Supporting Information

In Situ Ligand Stripping of CeO_2 Nanocrystals in Anion Exchange Membranes for Enhanced Water Electrolysis

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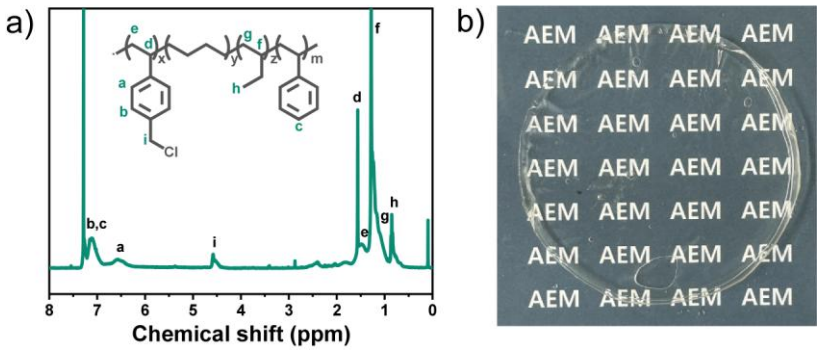

Figure S1. (a) ^{1}H NMR spectrum of CMSEBS. (b) Optical photo of the QSEBS membrane.

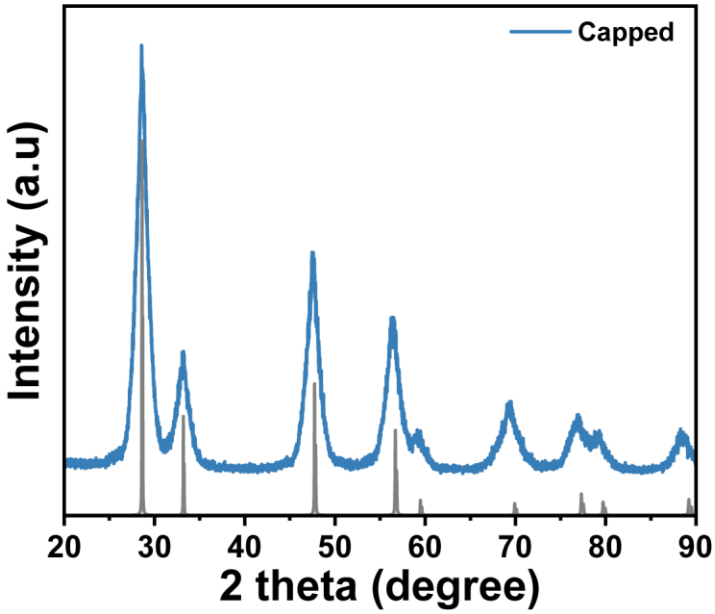

Figure S2. XRD pattern of CeO_2 nanocrystals and reference fluorite CeO_2 pattern (PDF # 01-081-0792).

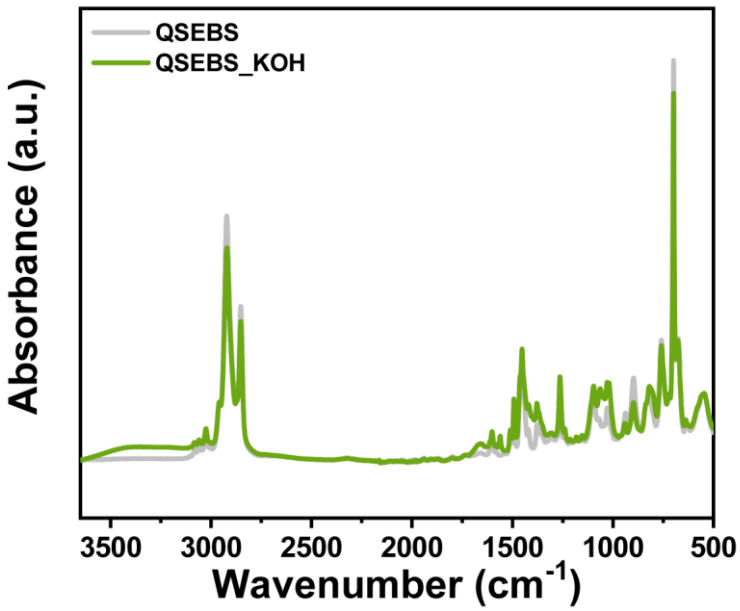

Figure S3. FT-IR spectra of before and after 1 M KOH treatment on QSEBS membrane.

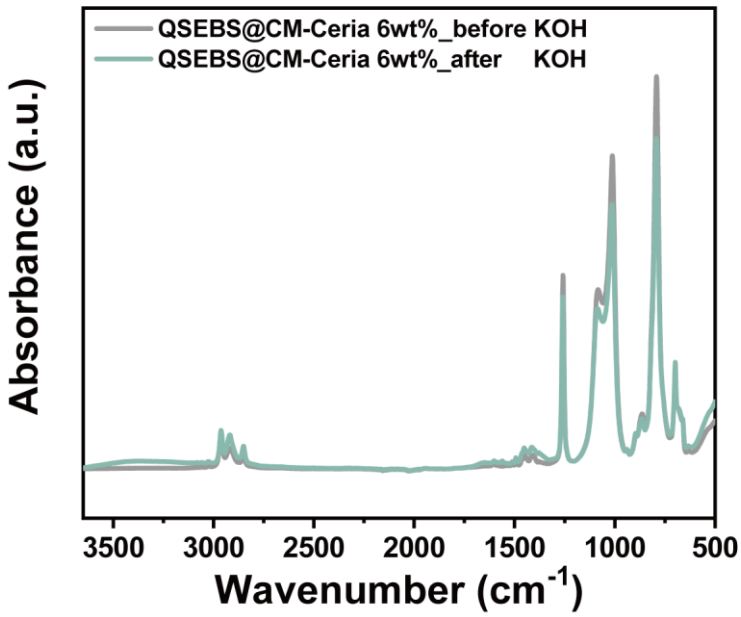

Figure S4. FT-IR spectra of before and after 1 M KOH treatment on QSEBS@CM-ceria-6.

Figure S5. Optical photo of commercial CeO_2 nanoparticles dispersed in chloroform.

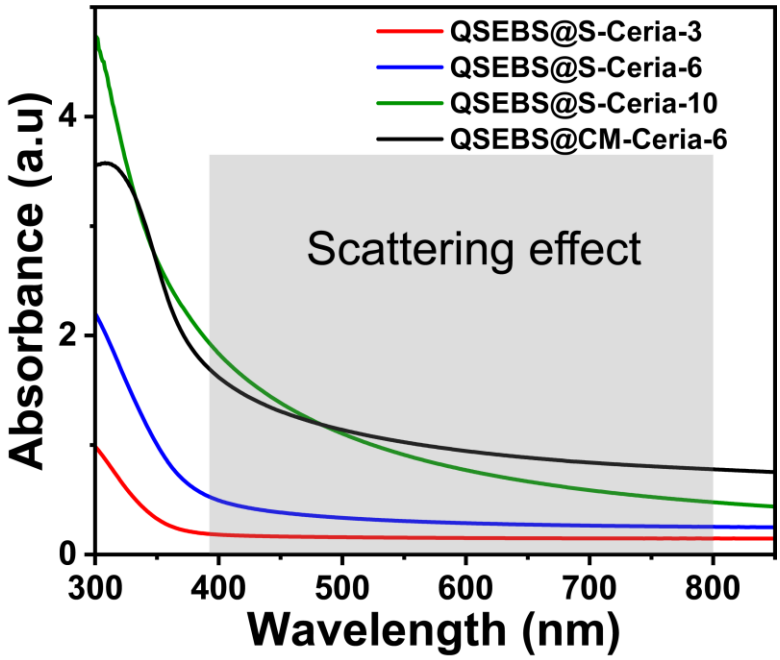

Figure S6. UV-Visible spectra of composite membranes exhibiting significant scattering effects in QSEBS@S-Ceria-10 and QSEBS@CM-Ceria-6.

Figure S7. Optical microscope image of a) QSEBS, b) QSEBS@S-Ceria-6, and c) QSEBS@CM-Ceria-6 membranes.

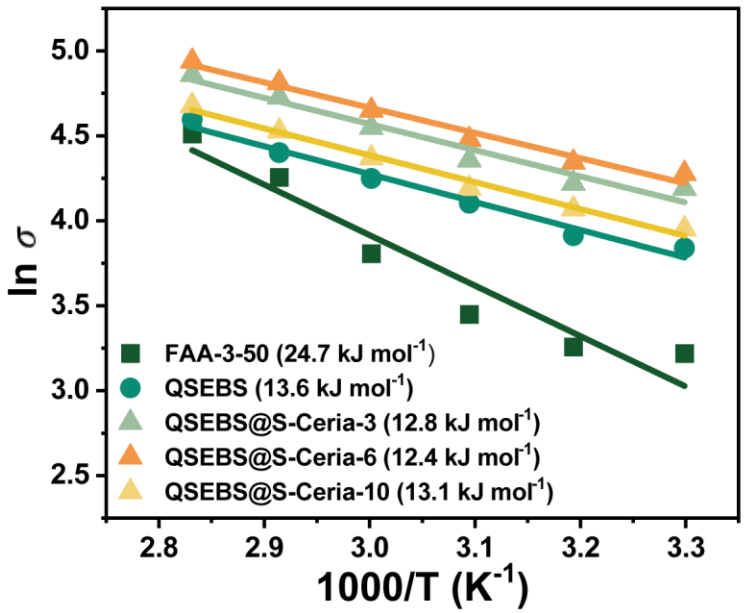

Figure S8. Arrhenius-type plots of the conductivity of membranes.

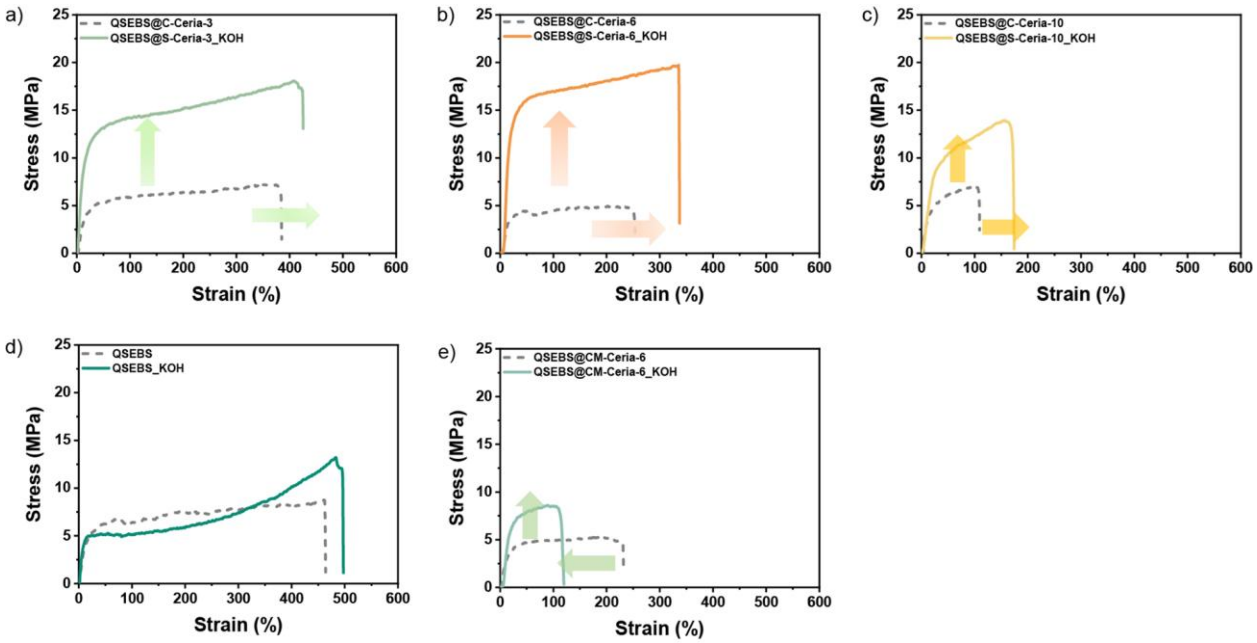

Figure S9. Comparison of the mechanical properties of the membranes before and after 1 M KOH treatment.

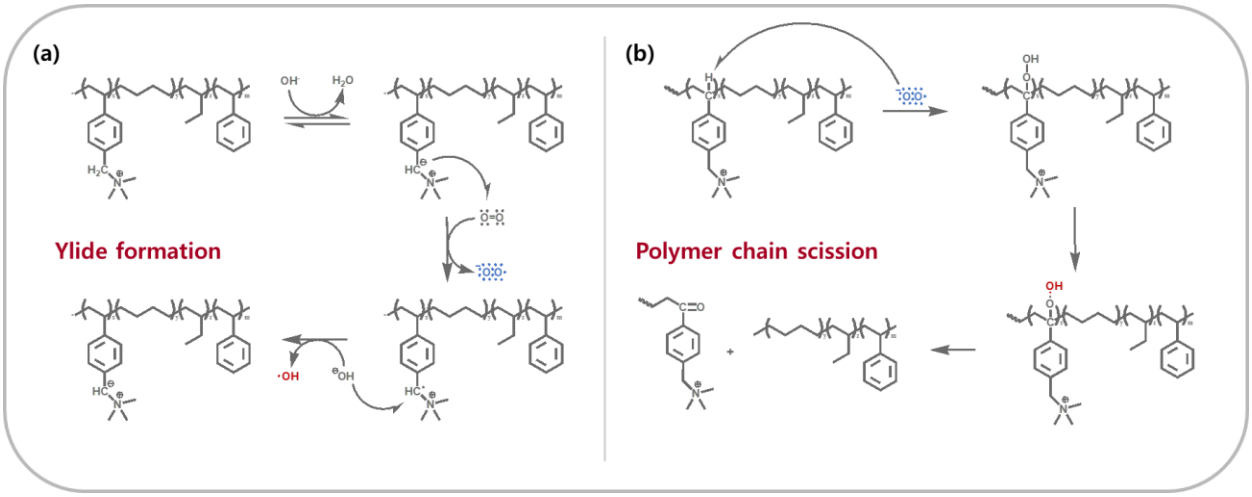

Figure S10. QSEBS-based AEM decomposition mechanism by hydroxyl radicals.

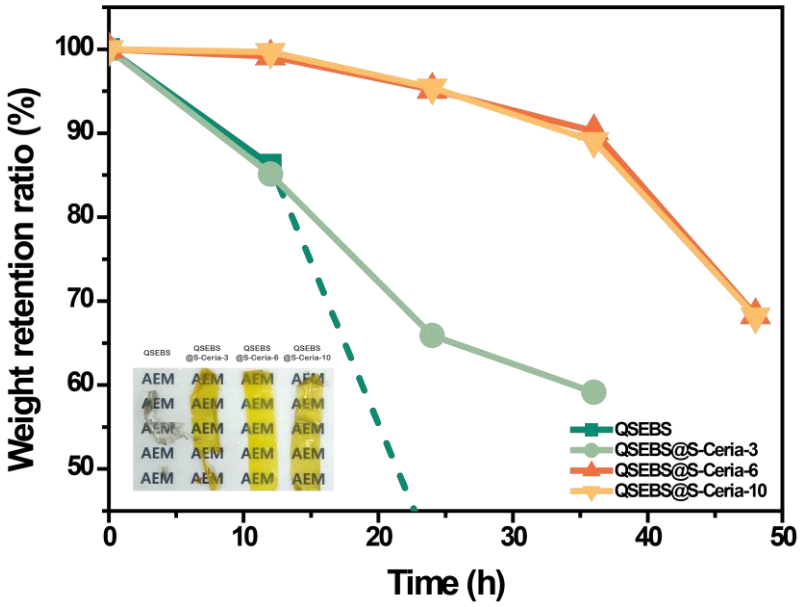

Figure S11. The weight-retention ratio over time as a function of S-Ceria nanocrystal content in the QSEBS matrix during the oxidation stability test using Fenton's reagent.

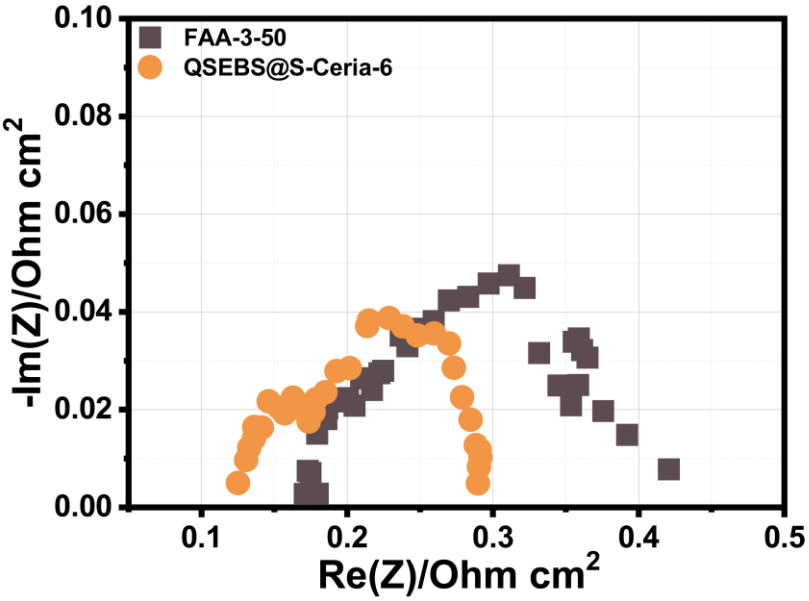

Figure S12. EIS curves of FAA-3-50 and QSEBS@S-Ceria-6 based AEMWE devices using PGM catalysts.

Membrane	IEC (mmol g^{-1})	WU (%)	SR (%)	λ
	IEC[a] / IEC[b]	30 °C / 80 °C	30 °C / 80 °C	30 °C / 80 °C
QSEBS	1.91 / 1.94	53.3 / 91.2	37.8 / 67.1	15.2 / 26.1
QSEBS@S-Ceria-3	1.86 / 2.20	63.0 / 103.5	40.0 / 70.0	15.9 / 26.1
QSEBS@S-Ceria-6	1.82 / 2.40	67.8 / 108.3	35.0 / 62.3	15.7 / 25.0
QSEBS@S-Ceria-10	1.77 / 2.13	56.1 / 98.1	32.2 / 56.7	14.6 / 25.6
QSEBS@CM-Ceria-6	1.82 / 2.10	62.1 / 102.1	33.5 / 58.4	16.4 / 27.0

a: Theoretical IEC, b: Experimental IEC

Table S1. IEC (ion exchange capacity), water uptake (WU), swelling ratio (SR), and hydration number (λ) of the membranes.

AEM	Anode	Cathode	Condition	Performance	Ref
QSEBS@S-Ceria-6	IrO_2 (2.0 mg cm^{-2})	PtRu/C (0.5 mg cm^{-2})	50 °C, 1 M KOH	2.52 A cm^{-2} at 2.0 V	This work
Q-PPI-b10	IrO_2 (2.0 mg cm^{-2})	Pt/C (0.6 mg cm^{-2})	60 °C, 1 M KOH	0.3 A cm^{-2} at 2.0 V	1
m-p-TP-40-BOP-ASU	IrO_2 (0.4 mg cm^{-2})	Pt/C (0.2 mg cm^{-2})	60 °C, 1 M KOH	1.96 A cm^{-2} at 2.0 V	2
x-TriPPO-50SEBS	IrO_2 (4.0 mg cm^{-2})	Pt/C (0.5 mg cm^{-2})	70 °C, 1 M KOH	0.71 A cm^{-2} at 1.8 V	3

40x-PBB-SEBS	IrO_2 (2.0 mg cm^{-2})	Pt/C (0.4 mg cm^{-2})	70 °C, 1 M KOH	1.04 A cm^{-2} at 1.8 V	4
TDMAP-50x-SEBS	IrO_2 (2.0 mg cm^{-2})	Pt/C (0.4 mg cm^{-2})	70 °C, 1 M KOH	0.74 A cm^{-2} at 1.8 V	5
30x-PIM-SEBS	IrO_2 (2.0 mg cm^{-2})	Pt/C (0.4 mg cm^{-2})	70 °C, 1 M KOH	1.91 A cm^{-2} at 2.0 V	6
C-QPAP-2-QPPO	IrO_2 (1.5 mg cm^{-2})	Pt/C (1.5 mg cm^{-2})	80 °C, 1 M KOH	1.44 A cm^{-2} at 2.0 V	7
QPTTP-5%	IrO_2 (2.0 mg cm^{-2})	Pt/C (1.5 mg cm^{-2})	80 °C, 1 M KOH	1.5 A cm^{-2} at 2.2 V	8
cPBI-0.4p-0.6s	IrO_2 (2.0 mg cm^{-2})	Pt/C (2.0 mg cm^{-2})	80 °C, 1 M KOH	0.55 A cm^{-2} at 2.1 V	9
PBP-M-35	IrO_2 (1.5 mg cm^{-2})	Pt/C (1.5 mg cm^{-2})	80 °C, 1 M KOH	2.0 A cm^{-2} at 1.8 V	10
m-qPCPT-10	IrO_2 (1.5 mg cm^{-2})	Pt/C (1.0 mg cm^{-2})	80 °C, 1 M KOH	2.4 A cm^{-2} at 1.9 V	11
QP(T-3-Pip)	FeOOH/NiFe	NiFe	80 °C, 1 M KOH	2.03 A cm^{-2} at 1.8 V	12
P(O-$F_{50\%}$-$C_{50\%}$)-GTA	Ni/Fe	Ni/Fe	80 °C, 1 M KOH	3.8 A cm^{-2} at 2.0 V	13

Table S2. AEMWE performance comparison of QSEBS@S-Ceria-6 and state-of-the-art AEMWEs with PGM catalysts-based anode and cathode.

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