Electronic Supporting Information(ESI)

Preparation of crosslinker-free anion exchange membranes with excellent physicochemical and electrochemical properties based on crosslinked PPO-SEBS

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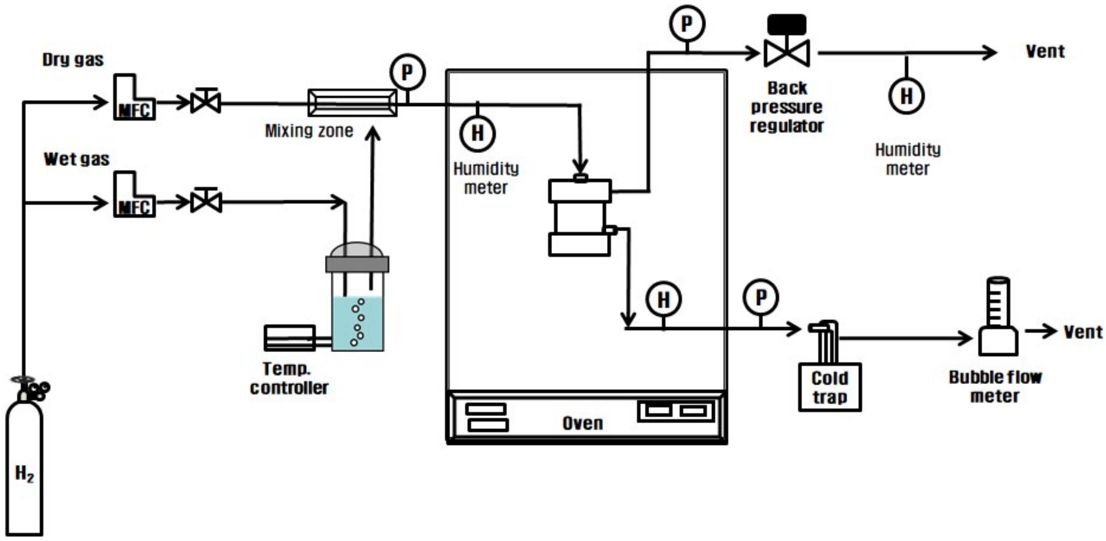

Figure S1. Schematic diagram of gas permeability test system[1]

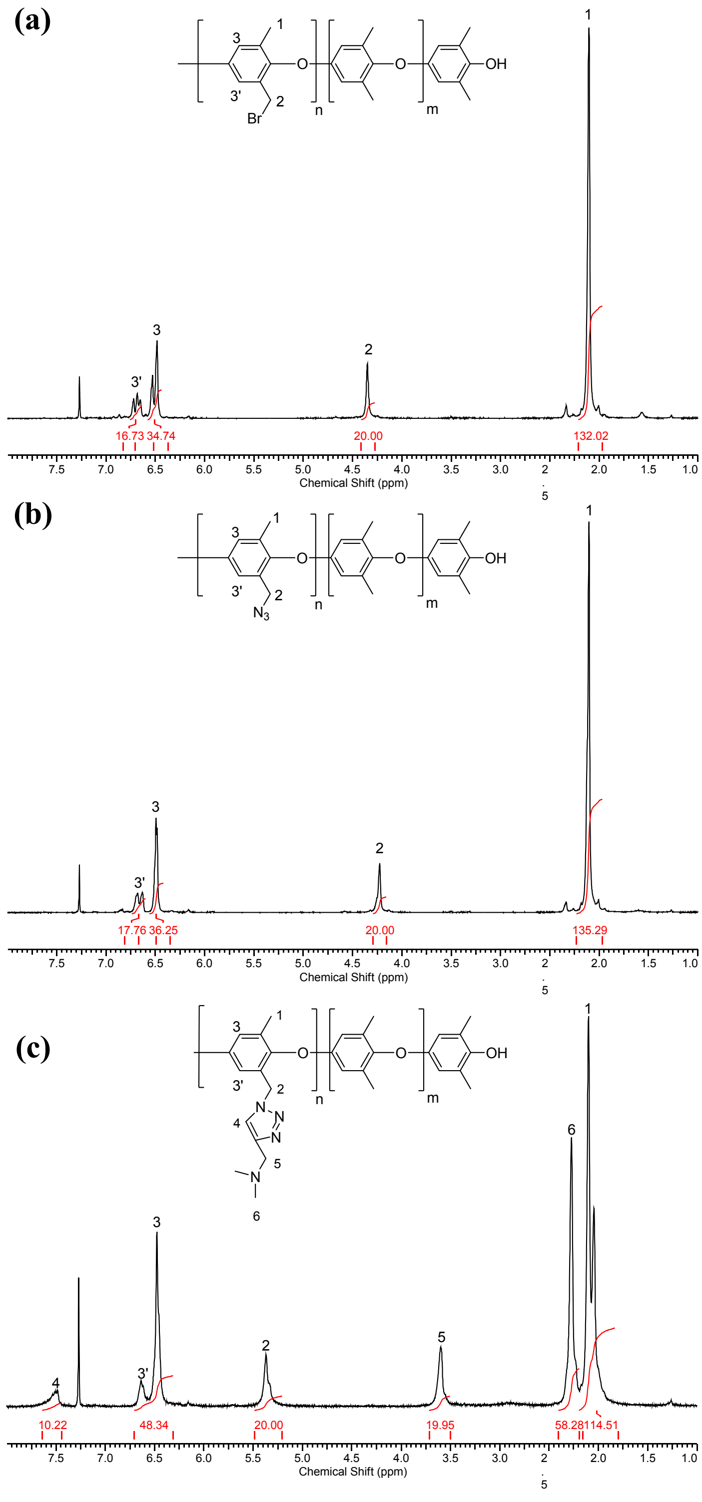

Figure S2. ^{1}H-NMR spectra for the (a) Br-PPO **2**, (b) N_3-PPO **3,** and (c) DMT-PPO **4**

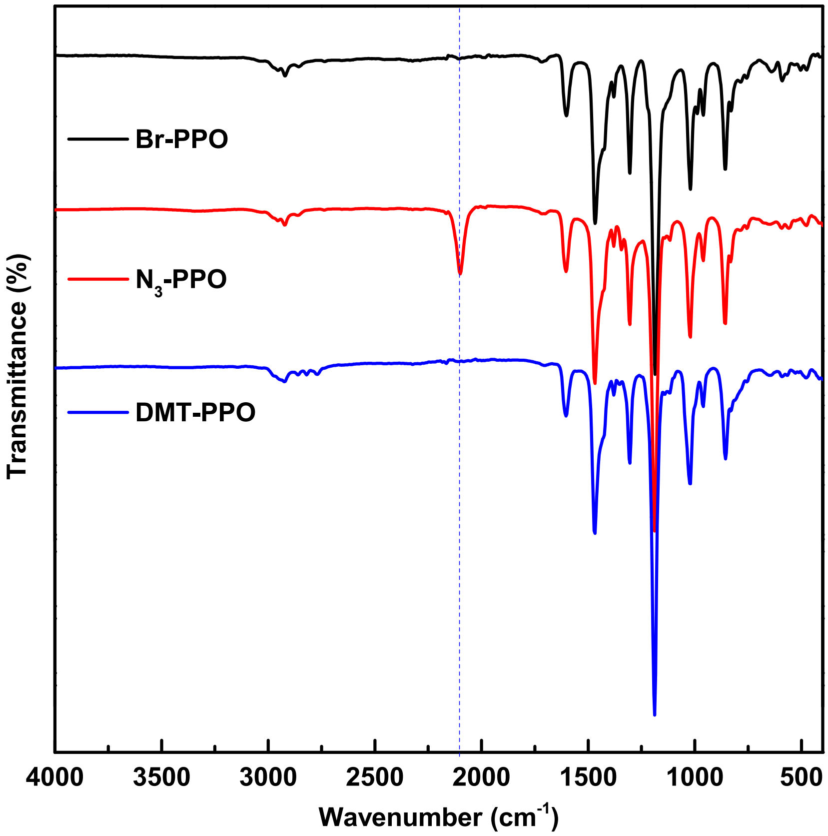

Figure S3. IR spectra for the Br-PPO **2** (black), N_3-PPO **3** (red), and DMT-PPO **4** (blue)

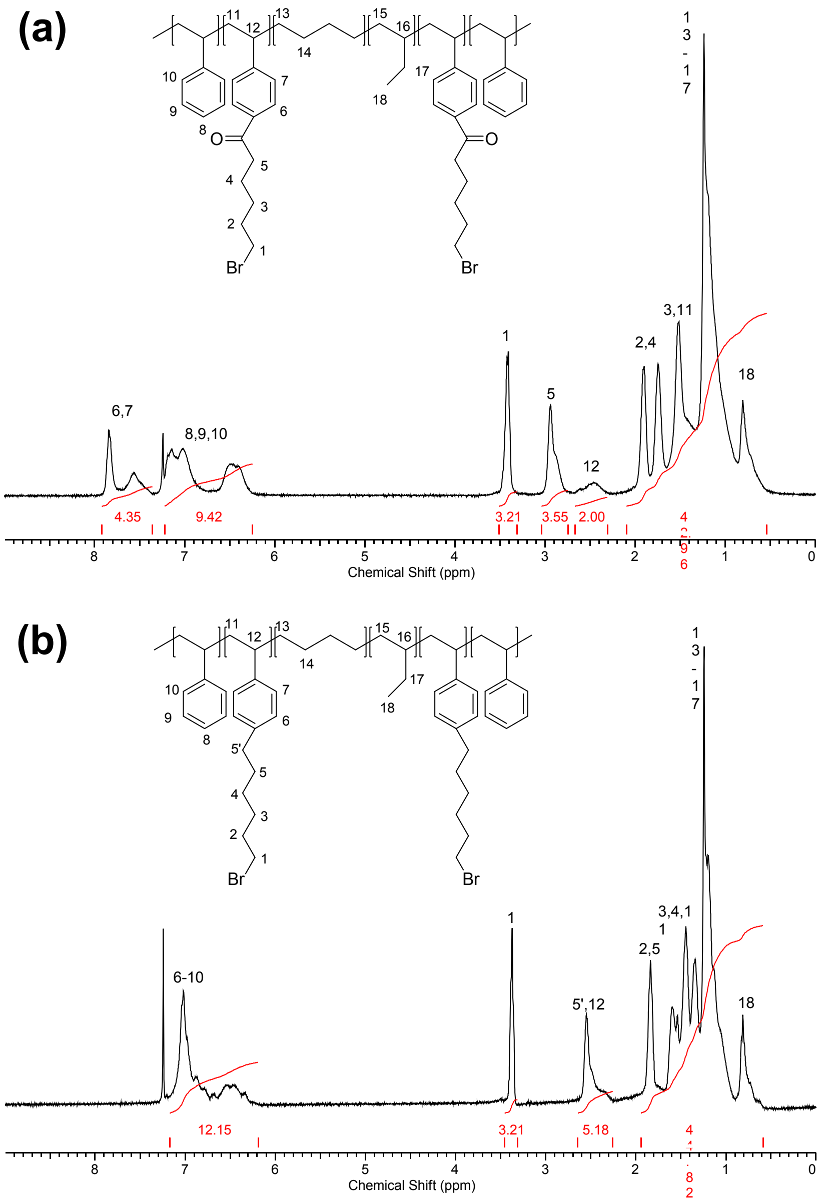

Figure S4. ^{1}H-NMR spectra for the (a) Br-Hex-CO-SEBS **5,** and (b) Br-Hex-SEBS **6**

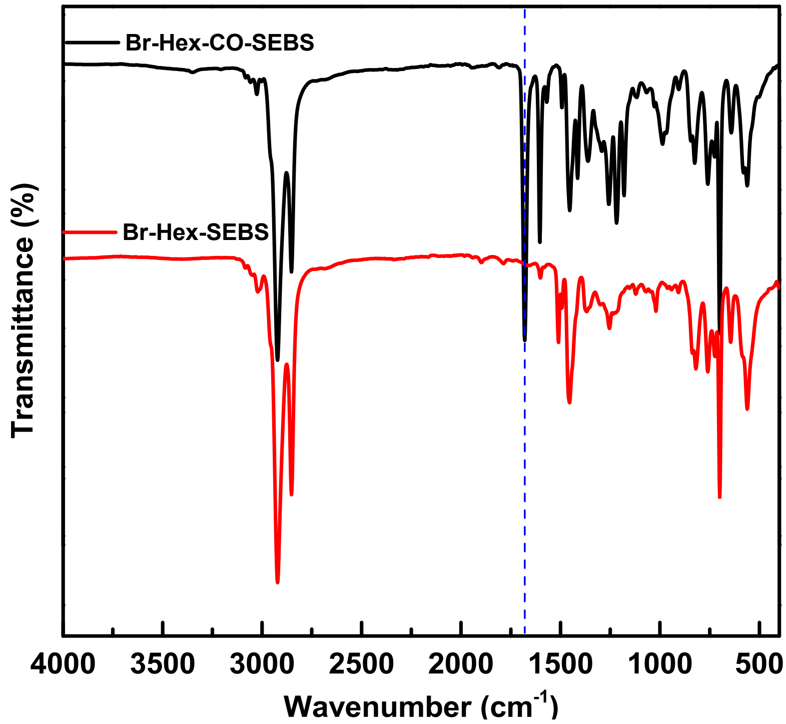

Figure S5. IR spectra for the Br-Hex-CO-SEBS **5** (black) and Br-Hex-SEBS **6** (red)

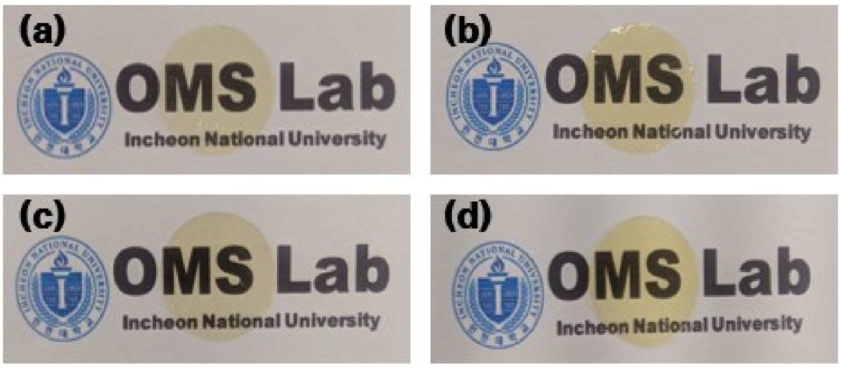

Figure S6. Photographs of (a) x20-PPO-SEBS, (b) x30-PPO-SEBS, (c) x40-PPO-SEBS, and (d) x50-PPO-SEBS

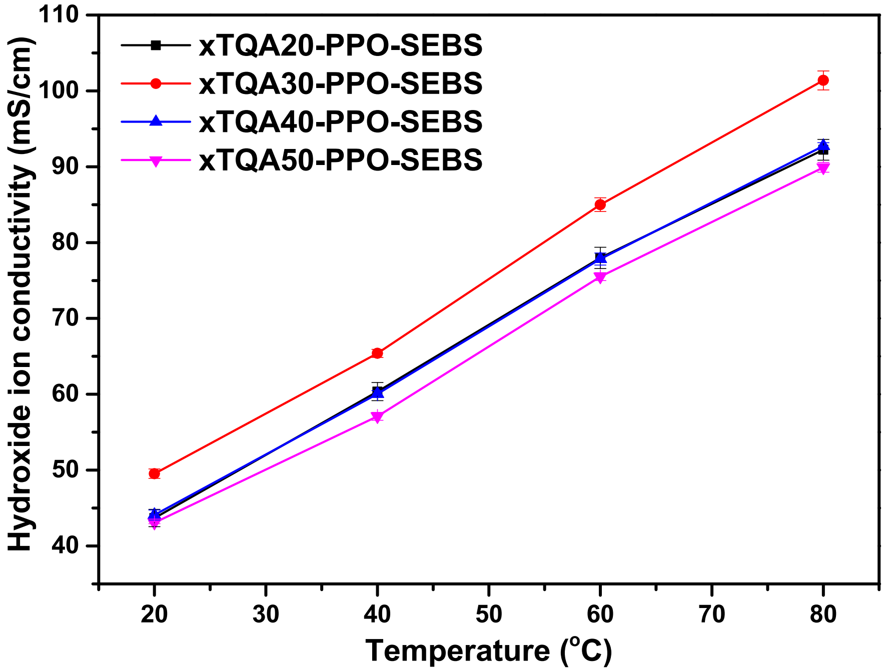

Figure S7. Temperature dependence of hydroxide ion conductivity of xTQAn-PPO-SEBS membranes in water

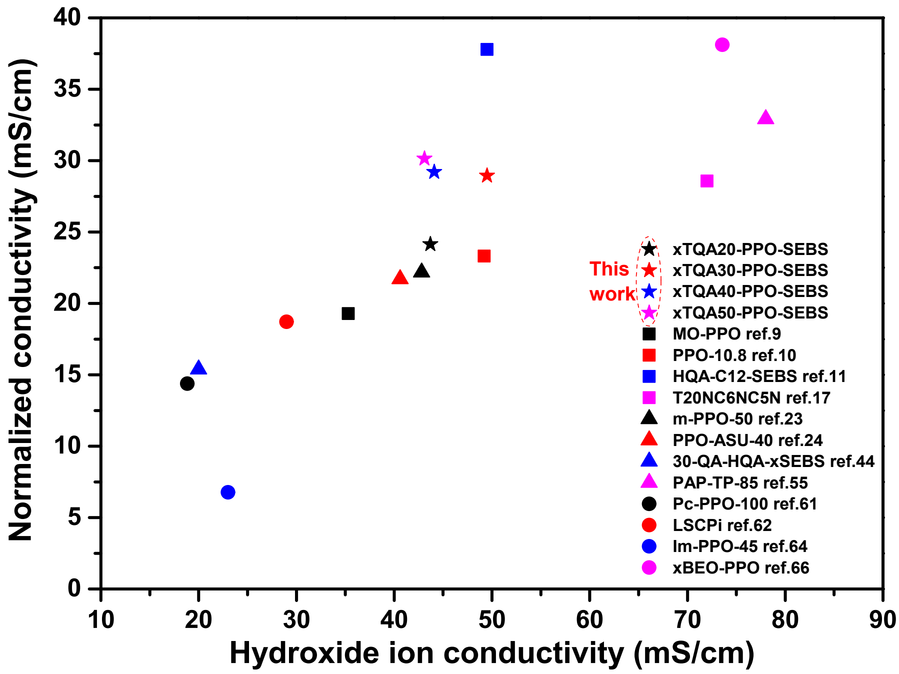

Figure S8. The hydroxide ion conductivity the xTQAn-PPO-SEBS developed in the current study compared with other PPO- and SEBS-based AEMs reported in the literature at 20 ℃ [9-11,17,23,24,44,61,62,64,66].

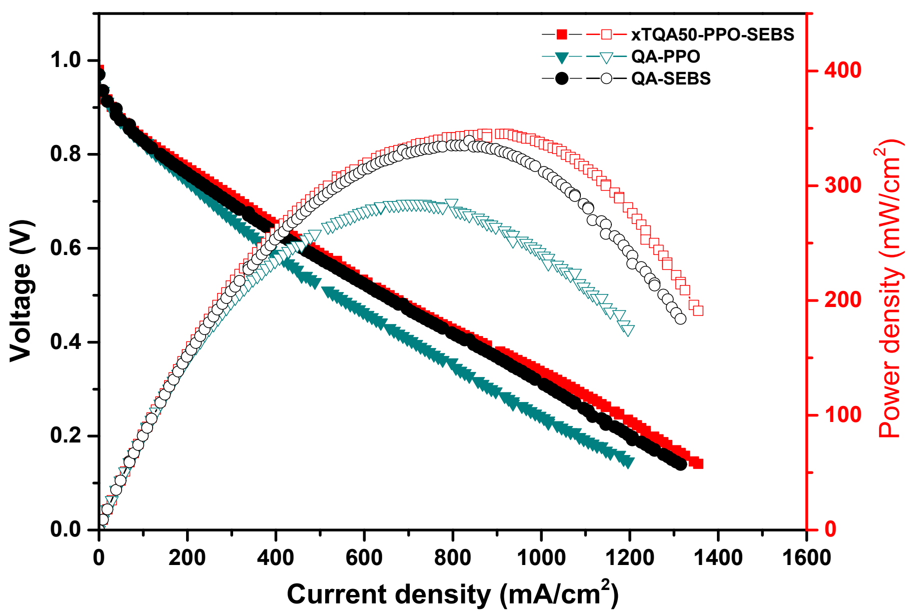

Figure S9. Single-cell performances of xTQAn-PPO-SEBS(30 μm), QA-PPO, and QA-SEBS at 60°C and 95% RH

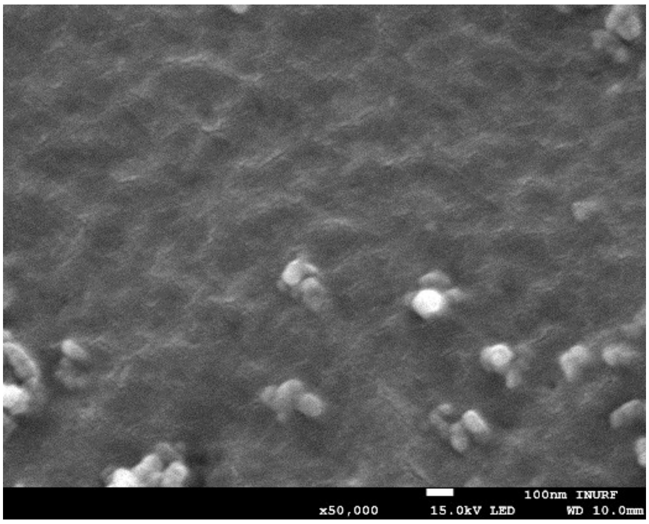

Figure S10. SEM surface image of xTQA50-PPO-SEBS membrane after the single-cell 300h durability test

Membrane Code	xTQA20-PPO-SEBS	xTQA30-PPO-SEBS	xTQA40-PPO-SEBS	xTQA50-PPO-SEBS
Gel fraction (%)	98.7	95.4	93.3	95.4

Table S1. Gel fractions of the xTQAn-PPO-SEBS membranes

Table S2. Tensile strengths, elongations at break, and Young's moduli of xTQAn-PPO-SEBS membranes at 50% RH and in a wet state

Membrane code	Tensile strength (MPa)	Elongation at break (%)	Young’s modulus (MPa)

	50% RH	Wet	50% RH	Wet	50% RH	Wet
xTQA20-PPO-SEBS	20.5	7.6	158.8	202.1	122.7	14.4
xTQA30-PPO-SEBS	24.4	11.7	151.6	175.5	182.8	37.2
xTQA40-PPO-SEBS	31.2	13.7	116.2	140.6	260.3	48.2
xTQA50-PPO-SEBS	34.3	18.1	91.6	106.4	401.7	128.1

Table S3. Water contents and fractions of water in each state for xTQAn-PPO-SEBS membranes with different degrees of crosslinking calculated from DSC plots

Membrane Code	Water content (%)			Ratio (%)	
	Total	Freezing	Bound	[Freezing] /[Total]	[Bound] /[Total]
xTQA20-PPO-SEBS	110.6	24.3	86.3	22.0	78.0
xTQA30-PPO-SEBS	100.0	21.4	78.7	21.4	78.6
xTQA40-PPO-SEBS	85.3	17.7	67.6	20.8	79.2
xTQA50-PPO-SEBS	67.2	13.6	53.6	20.2	79.8

Table S4. Hydroxide ion conductivity in 20℃ water of the xTQA50-PPO-SEBS membrane before and after the single-cell 300h durability test

Membrane Code	IEC (meq/g)		OH^- conductivity (mS/cm)	
	Before Durability test	After durability test	Before durability test	After durability test
xTQA50-PPO-SEBS	1.43 ± 0.03	1.39 ± 0.08	43.1 ± 0.14	42.3 ± 0.02

Table S5. Comparison of the hydrogen/oxygen fuel cell performances of different membranes collected from the open literature

Membrane Code	IEC (meq/g)	Operation temp (°C)	Backpressure (MPa)	Maximum power density (mW/cm^2)	Durability (h)	Ref
xTQA50-PPO-SEBS	1.43	60	0	405	300 (at 0.2A/cm^2)	This work
HQA-C12-SEBS	1.31	60	0	163	-	11
T20NC6NC5N	2.47	60	0.1	364.2	-	17
m-QPPO-50	1.93	60	0	333	-	23
PPO-ASU-30	1.6	60	0	124.7	40 (at 0.3V)	24
SEBS-CH2-QA-1.5	1.23	60	0	94.6	-	42
75-QA-HQA-xSEBS	2.13	60	0	315	-	44
SEBS-TMA	2.19	60	0.1	223	110 (at 0.3V)	60
SEBS30-TMA	1.35	70	0	300	-	61
HPPO/PPO-C8 AEM	2.69	60	0	222	-	62
Pc-PPO-10	1.36	80	0	343.8	-	63
LSCPi	1.55	60	0	116	5.5 (at 0.1A/cm^2)	64
PO-CE0.10-QA0.90	2.25	80	0	194.6	48 (at 0.1A/cm^2)	65

Im-PPO-45	3.4	60	0	224.84	-	66
Aligned 6%-QA-Fe3O4/TA-PPO	2.41	80	0	224	-	67
xBEO-PPO	1.93	70	0	444	-	68

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**, 21074