wt% in H_2O), and iodomethane (99%) were purchased from Sigma-Aldrich (St. Louis, MO, USA). Bisphenol A (99%) and trifluoromethanesulfonic acid (98%) were obtained from TCI (Tokyo, Japan). Methanesulfonic acid (98%) and triethylsilane (98%) were obtained from Alfa Aesar (Haverhill, MA, USA). Potassium carbonate (99.5%) and trifluoroacetic acid were obtained from Daejung Chemicals & Metals (Siheung-si, Republic of Korea). Poly(styrene-b-ethylene-co-butylene-b-styrene) (SEBS, A1535H) with 57% styrene content was obtained from Kraton (Houston, TX, USA). All other chemicals were obtained from other commercial sources.

Synthesis of 6,6'-dihydroxy-3,3,3',3'-tetramethyl-1,1'-spirobiindane (SBP). Bisphenol A (60.00 g, 262.82 mmol) was melted at 140 °C, and methanesulfonic acid (3.41 mL, 52.56 mmol) was added. Then, the mixture was reacted via mechanical stirring for 5 h. Next, it was slowly poured into water. The precipitated solid was washed several times with water and recrystallized with EA and hexane as the solvent. The product obtained after recrystallization was in the form of a white flocculent (12.98 g, 48.04%); δ_H (400 MHz, DMSO) 8.97 (2H, s, H_1), 6.99 (2H, d, *J*=8.0 Hz, H_6), 6.60 (2H, d, *J*=8.0 Hz, H_5), 6.11 (2H, s, H_4), 2.26 (2H, d, *J*=12.0 Hz, H_2), 2.11 (2H, d, *J*=12.0 Hz, $H_{2'}$), 1.30 (6H, s, H_3), 1.24 (6H, s, $H_{3'}$).

Synthesis of 6,6′-dimethoxy-3,3,3′,3′-tetramethyl-1,1′-spirobisindane (SBI). SBP (2 g, 6.48 mmol) was dissolved in 20 mL of DMF, and potassium carbonate (3.58 g, 25.94 mmol) and iodomethane (1.2 mL, 19.45 mmol) were added. Then, the mixture was reacted via mechanical stirring overnight. When the reaction was complete, water was added to the reaction mixture to dissolve K_2CO_3. The mixture was added to a separating funnel, and EA was added. Only the organic layer was separated, and the water layer was discarded. After evaporating all the solvent, it was purified via column chromatography (EA: Hex=1:30). After column chromatography, all solvents were evaporated to obtain white crystals (1.97 g, 90.23%); δ_H (400 MHz, DMSO) 7.13 (2H, d, *J*=8.0 Hz, H_6), 6.79 (2H, dd, *J*=8.0 Hz, *J*=2.0 Hz, H_5), 6.18 (2H, d, *J*=2.0 Hz, H_4), 3.62 (6H, s, H_1), 2.28 (2H, d, *J*=12.0 Hz, H_2), 2.16 (2H, d, *J*=12.0 Hz, $H_{2'}$), 1.34 (6H, s, H_3), 1.27 (6H, s, $H_{3'}$).

Synthesis of PIM-*N*-methyl piperidine l. SBI (3.00 g, 8.92 mmol) and *N*-methyl-*4*-piperidone (1.32 g, 11.59 mmol) were added to a completely dry 50-mL two-neck round-bottom flask with a magnetic stirrer under a nitrogen atmosphere and then dissolved in dichloromethane (12 mL). After the mixture was fully dissolved, the solution was cooled to 0 °C using an ice bath. Next, trifluoroacetic acid (1.52 g, 13.37 mmol) and trifluoromethanesulfonic acid (24.70 g, 89.16 mmol) were slowly added to the solution under

continuous stirring. The color of the solution changed from light brown to dark brown. After 48 h, the viscous solution was poured into a large amount of KOH solution (500 mL), and the precipitated polymer was filtered onto filter paper and washed with deionized (DI) water several times to remove any residual reactants. The obtained polymer was dried in a vacuum oven at 80 °C for 24 h. The resulting PIM-N-methyl piperidine **2** was an ivory powder (3.84 g, 99.3%); δ_H (400 MHz, CDCl$_3$) 7.85–6.73 (8H, broad signal, H$_{1,2}$), 3.05–2.67 (4H, d, H$_{3,3'}$), 2.60–2.13 (8H, broad signal, H$_{5,5',6}$), 2.12–1.67 (4H, d, H$_{4,4'}$).

Synthesis of bromohexanoyl SEBS. SEBS (5.00 g, 27.36 mmol) was added to a 500-mL two-neck round-bottom flask with a magnetic stirrer under a nitrogen atmosphere and then dissolved in dichloromethane (150 mL). After the polymer was fully dissolved, aluminum chloride (2.01 g, 15.06 mmol) and 6-bromohexanoyl chloride (3.21 g, 15.06 mmol) in dichloromethane (50 mL) were slowly added using a dropping funnel. After 24 h, the reaction mixture was added to a large amount of ethanol (1000 mL), and the precipitated polymer was filtered onto filter paper and washed with ethanol several times to remove any residual reactants. The obtained polymer was dried in a desiccator at room temperature (RT) for 24 h, and this yielded bromohexanoyl SEBS **4** as a white rubbery product with a 70% molar ratio of bromohexanoyl-functionalized side chains (8.29 g, 98.8%); δ_H (400 MHz, CDCl$_3$) 7.20–6.09 (4H, broad signal, H$_{aromatic}$), 3.35–3.90 (6H, broad signal, H$_1$), 2.70–1.78 (13H, broad signal, H$_{2,4,5,5',6}$), 1.75–1.05 (14H, broad signal, H$_{3,4}$).

Synthesis of bromohexyl SEBS. Bromohexanoyl SEBS **4** (8.00 g, 14.74 mmol) was added to a 500-mL two-neck round-bottom flask connected to a reflux condenser and fitted with a magnetic stirrer under a nitrogen atmosphere. It was then dissolved in chloroform (200 mL). After the polymer was fully dissolved, triethyl silane (23.55 mL, 147.4 mmol) and trifluoroacetic acid (22.56 mL, 294.8 mmol) were added. The reaction mixture was slowly heated to 105 °C and was maintained at this temperature for 48 h. The reaction mixture was cooled to RT, and 1 M KOH (200 mL) was added to neutralize the solution. The organic layer was added to methanol (1000 mL), and the precipitated polymer was filtered onto filter paper and washed with methanol several times to remove any residual reactants. The obtained polymer was dried in a desiccator at RT for 24 h, and the bromohexyl SEBS **3** was obtained as a white rubbery product (7.66 g, 93.54%); δ_H (400 MHz, CDCl$_3$) 7.23–6.19 (12H, broad signal, H$_{6-10}$), 3.51–3.38 (3H, broad signal, H$_1$), 2.67–2.26 (5H, broad signal, H$_{5',12}$), 2.11–0.55 (47H, broad signal, H$_{2-5,11,13-18}$).

Characterization and measurements. The chemical structure of the synthesized SBP, SBI, PIM-N-methyl piperidine **2**, pristine SEBS, bromohexnoyl **4,** and bromohexyl SEBS **3** were identified via ^{1}H NMR spectroscopy. ^{1}H NMR spectra were obtained using a 400 MHz NMR instrument (Agilent 400-MR) using

CDCl$_3$ as the reference. Attenuated total reflection–Fourier transform infrared (ATR–FTIR) spectra were recorded on a PerkinElmer FTIR Spectrum Two spectrometer.

Water uptake (WU) and swelling ratio (SR). The WU (%) and swelling ratio (SR, %) were calculated for each membrane by soaking the circular membranes in water at 20 °C and 80 °C. The membranes in their OH$^-$ form were immersed in DI water for at least 24 h, the surface of the membrane was wiped dry with a tissue, the sample was quickly weighed (W$_{wet}$), and the length (L$_{wet}$) and thickness (T$_{wet}$) were quickly measured. The membrane was dried under vacuum for 24 h, and the weight (W$_{dry}$), length (L$_{dry}$), and thickness (T$_{dry}$) of the dry membrane were also recorded. The following equations were used to determine the WU (%) and SR (%):

$$WU\ (\%) = \frac{W_{wet} - W_{dry}}{W_{dry}} \times 100$$

$$SR\ (\%) = \frac{L_{wet} - L_{dry}}{L_{dry}} \times 100\ or\ \frac{T_{wet} - T_{dry}}{T_{dry}} \times 100$$

The hydration number (λ) of each membrane was calculated from the WU and the experimental ion exchange capacity (IEC) of each membrane. The following equation was used to determine λ:

$$Hydration\ number\ (\lambda) = \frac{Water\ uptake\ (\%) \times 1000}{IEC \times 18}$$

IEC. The IEC values of each membrane in OH$^-$ form were determined by acid–base back titration. The samples in OH$^-$ form were washed with DI water several times and immersed in 10 mL of 0.01 M HCl standard aqueous solution for at least 24 h to neutralize OH$^-$. Then, the membranes were removed and dried in a 40 °C vacuum oven for 24 h. The residual HCl solution was titrated with a 0.01 M NaOH standard aqueous solution, using a phenolphthalein indicator. The following equation was used to determine the experimental IEC (meq g^{-1}):

$$IEC\ (meq\ g^{-1}) = \frac{(V_0 \times C_0 - V_{KOH} \times C_{KOH})}{W_{dry}}$$

where V$_0$ and C$_0$ are the volume and concentration of HCl standard aqueous solution, respectively, V$_{KOH}$ and C$_{KOH}$ are the volume and concentration of KOH standard aqueous solution in the back titration, respectively, and W$_{dry}$ is the weight of the membrane after drying in the oven at 40 °C for 24 h.

Mechanical properties and thermal stability. A benchtop tensile tester (Shimadzu EZ-TEST E2-L, Kyoto, Japan) was used to measure the mechanical properties of the membrane in its OH$^-$ form at a

crosshead speed of 10 mm min^{-1} at 25 °C under 50% relative humidity (RH). The cross-sectional area of the sample in its initial state was used to determine the engineering stress. The initial slope of the stress–strain curve was used to calculate Young's modulus (E). For this test, samples of each membrane were prepared in dumbbell shapes with a total area of 40 × 10 mm and a test area of 20 × 10 mm.

The thermal stability of the membranes was investigated by thermogravimetric analysis (TGA) using a Scinco TGA N-1000 instrument (Seoul, Korea). The TGA was operated at a heating rate of 10 °C min^{-1} from 30 to 800 °C in a nitrogen atmosphere.

The glass transition temperature (T_g) of each membrane was measured by differential scanning calorimetry (DSC) using a PerkinElmer DSC 4000 (Waltham, MA, USA). The samples were prepared in aluminum pans and measured from −40 to 200 °C for two cycles with heating and cooling rates of 10 °C min^{-1}. T_g was determined from the second heating cycle.

Density and fractional free volume (FFV). The density of each dry membrane in its Br$^-$ form and wet membrane in its OH$^-$ form was measured using the following procedure. Before the dry membrane measurement, the membranes were dried in an oven at 40 °C for at least 24 h, and the density was measured via the buoyancy method using n-heptane (density = 0.684 g cm^{-3}) at RT. Before the wet membrane measurement, to make each membrane into the OH$^-$ form, it was soaked in 1 M KOH solution for 24 h and then rinsed with DI water. The surface of the wet membrane was wiped dry with a tissue, the sample was quickly measured via the buoyancy method using n-heptane at RT. The following equation was used to determine the density (g cm^{-3}) of each membrane:

$$density\ (g\ cm^{-3}) = \frac{W_{air}}{W_{air} - W_{hep}} \times D_{hep}$$

where W_{air} is the weight of the membrane in air, W_{hep} is the weight of the membrane immersed in heptane, and D_{hep} is the density of n-heptane (0.684 g cm^{-3}).

The FFV is a dimensionless parameter that characterizes the volume not occupied by the polymer in a cell and can be calculated using the *Visualizer* module of the Material Studio package. The molecular surface can be calculated in three ways, and in this study, the van der Waals (vdW) surface, which is created by the surface intersecting the vdW radius of the atom, was obtained. The following equation was used to determine the fractional free volume:

$$FFV = \frac{V_{sp} - 1.3V_{vdW}}{V_{sp}}$$

where V_{vdW} is the vdW volume calculated via the group contribution method, and 1.3 is the universal packing coefficient. V_{sp} is the specific volume, which is defined as the reciprocal density.

Water retention capacity. The freezing and non-freezing water contents of the membranes were measured from the DSC of their fully hydrated state using the PerkinElmer DSC 4000. A sample fully hydrated membrane was sealed in an aluminum pan, and a sealed empty aluminum pan was prepared for use as the reference. Both pans were weighed and frozen at $-40\ ^\circ$C inside the DSC chamber. Then, the temperature was held constant while the system was equilibrated. Afterward, the DSC chamber was heated to $20\ ^\circ$C at a heating rate of $2\ ^\circ$C min^{-1}. This cycle was repeated twice, and the values were recorded from the second heat cycle.

Wide-angle X-ray diffraction (WAXD). WAXD spectra of the dry membranes were collected using a Rigaku HR-XRD Smart Lab diffractometer by employing a scanning rate of 0.2° min^{-1} in the 2θ range of 10° to 30° using Cu Kα X-rays ($\lambda = 1.5412$ Å). The dried membranes were placed under vacuum at $60\ ^\circ$C for 12 h and equilibrated at 50% RH at least 24 h before the measurement.

Hydrogen permeability. H_2 permeability measurements were carried out via the traditional constant volume/variable pressure method at RT under dry and humidified conditions by slightly modifying the method described in the literature, as shown in **Scheme S1**.[1] The measurement was repeated more than three times for each membrane using different specimens, and the average value was used for subsequent calculations. The H_2 permeability was calculated using the following equation:

$$Permeability\ (barrer) = DS = \frac{V_p l (P_{p2} - P_{p1})}{[ART\Delta t (P_f - \frac{P_{p2} - P_{p1}}{2})]}$$

where D is the H_2 gas diffusivity coefficient (cm^2 S^{-1}), S is the solubility coefficient [cm^3 (cm^{2}scmHg)$^{-1}$], V_p is the constant permeation volume (cm^3), l is the thickness (cm), A is the active membrane surface (cm^2), R is the universal gas constant (J mol^{-1} K^{-1}), T is the temperature (K), Pf is the feed pressure (cmHg), and Δt is the time taken for the pressure to change from P_{p1} to P_{p2} (s).
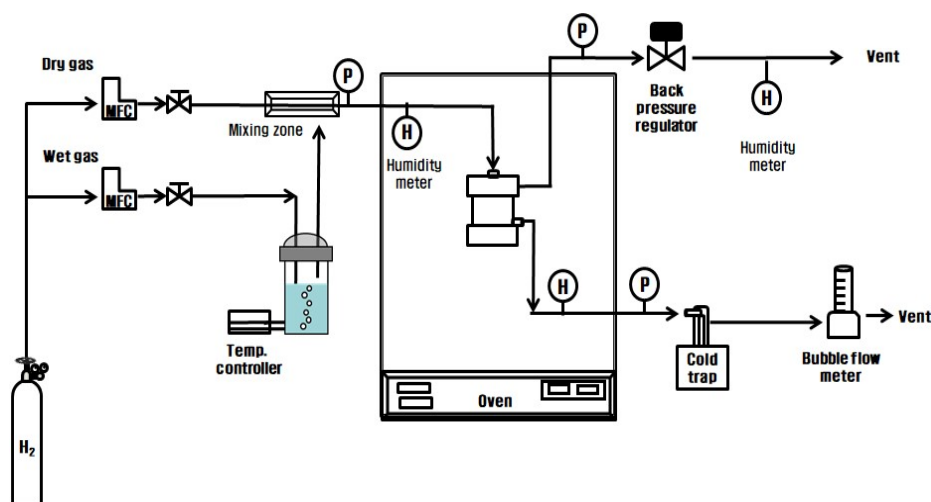
Scheme S1. Schematic of the gas permeability measurement system

Morphological analysis. The morphology of each membrane was analyzed using field emission–transmission electron microscopy (FE–TEM, Talos F200X, Thermo Fisher Scientific, Waltham, MA, USA) at an accelerating voltage of 200 kV. The samples were prepared as follows: 3–4 drops of 0.5 wt% polymer solution in $CHCl_3$ were placed on a copper grid to make a thin homogeneous film. The grid was dried at 40 °C for 12 h and then treated with TMA solution at 45 °C for 12 h. After TMA treatment, the grid was washed with DI water to remove excess TMA and dried in the oven at 40 °C.

The microphase separation of the membranes was observed using atomic force microscopy (AFM, Bruker MULTIMODE-8-AM, Billerica, MA, USA). The AFM samples were equilibrated to 50% RH for at least 24 h before imaging, and the AFM analysis of each sample was conducted under the same conditions for consistency. The AFM phase images are provided as recorded without further image processing.

Hydroxide ion conductivity. The hydroxide ion conductivity (σ) of each membrane was measured via two-probe impedance spectroscopy using an AC impedance analyzer (SP-200, Bio-Logic SAS, Claix, France). The electrode systems were connected at frequencies from 100 mHz to 2 MHz. Rectangular samples were prepared with the dimensions of 1×4 cm. The OH^- conductivity was measured using the resistance (R) in DI water from 20 to 80 °C. The OH^- conductivity was calculated using the following equation:

$$\sigma = \frac{L}{R \times A}$$

where L is the distance between the reference electrodes, and A is the cross-sectional area of the membrane.

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Alkaline stability. The membranes in their OH$^-$ form were soaked in a 1 M KOH solution at 80 °C for 1080 h to evaluate their chemical stability by measuring the changes in IEC, conductivity, and FTIR spectra. Before the measurements, each membrane was soaked in freshly prepared 1 M KOH solution at 60 °C for at least 24 h. After this period, the OH$^-$ conductivity of each membrane was measured in DI water at 20 °C, and the IEC was measured using the back-titration method, as described in Section 2.8.

Oxidative stability (Fenton test). The membranes were soaked in Fenton solution (4 ppm Fe^{2+} in 3 wt% H$_2$O$_2$) at RT and 60 °C for 106 h at intervals of 24 h. After this period, each membrane was washed in DI water several times to remove the Fenton solution and then dried in the oven at 40 °C for at least 24 h. The oxidative stability of the membranes was evaluated from their changes in weight and thermal stability.

Fabrication of MEAs and single-cell measurements of AEMWEs. For the fabrication of an MEA for the AEMWE single-cell measurement, the catalyst ink was prepared by ultra-sonication with IrO$_2$ (Alfa Aesar, Haverhill, MA, USA) or Pt/C (60 wt% Pt, Boyazenergy, Seoul, Republic of Korea) as the catalyst and isopropyl alcohol, DI water, and an ionomer (FAA-3-SOLUT-10, Fumatech Co., Germany). Then, the catalyst ink was coated onto the surface of the prepared membranes using an air spray gun. The catalyst was loaded on the anode with a coverage of 2.0 mg Ir cm^{-2} on the anode and 0.4 mg Pt cm^{-2} on the cathode. The prepared MEA was pretreated in 1 M KOH solution for 24 h and washed with DI water. The MEA was sandwiched between the gas diffusion layer (SIGRACET 39BB), porous transport layer (Porous Nickel Alloy, Boyazenergy, Seoul, Republic of Korea), and the gasket, and the active area of the unit cell was 5 cm^2. For the AEMWE single-cell performance measurements, the cell temperature was maintained at 70 °C, and 1 M KOH was fed into the cell anode and cathode at 10 mL min^{-1}.

Durability test. The in situ durability of the single cell was measured for the water electrolysis cell test mentioned above at 70 °C at a flow rate of 10/10 mL min^{-1} for 1 M KOH for the anode (A) / cathode (C). A constant current density of 200 mA cm^{-2} was applied, and the cell voltage was monitored for 50 h.
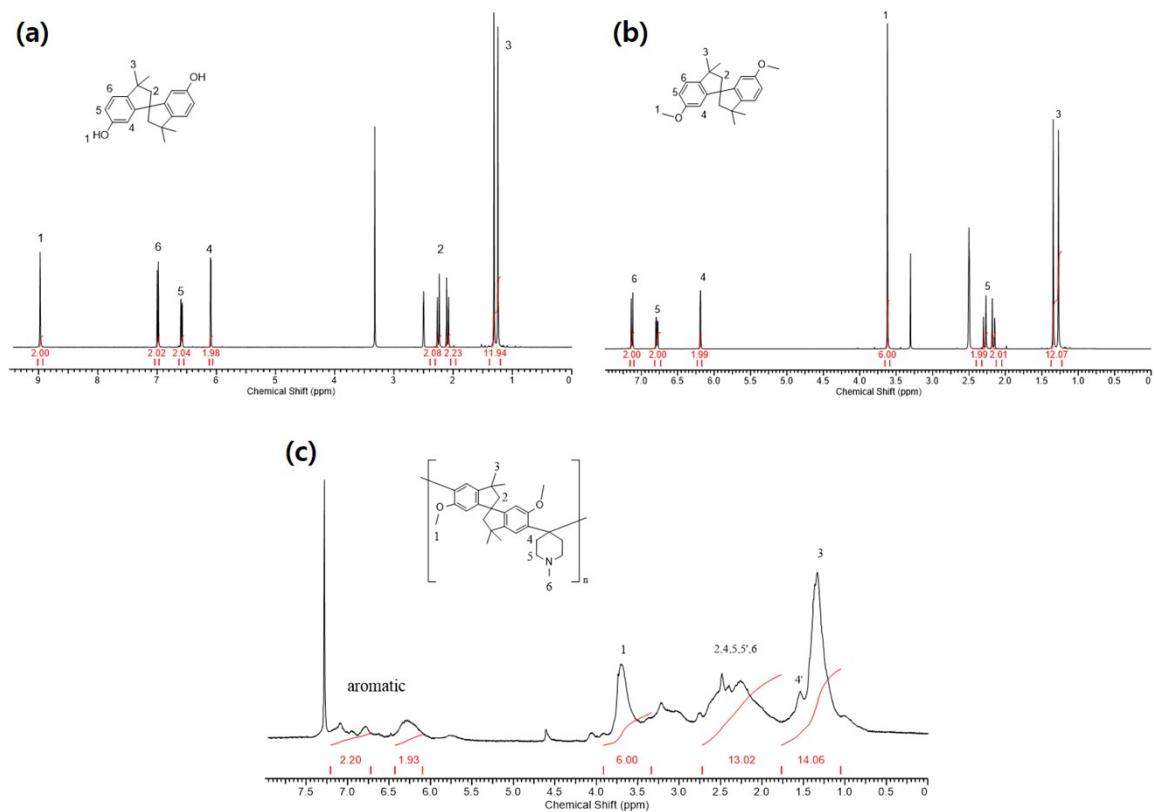
Figure S1. ^{1}H NMR spectra of (a) SBP, (b) SBI, and (c) PIM-*N*-methylpiperidine **2**
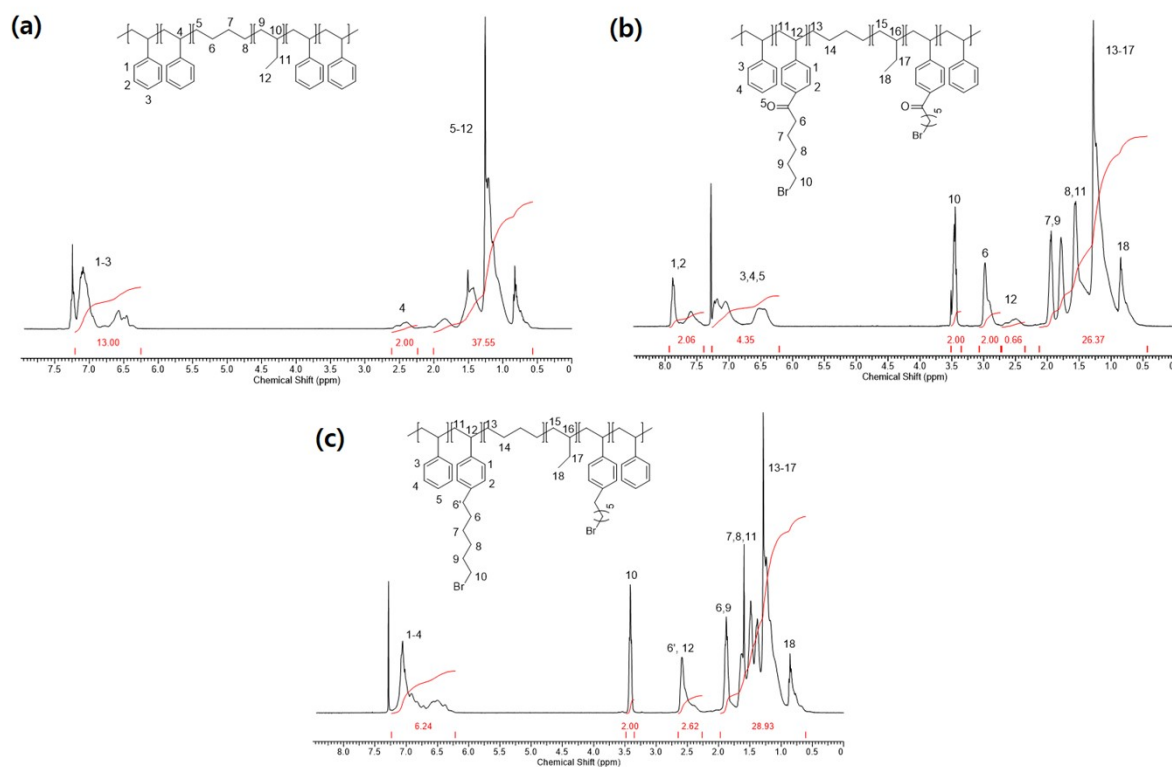
Figure S2. ^{1}H NMR spectra of (a) pristine SEBS, (b) bromohexanoyl SEBS **4**, and (c) bromohexyl SEBS **3**

Figure S3. Photographs of the crosslinked (PIM-*N*-methyl piperidinium)-SEBS membranes (x-PIM-SEBS) with different crosslinking degrees
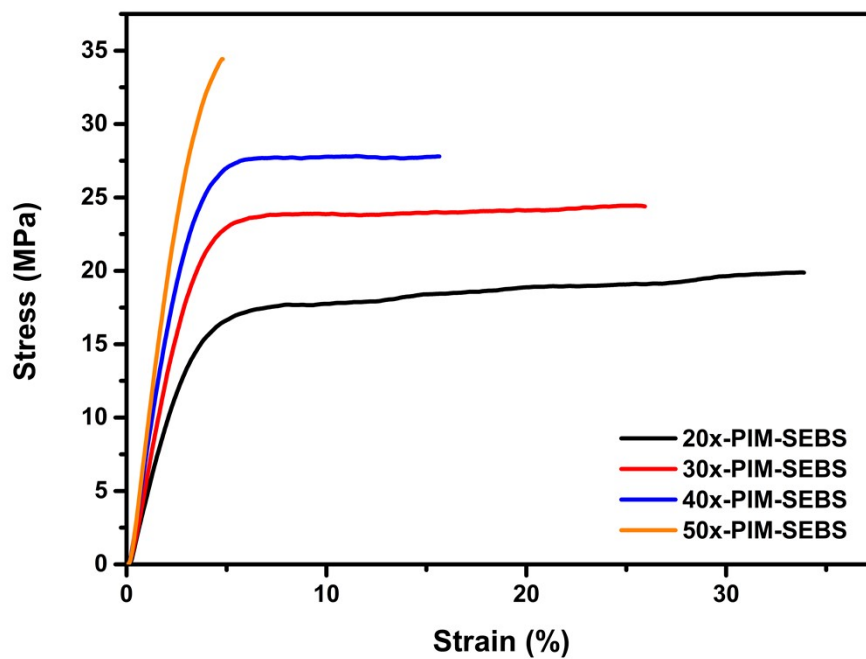
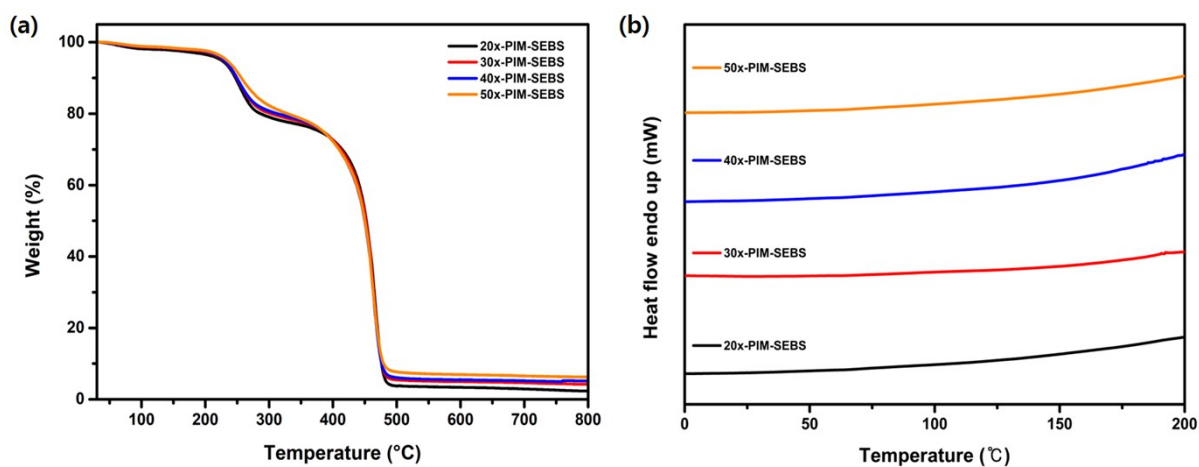**Figure S4**. Stress–strain curves of the x-PIM-SEBS membranes

Figure S5. (a) TGA and (b) DSC curves of the x-PIM-SEBS membranes

Table S1. Tensile strength (stress), elongation at break (strain), and Young's modulus of the x-PIM-SEBS membranes with different crosslinking degrees

	Stress (MPa)	Strain (%)	Young's modulus (MPa)
20x-PIM-SEBS	19.89	33.81	546.59
30x-PIM-SEBS	24.40	25.93	708.05
40x-PIM-SEBS	27.80	15.64	853.02
50x-PIM-SEBS	34.43	4.81	1097.18

Table S2. Density and freezing point of water in the x-PIM-SEBS and 50x-PmTP-SEBS membranes with different crosslinking degrees

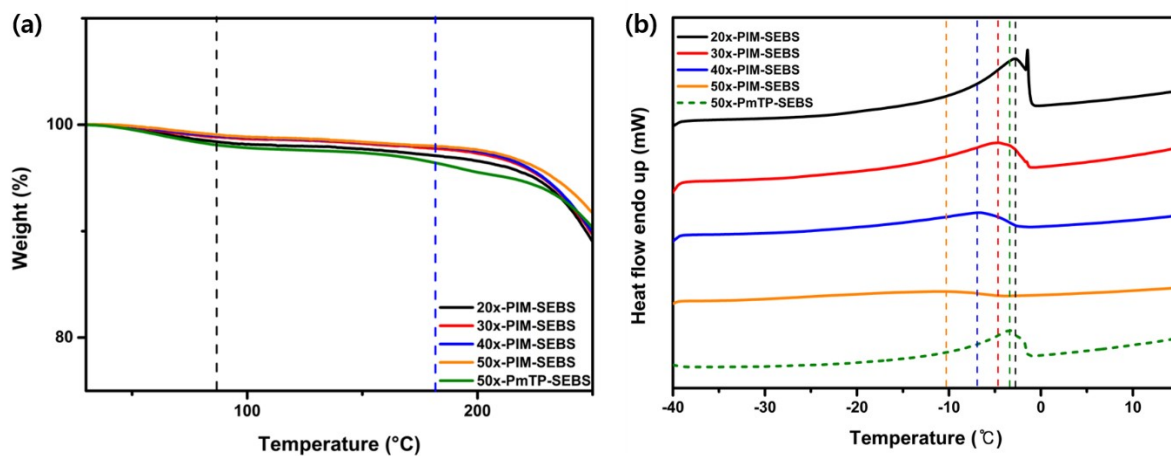|	Density (g/cm³)		FFV (%)	Freezing point (°C)
	Dry	Wet		
20x-PIM-SEBS	1.132	1.096	3.22	-2.91
30x-PIM-SEBS	1.118	1.084	5.20	-4.67
40x-PIM-SEBS	1.109	1.077	6.61	-7.06
50x-PIM-SEBS	1.097	1.068	8.28	-10.29
50x-PmTP-SEBS	1.127	N/A	4.42	-3.37

Figure S6. (a) TGA curves from 30 to 250 °C and (b) DSC plots from -40 to 15 °C of the x-PIM-SEBS and 50x-PmTP-SEBS membranes
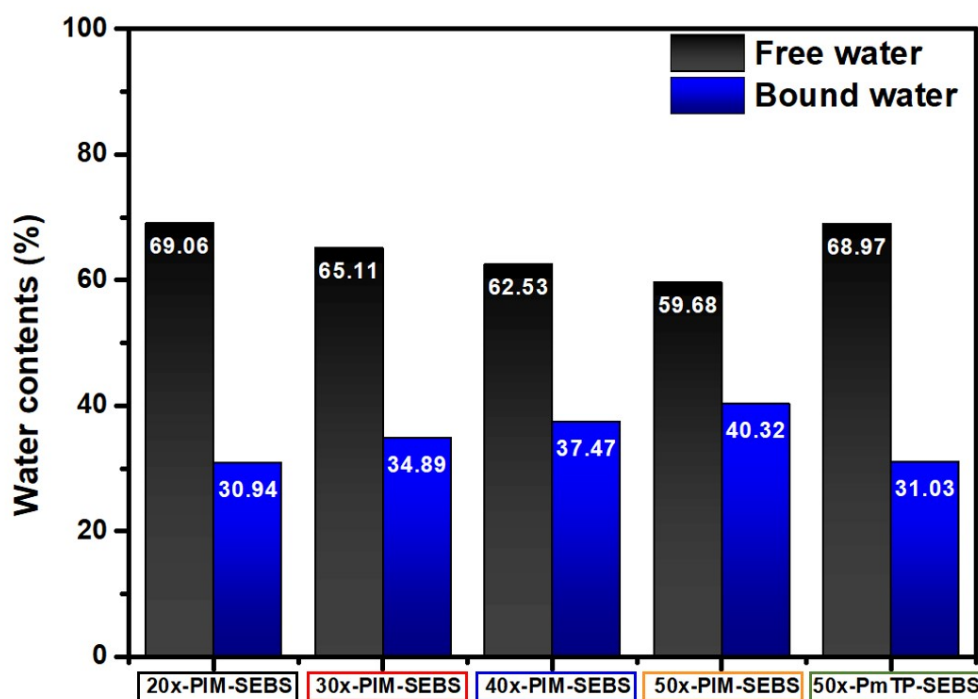

Figure S7. Relative ratios of free water to bound water in the x-PIM-SEBS and 50x-PmTP-SEBS membranes

Table S3. Hydroxide ion conductivity of x-PIM-SEBS membrane and 50x-PmTP-SEBS at different temperatures

|	IEC (meq g^{-1})	OH$^-$ Conductivity (mS cm^{-1})			
	Exp[a]	20 °C	40°C	60 °C	80 °C
20x-PIM-SEBS	1.91±0.02	58.90±0.05	82.95±0.06	105.30±0.20	125.73±0.40
30x-PIM-SEBS	1.79±0.04	67.65±0.11	96.16±0.04	125.23±0.15	147.66±0.54
40x-PIM-SEBS	1.64±0.03	52.63±0.06	73.33±0.09	98.94±0.16	118.90±0.33
50x-PIM-SEBS	1.56±0.03	42.54±0.21	58.91±0.15	81.91±0.18	98.58±0.33
50x-PmTP-SEBS	1.68±0.05	56.31±0.11	75.57±0.15	95.30±0.11	116.31±0.09

[a] Experimental values obtained via back-titration
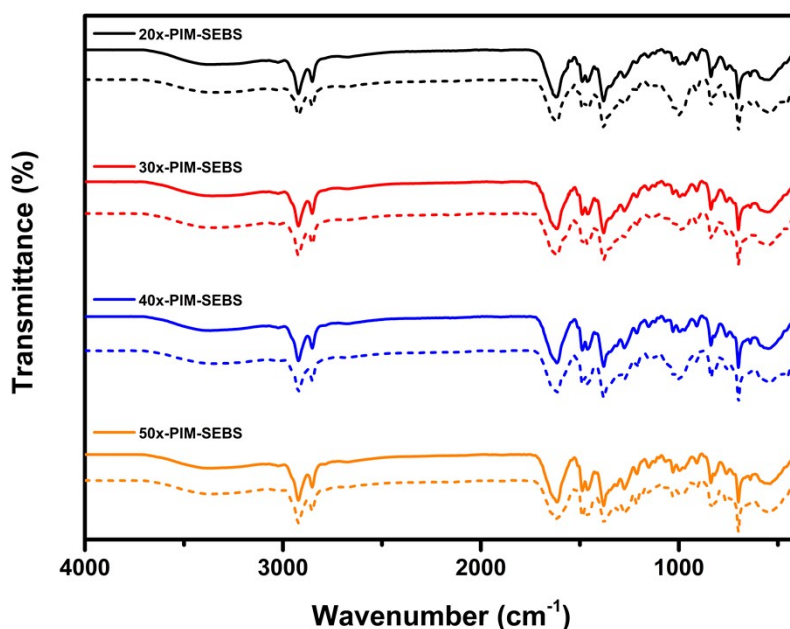
Figure S8. Fourier-transform infrared (FT-IR) spectra of the x-PIM-SEBS membranes before (solid lines) and after (dashed lines) the alkaline stability tests
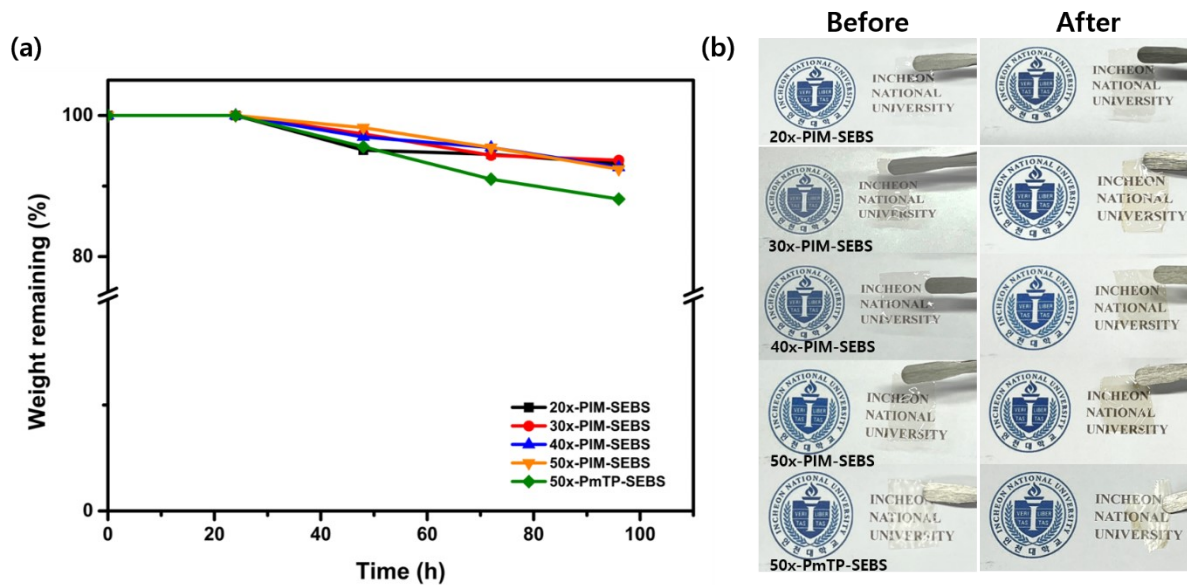
Figure S9. (a)Weight remaining of x-PIM-SEBS and 50x-PmTP-SEBS membranes after Fenton test for 96 h at 60°C, and (b) membranes photographs of before and after Fenton test
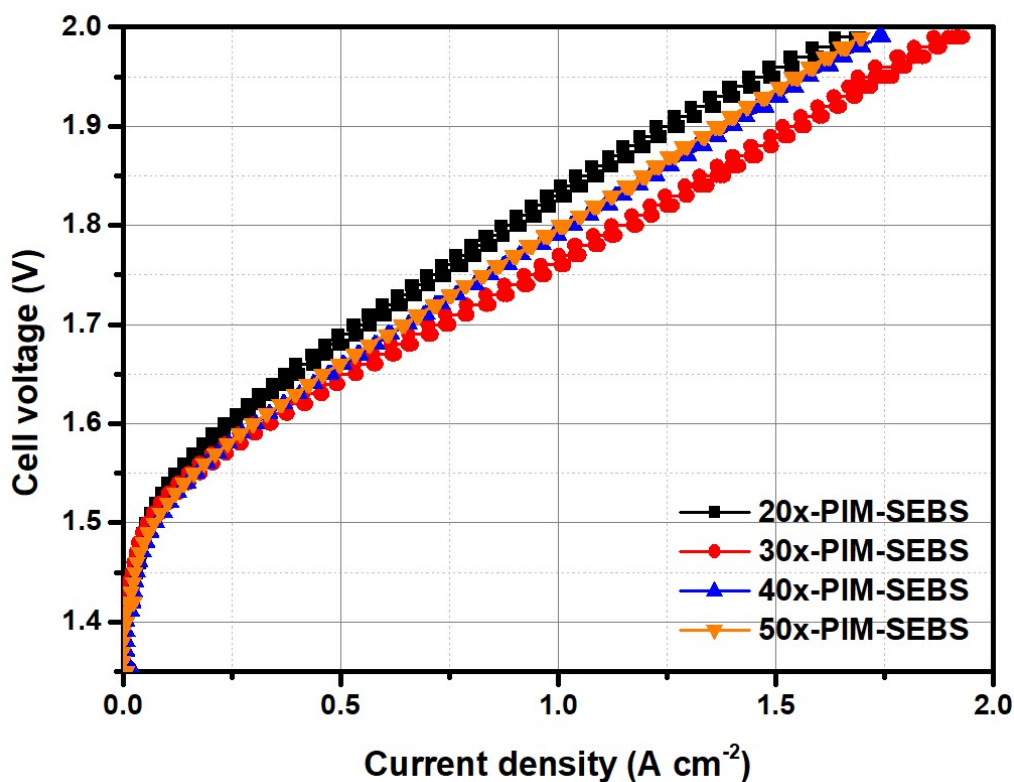

Figure S10. AEMWE single-cell performance of x-PIM-SEBS membranes at 70°C cell temperature with 1-M KOH solution

Table S4. Comparison of the AEMWE single cell performance of 30x-PIM-SEBS with that of other representative AEMs

AEMs	Test conditions	Catalysts		Performance	Ref
		Anode	Cathode		
30x-PIM-SEBS	70 °C, 1 M KOH	IrO_2	Pt/C	1.905 A cm^{-2} @2.0 V	This work
FAA-3-50	70 °C, 1 M KOH	IrO_2	Pt/C	1.083 A cm^{-2} @2.0 V	This work
x-TriPPO-50SEBS	70 °C, 1 M KOH	IrO_2	Pt/C	0.71 A cm^{-2} @2.0 V	20
40x-PBB-SEBS	70 °C, 1 M KOH	IrO_2	Pt/C	1.042 A cm^{-2} @1.8 V	19
SEBS-P2O6	60 °C, 1 M KOH	Ir-Black	Pt/C	0.680 A cm^{-2} @ 2.0 V	64
SEBS-Pi	50 °C, 5.6wt% KOH	IrO_2	Pt/C	0.4 A cm^{-2} @2.0 V	65
Sustainion Grade-T	60 °C, 1 M KOH	$NiFe_2O_4$,	Raney nickel	0.837 A cm^{-2} @1.8 V	66
cPVBMP-3.0 cQPPO	60 °C, DI water	CoFeP TPAs	Pt/C	0.21 Acm^{-2} @ 1.8 V	67
C-IL-100	80 °C, 1 M KOH	$NiFe_2O_4$	NiFeCO	0.55 A cm^{-2} @ 2.0 V	68
m-TPNIPiQA	80 °C, 1 M KOH	$NiFe_2O_4$	NiFeCO	0.25 A cm^{-2} @ 2.0 V	68

PFOTFph-TMA-C6	80 °C, 1 M KOH	IrO$_2$	Pt/C	1.0 A cm^{-2} @ 1.77 V	69
PAES-MQA-0.18	RT, 2M NaOH	IrO$_2$	Pt/C	1.1215 A cm^{-2} @ 2.0V	70
PFPB-QA	70 °C, 1 M KOH	IrO$_2$	Pt/C	1.53 A cm^{-2} @2.0 V	71
PTP-90	75 °C, 1 M NaOH	IrO$_2$	Pt/C	1.0 A cm^{-2} @2.2 V	72
M-6#	80 °C, 1 M KOH	NiFe	NiMo	0.6 A cm^{-2} @1.9 V	73
PVBC-MPy/35%PEK-cardo	70 °C, 1 M KOH	NiFe-LDH/NF	MoNi/NF	0.5 A cm^{-2} @ 2.0 V	74
PQP-100	85 °C, 1 M NaOH	IrO$_2$	Pt/C	1.544 A cm^{-2} @ 2.0 V	51
PFTP-13	80°C, 1M KOH	Ni-Fe	Ni-Fe	1.76 A cm^{-2} @ 2.0V	56
PFTP-13	80°C, 1M KOH	IrO$_2$	Pt/C	7.680 A cm^{-2} @ 2.0V	56
MTCP-50	90 °C, 1 M KOH	NiFe	Pt/Ru/C	5.4 A cm^{-2} @ 1.8 V	12

Table S5. Comparison of the AEMWE single cell durability of 30x-PIM-SEBS with that of other representative AEMs

AEMs	Test conditions	Catalysts		Durability	Ref
		Anode	Cathode		
30x-PIM-SEBS	70 °C, 1 M KOH	IrO$_2$	Pt/C	~65 h (0.2 A cm^{-2})	This work
FAA-3-50	70 °C, 1 M KOH	IrO$_2$	Pt/C	~21 h (0.2 A cm^{-2})	This work
C-IL-100	80 °C, 1 M KOH	NiFe$_2$O$_4$	NiFeCO	~8 h (0.1 A cm^{-1})	68
m-TPNIPiQA	80 °C, 1 M KOH	NiFe$_2$O$_4$	NiFeCO	~8 h (0.01 A cm^{-1})	68
PFOTFph-TMA-C10	80 °C, Pure water	IrO$_2$	Pt/C	~150 h (0.2 A cm^{-1})	69
PAES-MQA-0.18	30 °C, 2M NaOH	IrO$_2$	Pt/C	~480 h (0.5 A cm^{-1})	70
PFPB-QA	70 °C, 1 M KOH	IrO$_2$	Pt/C	~4 h (0.2 A cm^{-1})	71
PTP-85	55 °C, 1 M NaOH	IrO$_2$	Pt/C	~120 h (0.4 A cm^{-1})	72
M-6#	80 ºC, 1 M KOH	NiFe	NiMo	~168 h (0.5 A cm^{-1})	73
PVBC-MPy/35%PEK-cardo	60 °C, 1 M KOH	NiFe-LDH/NF	MoNi/NF	~45 h (0.5 A cm^{-1})	74

PQP-100	60 °C, 1 M NaOH	IrO$_2$	Pt/C	~400 h (0.2 A cm^{-1})	51
PFTP-13	40 ºC, 1M KOH	IrO$_2$	Pt/C	~1,100 h (0.5 A cm^{-2})	56
MTCP-50	60 °C for 2,500 h, 80 °C for 500 h, 1 M KOH	NiFe	Pt/Ru/C	~3,000 h (0.5 A cm^{-2} for 2,500 h, 1.0 A cm^{-2} for 500 h)	12

Reference

1 F. Zhou, H. N. Tien, W. L. Xu, J.-T. Chen, Q. Liu, E. Hicks, M. Fathizadeh, S. Li and M. Yu, *Nat. Commun.*, 2017, **8**, 2107.