Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Electronic Supplementary Information

Highly proton conductive and stable sulfonated poly(arylene-alkane) for fuel cells with performance over 2.46 W cm^{-2}

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Fig. S1 Digital photograph of Poly(FL50-BP50)-SO_3H ionomer in EtOH.

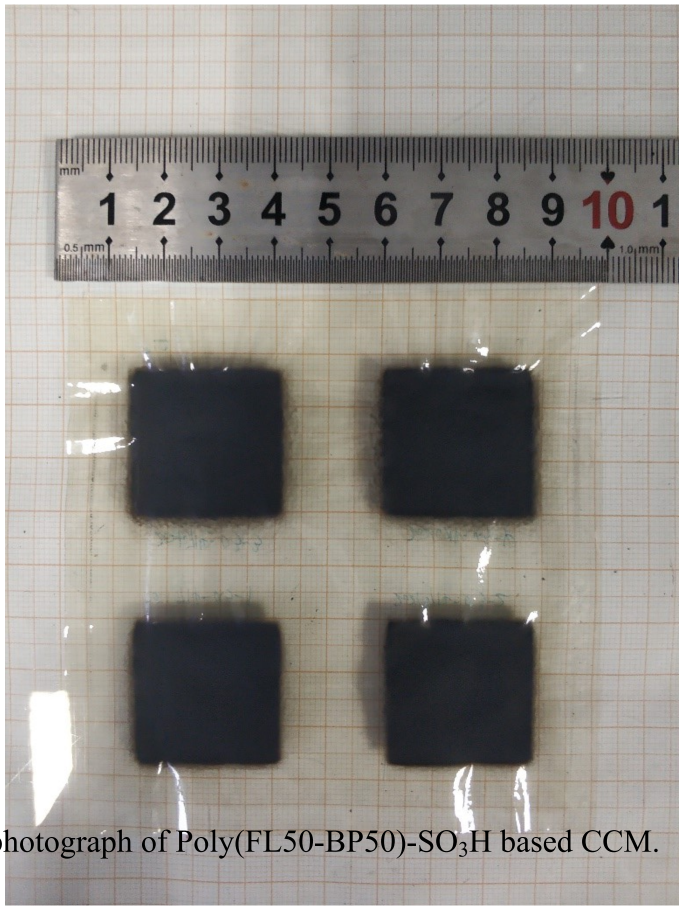

Fig. S2 Digital photograph of Poly(FL50-BP50)-SO_3H based CCM.

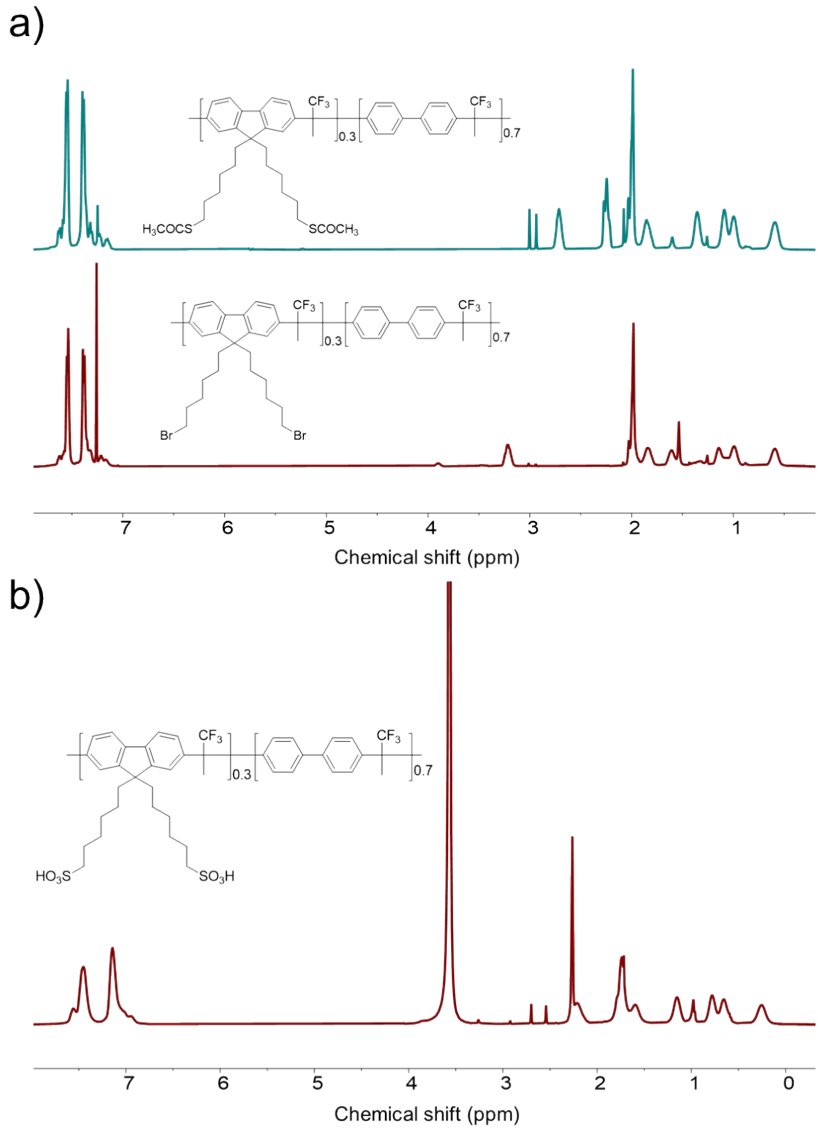

Fig. S3 ^{1}H NMR spectra of a) Poly(FL30-BP70)-Br and Poly(FL30-BP70)-SAc in $CDCl_3$, and b) Poly(FL30-BP70)-SO_3H in DMSO-d_6.

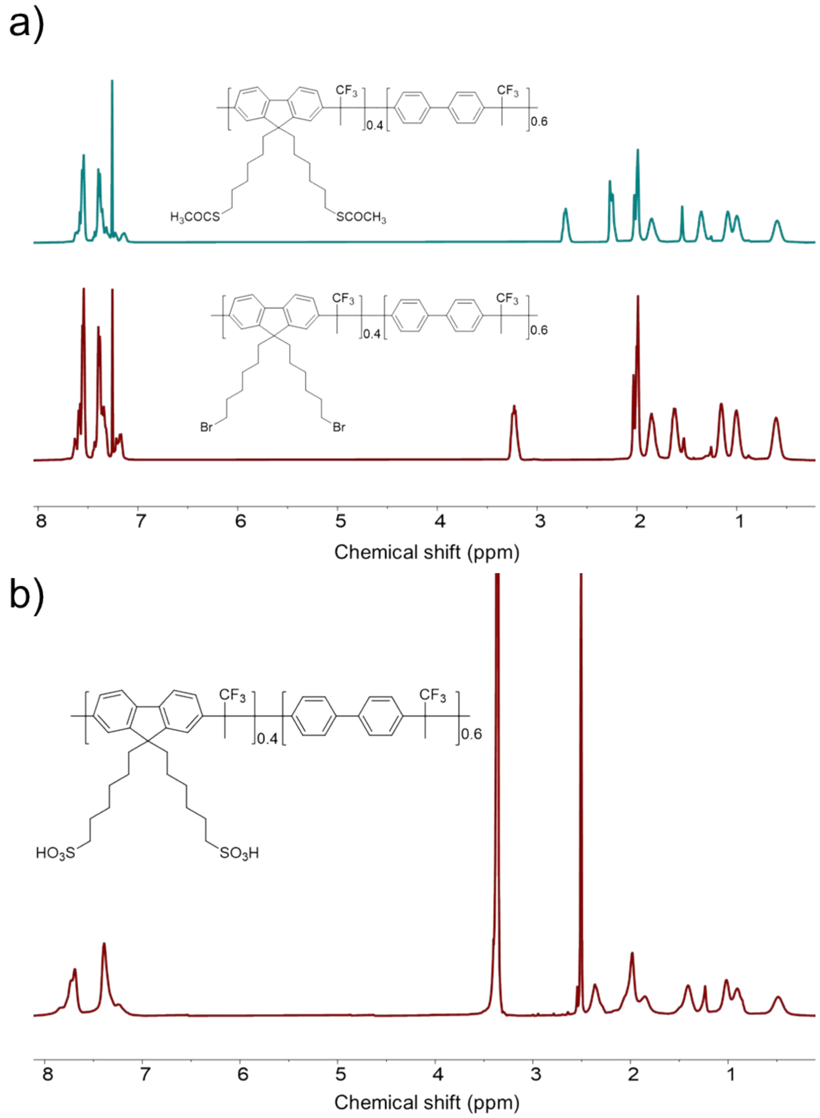

Fig. S4 ^{1}H NMR spectra of a) Poly(FL40-BP60)-Br and Poly(FL40-BP60)-SAc in $CDCl_3$, and b) Poly(FL40-BP60)-SO_3H in DMSO-d_6.

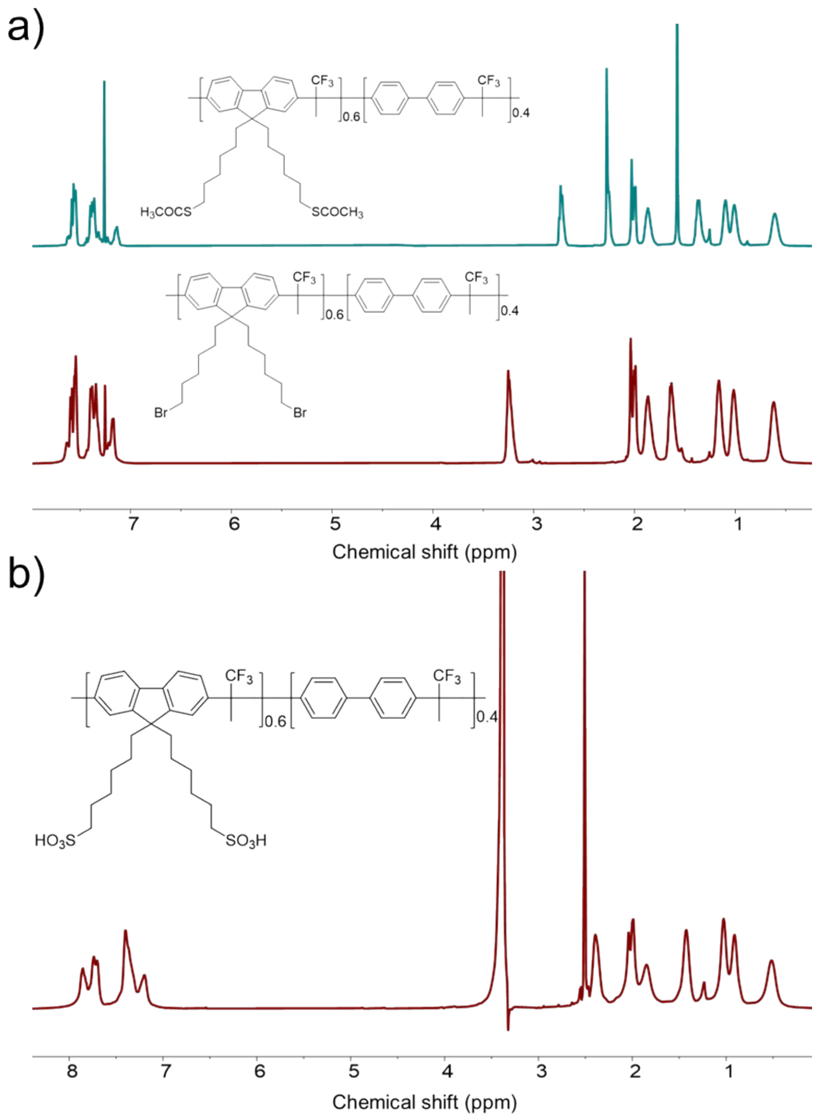

Fig. S5 ^{1}H NMR spectra of a) Poly(FL60-BP40)-Br and Poly(FL60-BP40)-SAc in $CDCl_3$, and b) Poly(FL60-BP40)-SO_3H in DMSO-d_6.

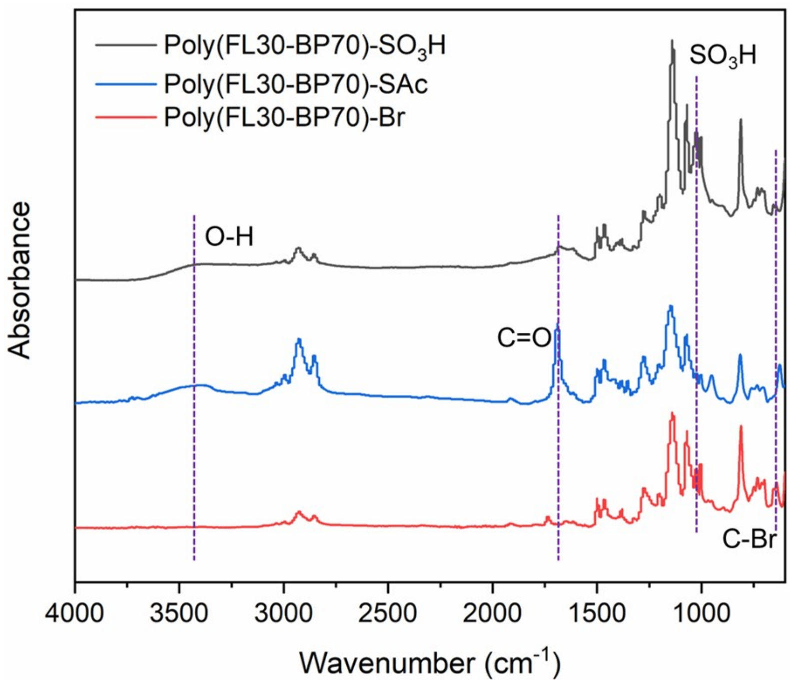

Fig. S6 FT-IR spectra of Poly(FL30-BP70)-Br, Poly(FL30-BP70)-SAc and Poly(FL30-BP70)-SO_3H.

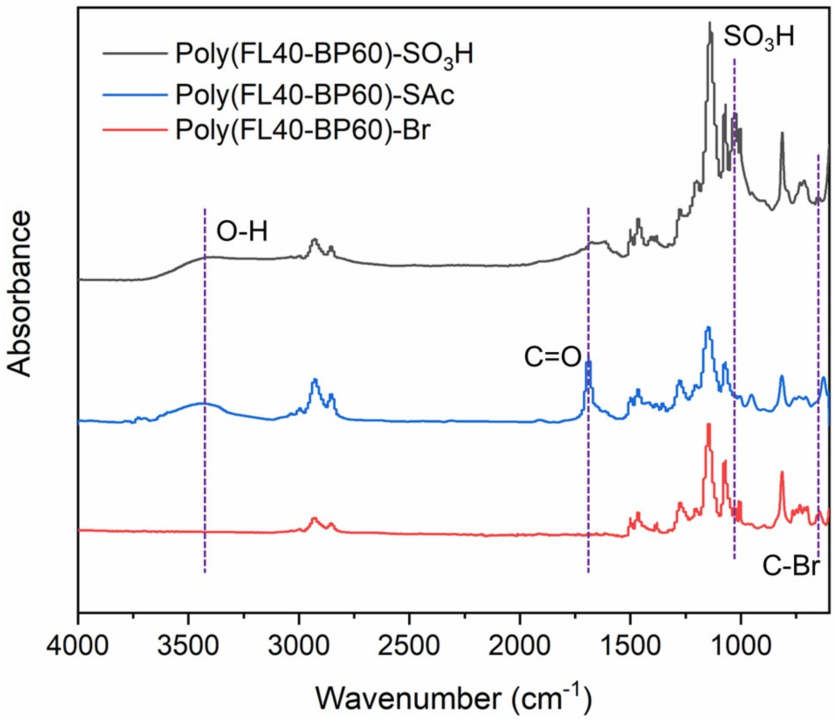

Fig. S7 FT-IR spectra of Poly(FL40-BP60)-Br, Poly(FL40-BP60)-SAc and Poly(FL40-BP60)-SO_3H.

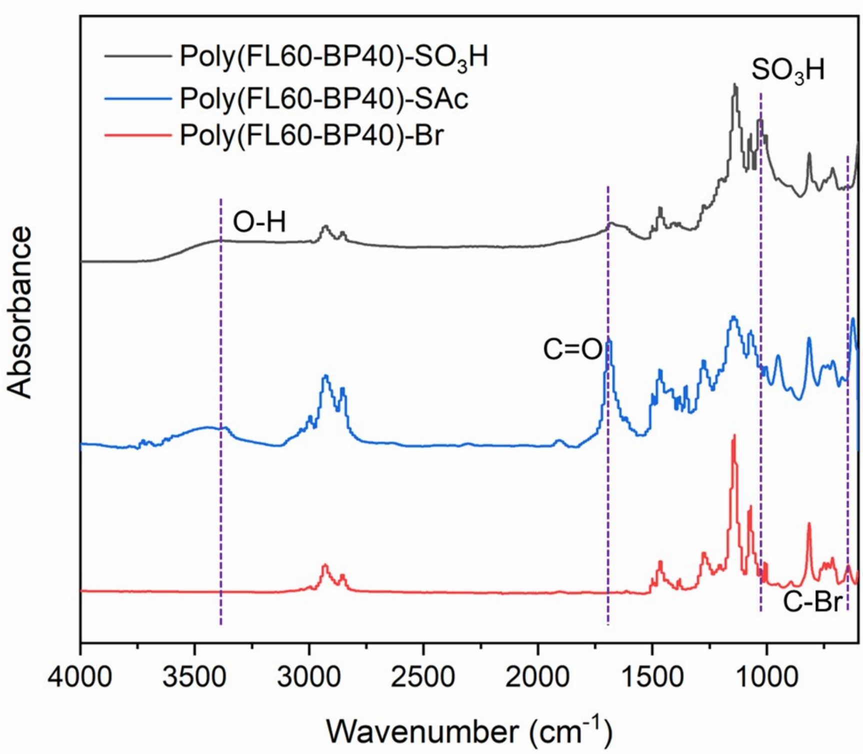

Fig. S8 FT-IR spectra of Poly(FL60-BP40)-Br, Poly(FL60-BP40)-SAc and Poly(FL60-BP40)-SO_3H.

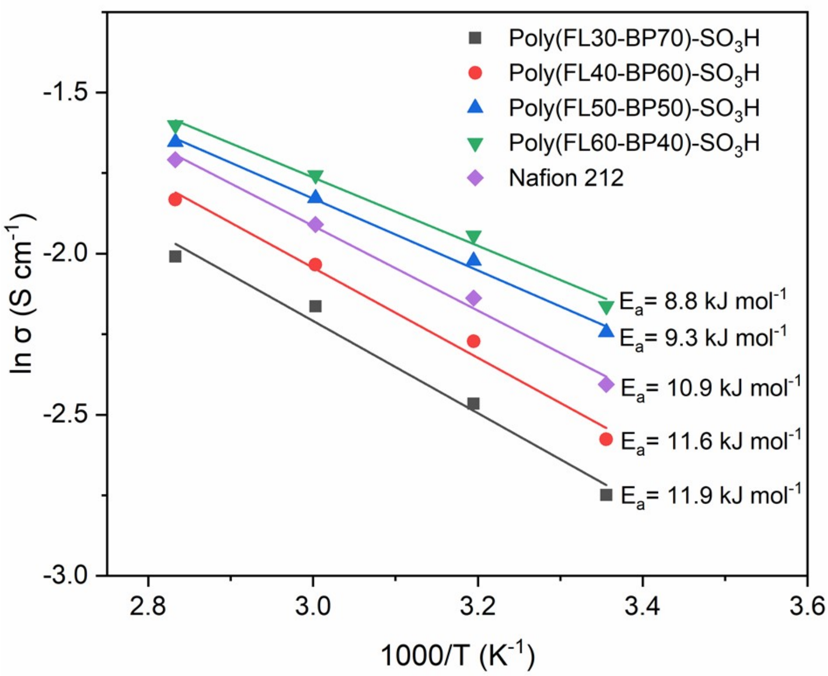

Fig. S9 Arrhenius plots of proton conductivity.

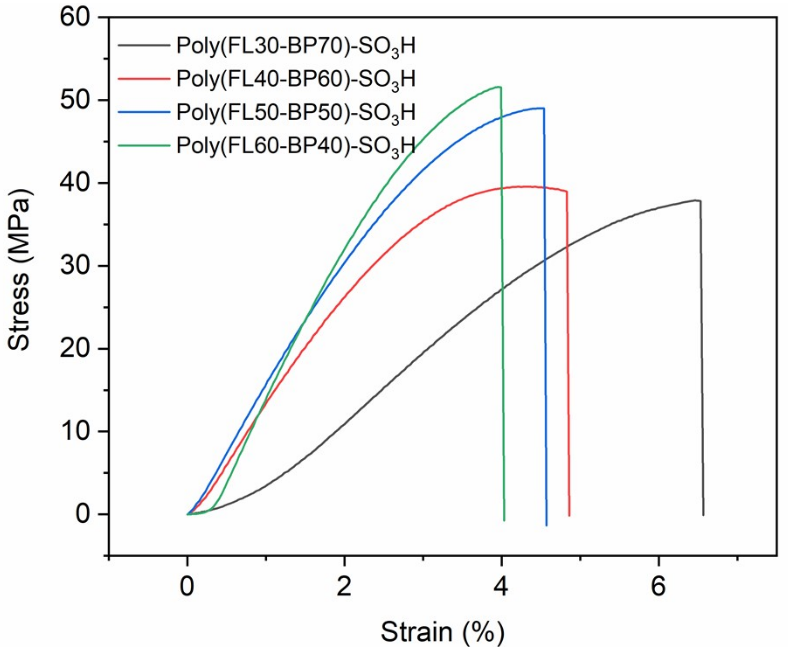

Fig. S10 Stress-strain curves of Poly(FLx-BPy)-SO_3H membranes at ambient with a speed of 1 mm min^{-1}.

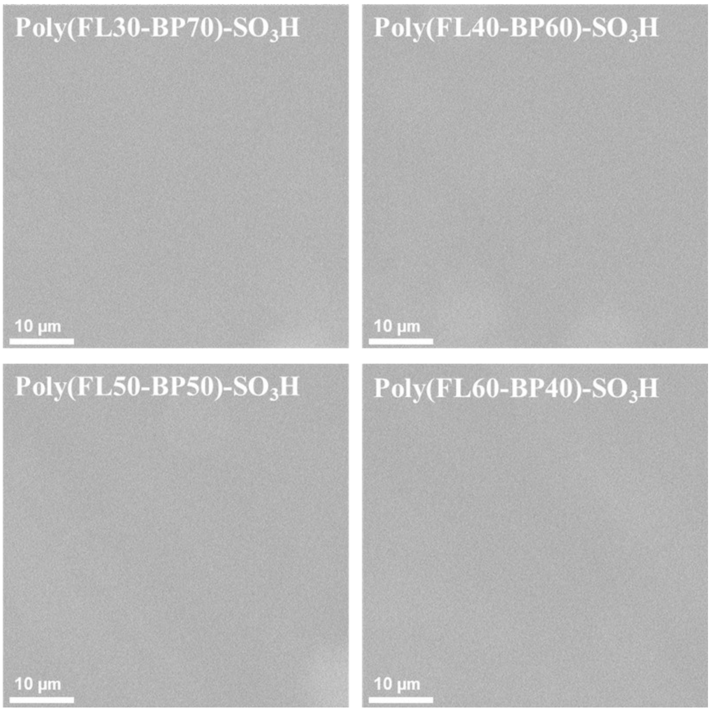

Fig. S11 SEM images of the surface of Poly(FLx-BPy)-SO_3H membranes.

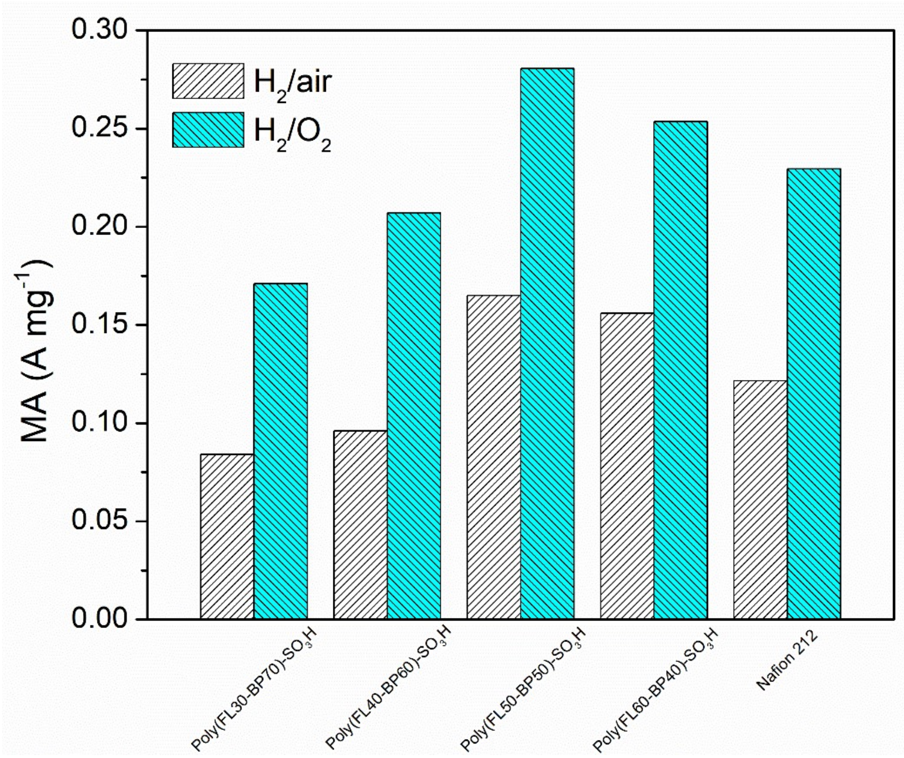

Fig. S12 Mass activities of Poly(FLx-BPy)-SO_3H based MEA at 0.9 V under H_2/air and H_2/O_2 fuel cell operations.

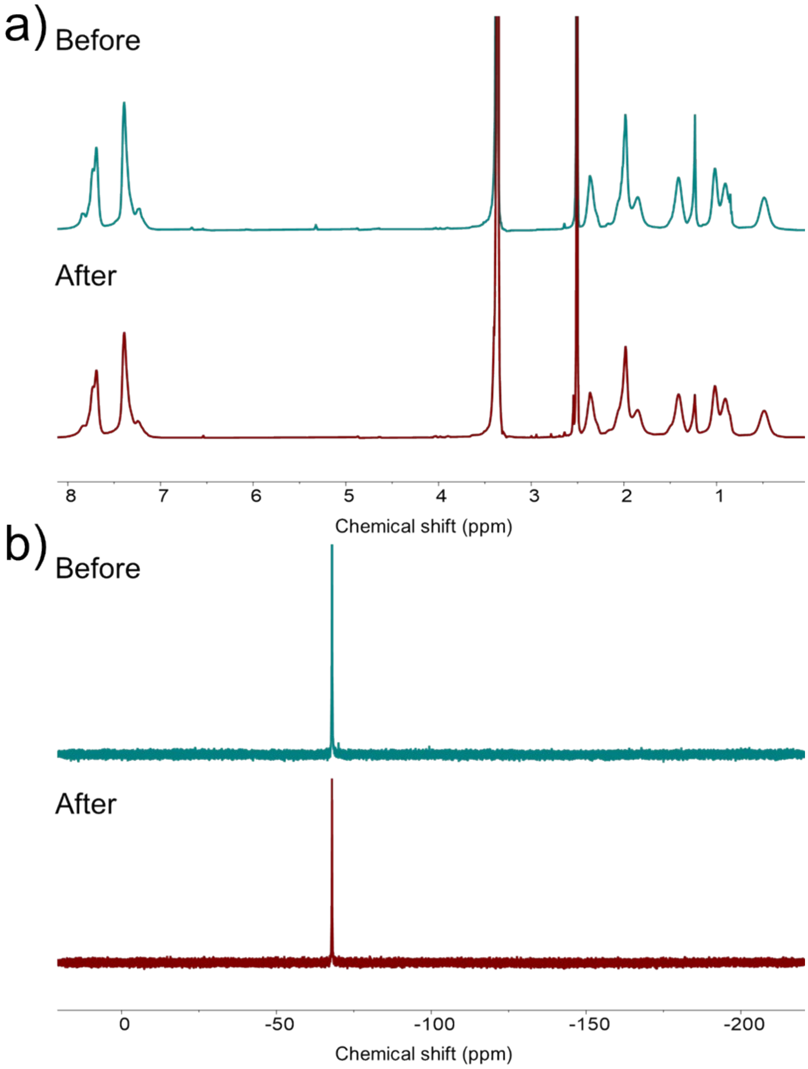

Fig. S13 a) ^{1}H NMR spectra and b) ^{19}F NMR spectra of Poly(FL50-BP50)-SO_3H before and after durability test in DMSO-d_6.

Table S1 Open-circuit voltages for H_2/air and H_2/O_2 fuel cell operations

Sample	OCV for H_2/air / V	OCV for H_2/O_2 / V
Poly(FL30-BP70)-SO_3H	0.967	1.016
Poly(FL40-BP60)-SO_3H	0.970	1.017
Poly(FL50-BP50)-SO_3H	0.987	1.036
Poly(FL60-BP40)-SO_3H	0.973	1.020
Nafion 212	0.957	1.013

Table S2 Comparison of Fuel cell performance of Poly(FLx-BPy)-SO_3H and partial membranes reported in recent years

Sample	Temp / °C	RH / %	Gas	Power density / mW cm^{-2}	Current density / mA cm^{-2}	Durability / h	Reference
Poly(FL30-BP70)-SO_3H	80	100	H_2/O_2	1668	—	—	This work
Poly(FL40-BP60)-SO_3H	80	100	H_2/O_2	1915	500	400	This work
Poly(FL50-BP50)-SO_3H	80	100	H_2/O_2	2465	—	—	This work
Poly(FL60-BP40)-SO_3H	80	100	H_2/O_2	2242	—	—	This work
SP-BNP-10	80	100	H_2/O_2	1790	—	—	[1]
SPEEK74-O-PA100	65	100	H_2/O_2	1358	400	50	[2]
B2SP	70	65	H_2/O_2	2140	200	72	[3]
CSP-1	70	65	H_2/O_2	1660	200	72	[4]
MM40-PC	80	80	H_2/O_2	975	—	960 (0.7 V)	[5]
CFC-1.12	90	30	H_2/O_2	159	—	80 (OCV)	[6]
MM45-PC	95	100	H_2/O_2	1107	—	768 (0.7 V)	[7]
SPX-BP-0.95	80	100	H_2/O_2	370	—	—	[8]
C-SPAES-7	80	95	H_2/air	692	—	—	[9]
SI-PPBP 40	70	100	H_2/air	650	—	—	[10]
BPAEK25- SDPA	80	100	H_2/O_2	470	—	—	[11]
SPAEK/PSSAMA-20	80	30	H_2/O_2	450	200	100	[12]
SPAEK X9.1Y8.8	60	100	H_2/O_2	324	—	—	[13]
ALSPI-5	80	100	H_2/O_2	932	—	—	[14]
M10N5-CR	80	95	H_2/O_2	1070	500	24 (OCV) + 144	[15]
SPFAE-ODP	80	80	H_2/O_2	679	—	—	[16]
Me-m-SPEEKK	80	100	H_2/O_2	657	—	—	[17]
mSPAE	80	100	H_2/O_2	928	—	120 (OCV)	[18]
A2:1-SCNT	25	—	H_2/air	129	318	120	[19]
1,5-DHN (2.2)	80	100	H_2/air	384	—	—	[20]

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