

## Supporting information

### **Cyclic Olefin Copolymer-based Reinforced Anion Exchange Membranes for Water Electrolyzers**

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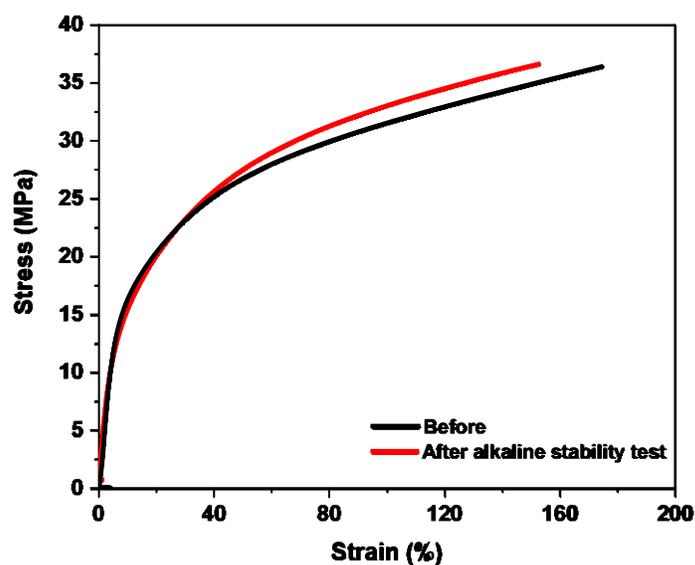
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**Table S1. Properties of COC polymer alkylation reactions.**

Entry	COC polymer (eq)	Triflic acid (eq)	1,7-dibromo alcohol (eq)	Time (min)	Degree of functionalization (%)	Pristine COC-Ph (M <sub>w</sub> , kDa)	Alkylated COC-2Br (M <sub>w</sub> , kDa)
(a)	1	0.5	0.8	10 (in ice)	23	270	825
(b)	1	0.5	0.8	20 (in ice)	26	270	1022
(c)	1	0.9	1.4	15 (in ice)	32	255	693
(d)	1	0.9	1.4	15 ice + 15 RT	31	255	893
(e)	1	0.9	1.4	15 ice + 15 RT	38	270	950

**Table S2. Tensile stress-strain curves of non-reinforced COC membranes, PE pore-filled reinforced membranes, and the state-of-the-art AEMs based on polynorbornenes.**

Entry	Membrane	Tensile strength (MPa)	Elongation at break (%)	Ref.
(a)	PE substrate	29.5 ± 0.2	47.8 ± 2.2	This work
(b)	XL20-COC-2N-2.1	23.6 ± 0.2	104.2 ± 0.2	This work
(c)	R-XL20-COC-2N-2.2-PE	49.4 ± 0.4	193.0 ± 11	This work
(d)	R-XL20-COC-2N-2.3-PE	43.3 ± 1.4	220.9 ± 4.7	This work
(e)	R-XL20-COC-2N-2.5-PE	50.0 ± 6.5	181.9 ± 3.1	This work
(f)	R-XL20-COC-2N-2.8-PE	43.8 ± 1.6	200.1 ± 12.1	This work
(g)	QPN	25	9-38	[1]
(h)	XL35-rPNB-X60-Y40	2.5	51.7	[2]
(g)	DCPD/TCPD	28-38	17-27	[3]



**Figure S1.** Tensile stress–strain curves of the R-XL20-COC-2N-2.2-PE membrane after alkaline stability testing in 1 M NaOH at 95 °C for 500 h (measured at 50 °C and 50% RH).

**Table S3.** Cl<sup>-</sup> conductivity of the R-XL20-COC-2N-2.2-PE membrane after alkaline stability testing in 1 M NaOH at 95 °C for 500 h.

Temperature (°C)	Cl <sup>-</sup> conductivity (mS/cm)	
	Before	After 500 h
30	14.5	14.1
60	27.4	26.5
80	42.1	39.8

**Table S4. Performance of the state-of-the-art AEM water electrolyzers and their operating conditions.**

Membrane	Thickness ( $\mu\text{m}$ )	Anode	Cathode	Temperature ( $^{\circ}\text{C}$ )	Current density ( $\text{A}/\text{cm}^2$ )	Voltage (V)	Ref.
R-XL20-COC-2N-2.2-PE	26	NiFe-LDH	PtRu/C	80	2.23	1.8	This work
QP(T-3-Pip)	40	FeOOH/NiFe	NiFe	80	2.03	1.8	[4]
P(O-F <sub>50%</sub> -C <sub>50%</sub> )-GTA	20	Ni/Fe	N/A	80	3.8 (1.73)	2.0 (1.8)	[5]
PVBC-MPy/35%PEK-cardo	60	NiFe-LDH/NF	MoNi/NF	60	0.5 (0.25)	2.0 (1.8)	[6]
b-PP1PE3-Im	N/A	IrO <sub>2</sub>	Pt/C	60	2.24 (1.4)	2.0 (1.8)	[7]
AEM from Versogen	N/A	NiFeOOH	Pt/C	60	2.0 (1.1)	1.95 (1.8)	[8]
AP2-HNN6-00-X (Aemion)	N/A	NiFe LDH	Pt/C	80	2.0	1.8	[9]
qPSU	45	Ni foam	Pt/C	80	3.7 (0.81)	2.2 (1.8)	[10]
b-PDTP-Trip-5	50	IrO <sub>2</sub>	Pt/C	80	1.0 (1.11)	1.77 (1.8)	[11]
PSTP-20 AEM	25	FNC	PtRu/C	80	10.7 (5.7)	2.0 (1.8)	[12]

Values shown in parentheses are estimated from the polarization curves in the referenced publications

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