"Rock-solid" CoB-based sponge electrodes for overall seawater splitting at industrial-level current density

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1.1. (Preparation of Other Elements (Ni, P and Fe)-Doped CoB-Based Electrodes)

Table 1 shows the conditions and reagent consumption of CoB-based electrodes.

Table 1. Conditions and reagent consumption of CoB-based electrodes.

Electrodes	CoNiB@HPS [a)]	CoFeB@HPS[b)]	CoFeNiB@HPS[c)]	CoPB@HPS[d)]
Reagents	$(NH_4)_2SO_4$ (1.50 g), $HOC(COONa)(CH_2COONa)_2 \cdot 2H_2O$ (1.50 g)			
	$CoSO_4 \cdot 7H_2O$ 4.00 g	$CoSO_4 \cdot 7H_2O$ 6.00 g	$CoSO_4 \cdot 7H_2O$ 3.00 g	$CoSO_4 \cdot 7H_2O$ 8.00 g
	$NiSO_4 \cdot 6H_2O$ 4.00 g	$(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ 1.50 g	$NiSO_4 \cdot 6H_2O$ 3.00 g	$NaH_2PO_2 \cdot H_2O$ 1.50 g
	DMAB 4.40g	DMAB 4.40g	$(NH_4)_2Fe(SO_4)_2 \cdot 6H_2O$ 1.50 g DMAB 4.40g	DMAB 3.70g
Conditions	100 mL H_2O, 10 h, 273 K			

a) In the CoNiB@HPS sample, the molar content of nickel element is equal to that of Co element; b) In the CoFeB@HPS sample, the molar content of iron element is 15% of that of Co element; c) In the CoFeNiB@HPS sample, the molar content of iron element is 15% of the sum of Co and nickel elements; d) In the CoPB@HPS sample, the molar content of P element is 20% of that of B element.

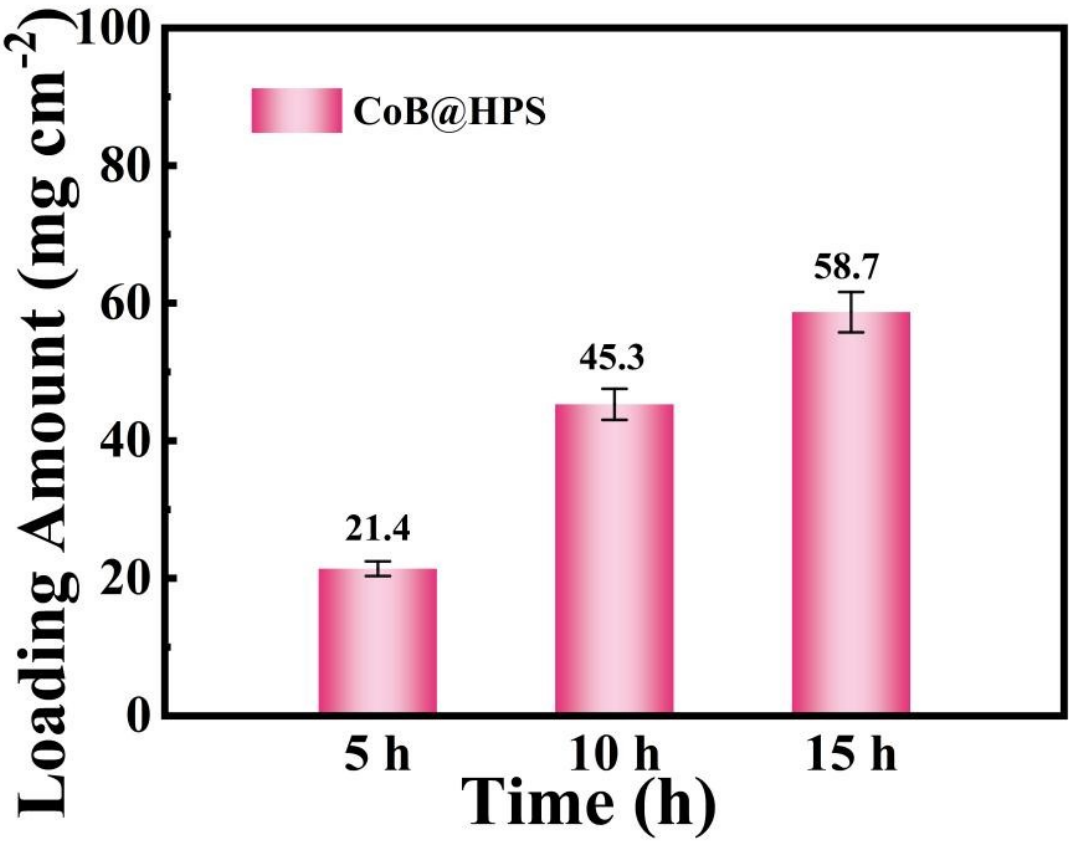

Figure S1. The loading amount of CoB@HPS under different electroless plating time.

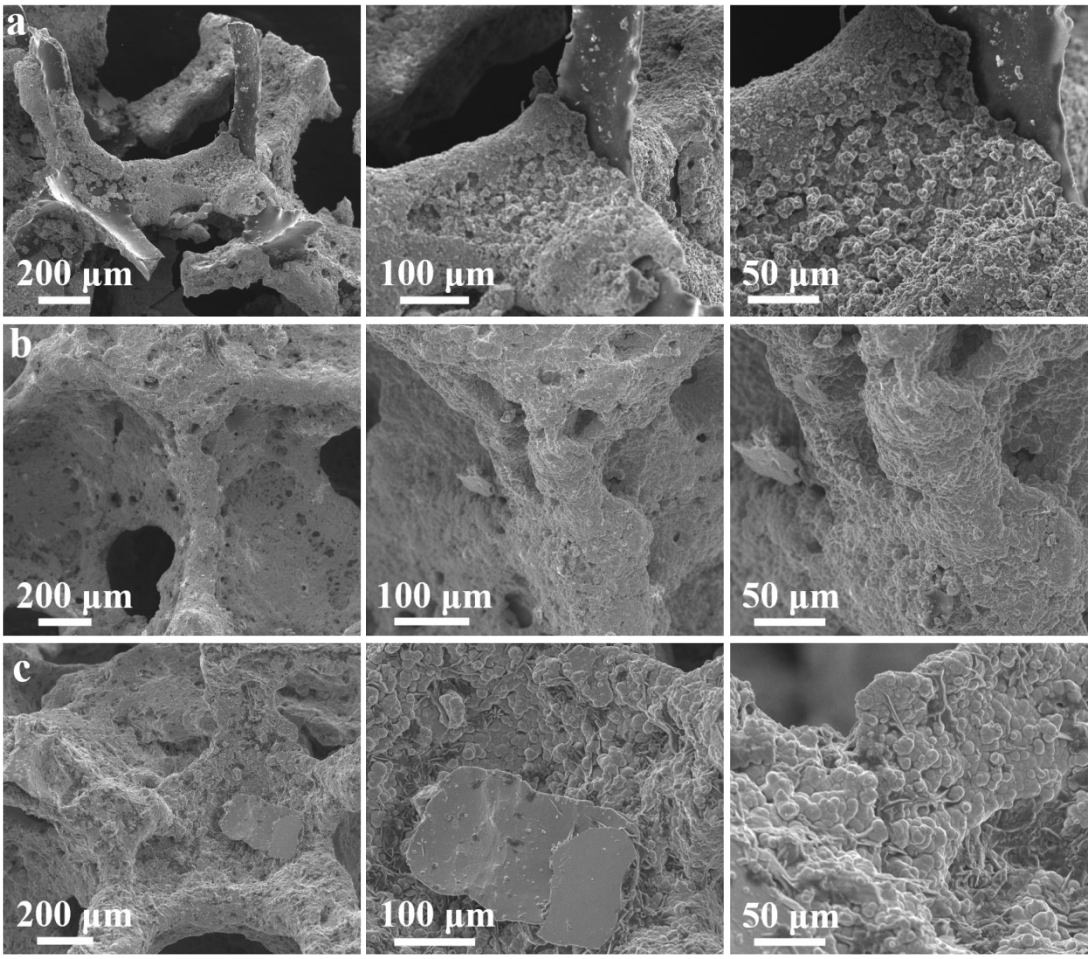

Figure S2. SEM images of (a) CoB@HPS-5 h; (b) CoB@HPS-10 h and (c) CoB@HPS-15 h under different magnifications.

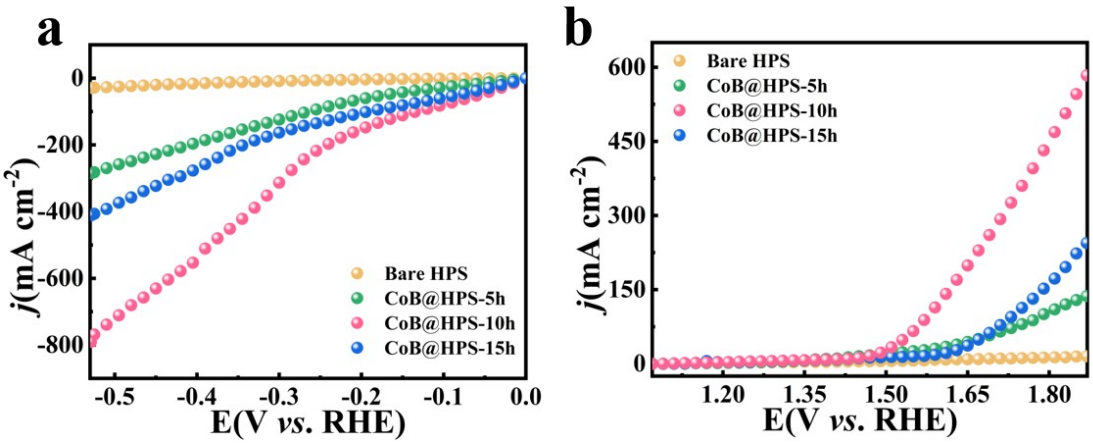

Figure S3. LSV curves of CoB@HPS under different plating time during (a) HER process and (b) OER processes in 1.0 M KOH + 0.5 M KOH.

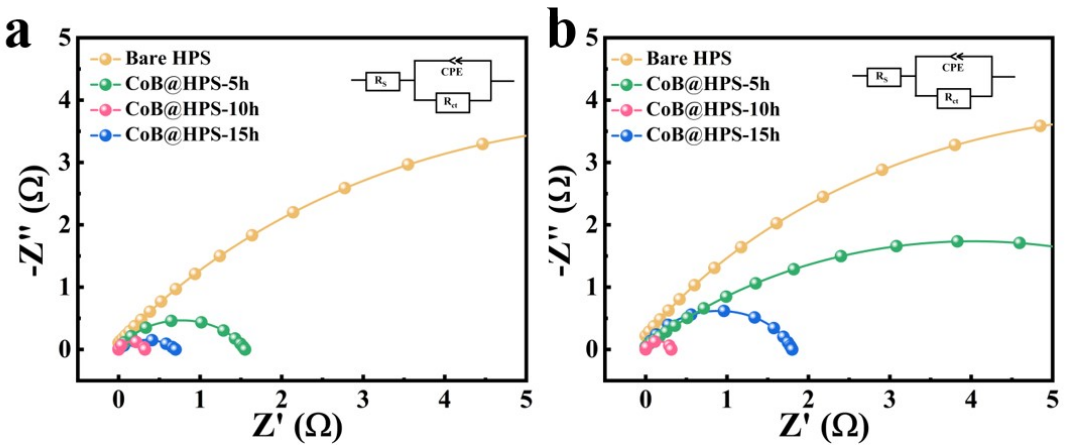

Figure S4. Nyquist plots of CoB@HPS under different plating time during (a) HER process and (b) OER processes in 1.0 M KOH + 0.5 M KOH.

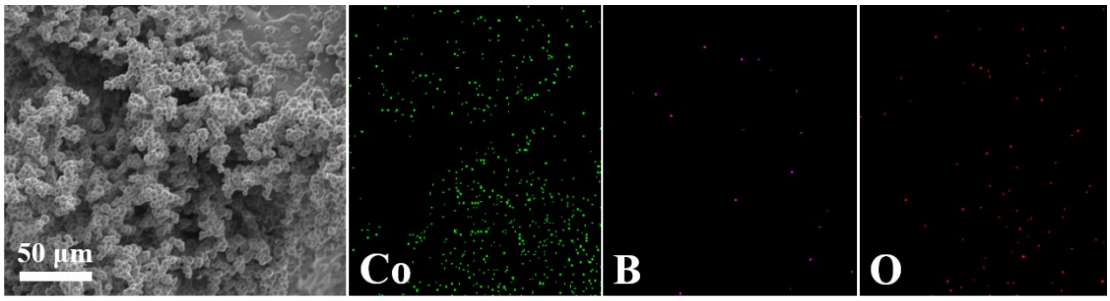

Figure S5. SEM Energy Dispersive X-ray spectroscopy (EDS) elements mapping of CoB@HPS

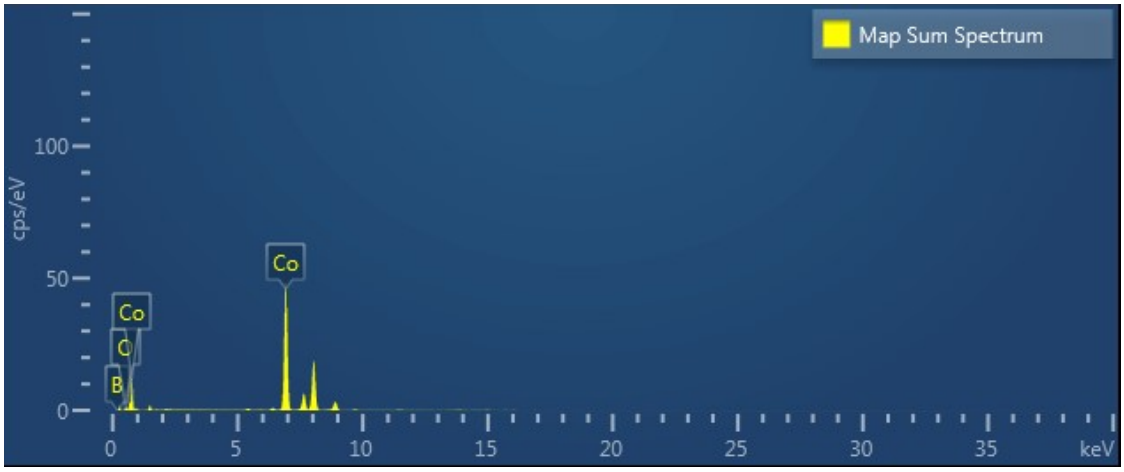

Figure S6. Dark-field scanning transmission electron microscopy combined with energy dispersive X-ray spectroscopy (HAADF-STEM-EDX) results of CoB@HPS.

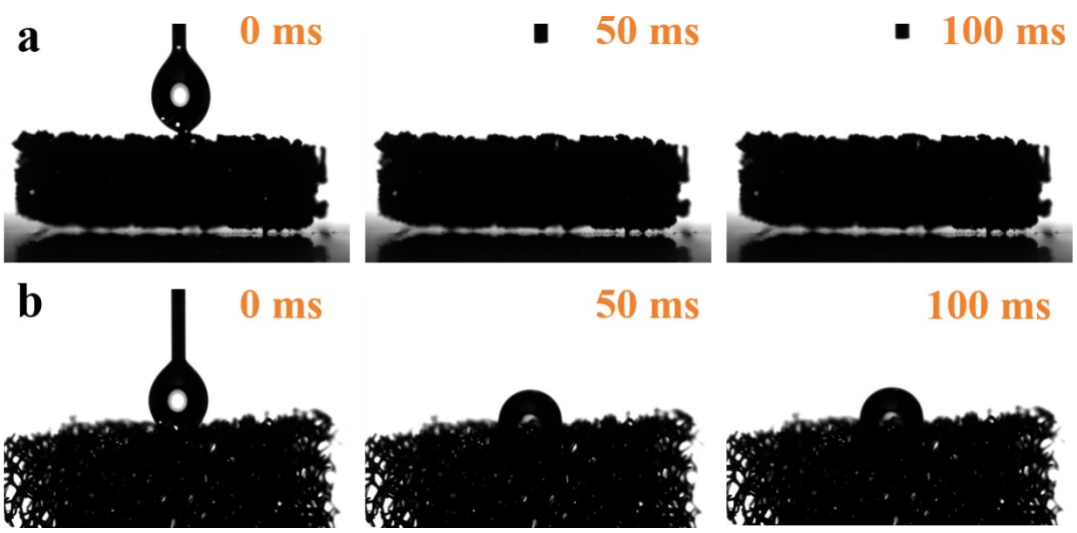

Figure S7. Contact angle images of (a) CoB@HPS and (b) Bare HPS.

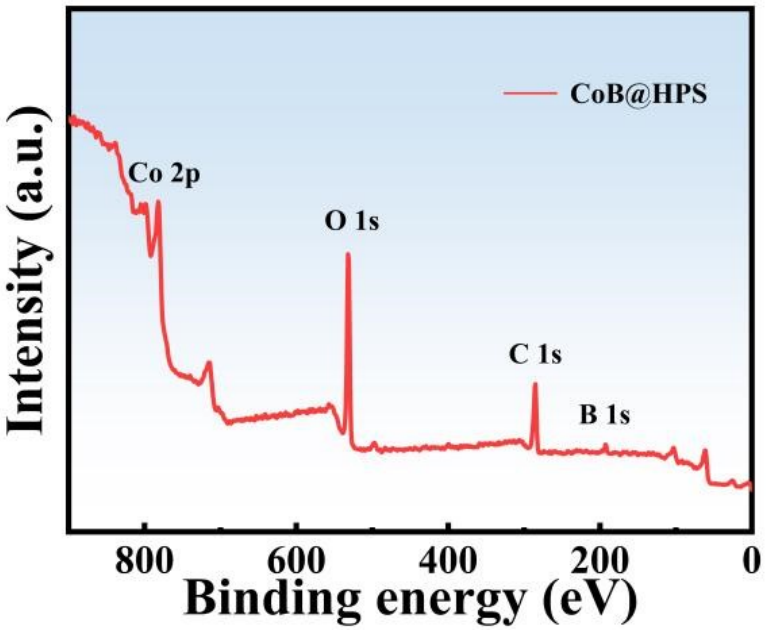

Figure S8. Full XPS survey spectra for CoB@HPS electrode.

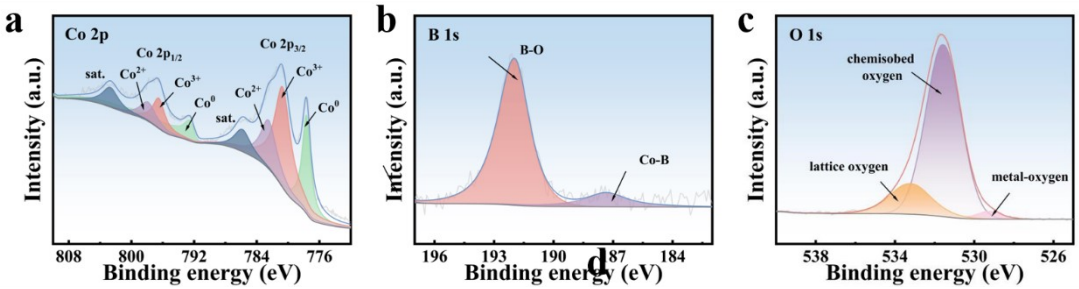

Figure S9. High-resolution XPS results of (a) Co 2p; (b) B 1s and (c) O 1s.

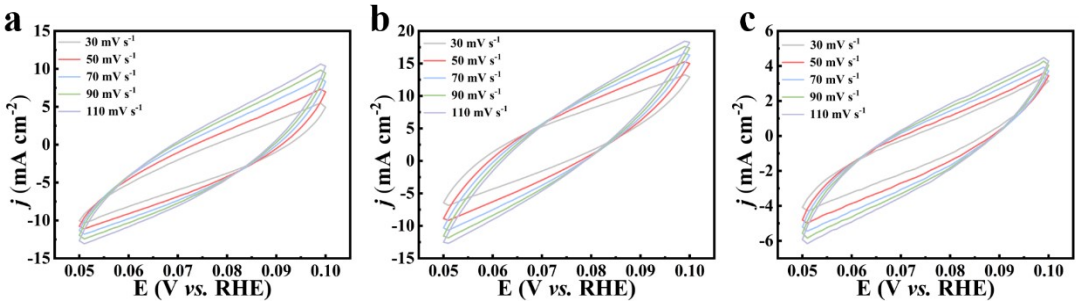

Figure S10. CV curves within a non-faradaic reaction region from 0.05-0.10 V (vs. RHE) at different scan rates toward HER process for (a) CoB@HPS; (b) CoB@HA and (c) CoB@NF.

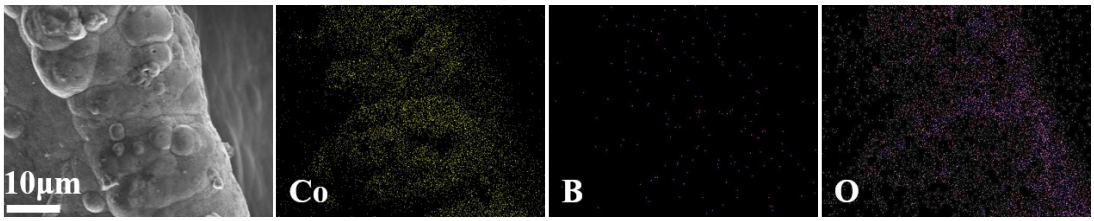

Figure S11. SEM images and corresponding elemental mapping of CoB@HPS after HER stability test in 1.0 M KOH + 0.5 M NaCl.

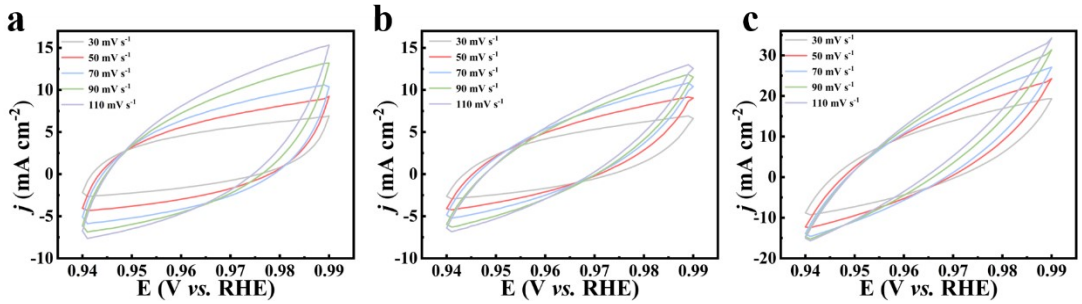

Figure S12. CV curves within a non-faradaic reaction region from 0.94-0.99 V (vs. RHE) at different scan rates toward OER process for (a) CoB@HPS; (b) CoB@HA and (c) CoB@NF.

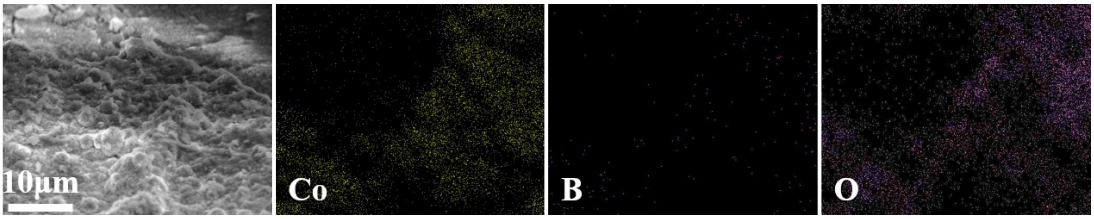

Figure S13. SEM images and corresponding elemental mapping of CoB@HPS after OER stability test in 1.0 M KOH + 0.5 M NaCl.

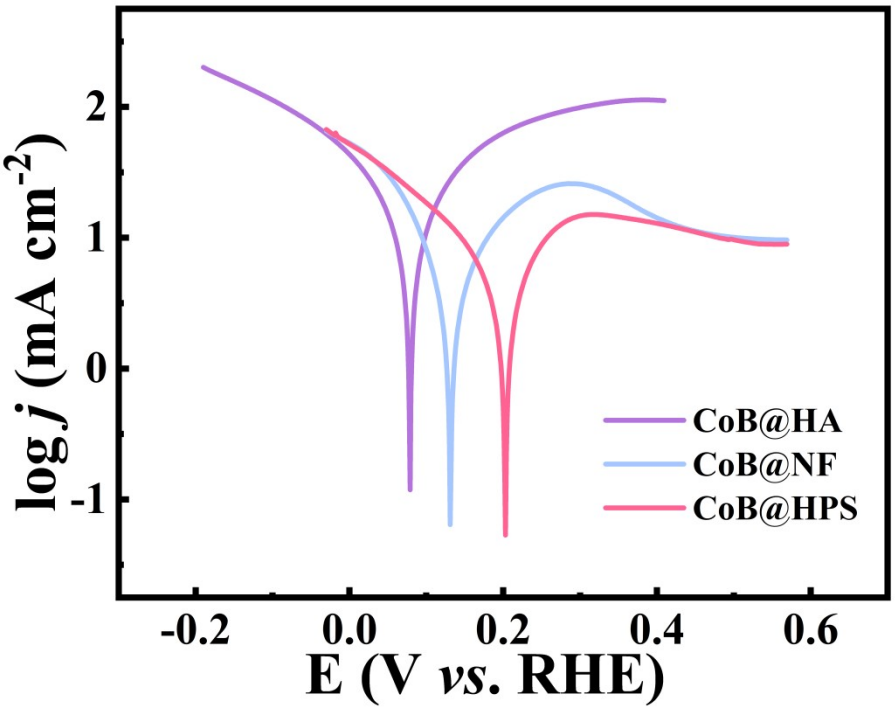

Figure S14. Tafel plots of CoB@HA,CoB@NF and CoB@HPS.

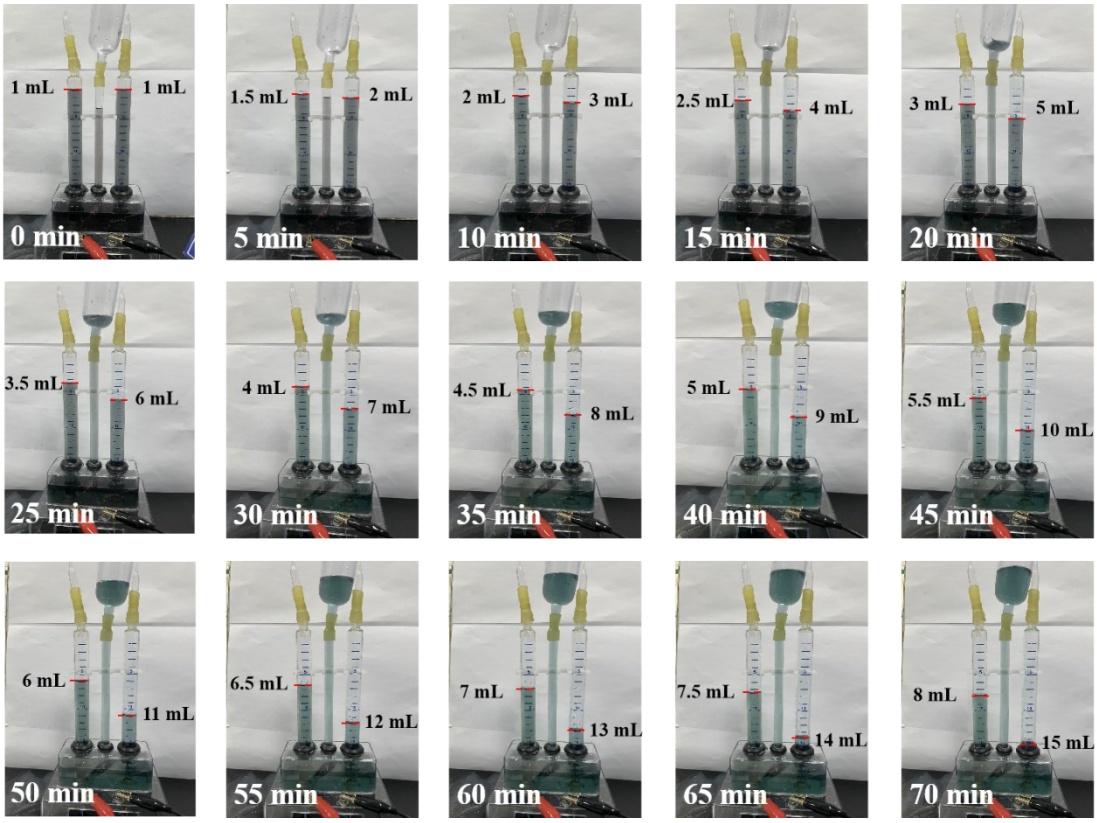

Figure S15. Photographs of gas generation amount (H_2 and O_2) collected per 5 min at the current density of 500 mA cm^{-2}.

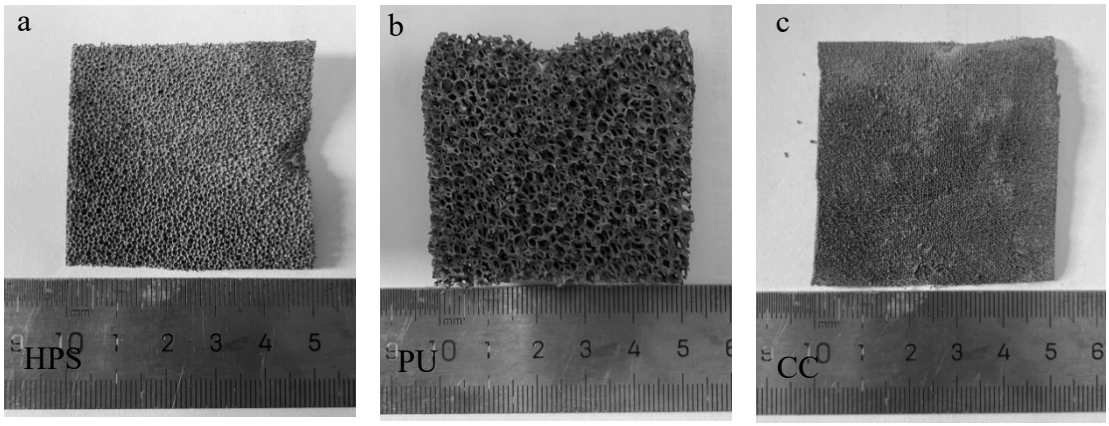

Figure S16. Large area (5cm×5cm) preparation of CoB on different substrates (HPS, PU, CC)

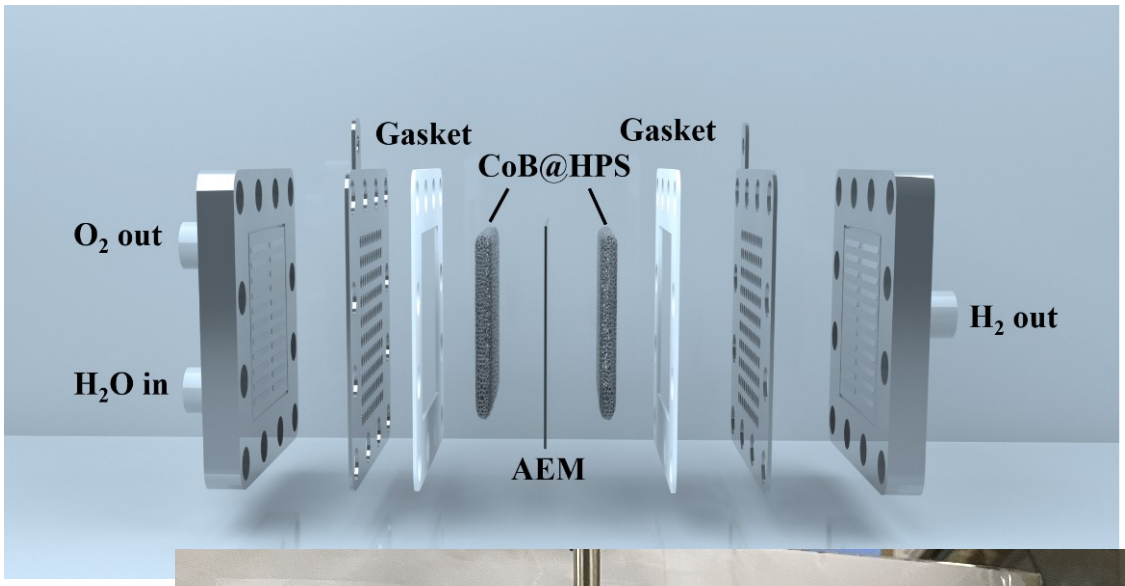

Figure S17. T

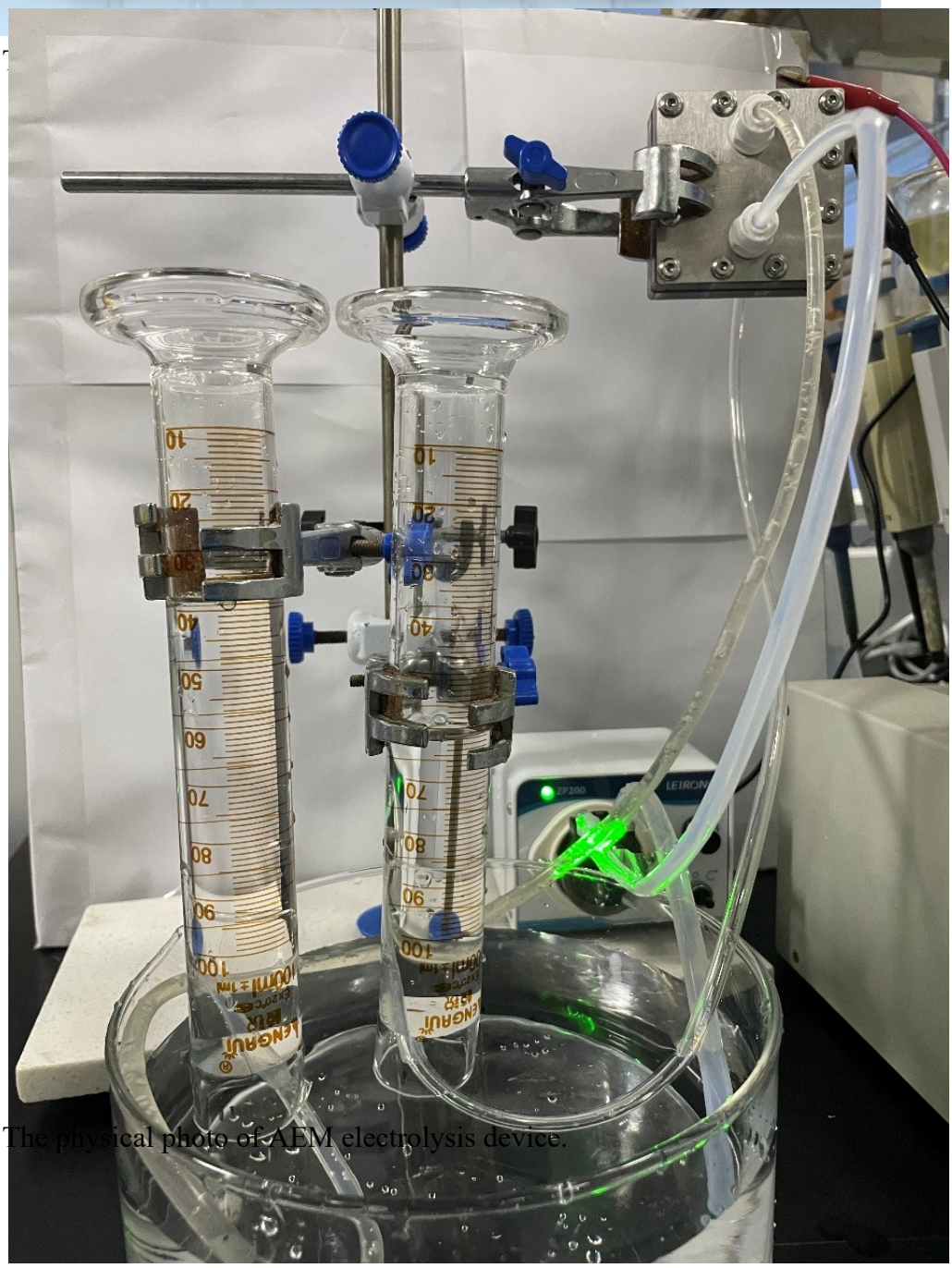

Figure S18. The physical photo of AEM electrolysis device.

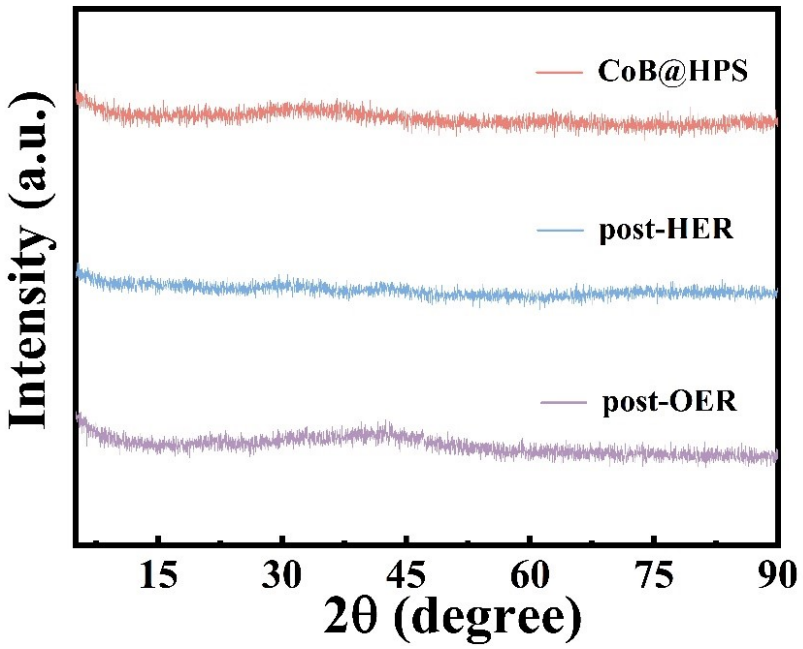

Figure S19. XRD patterns of CoB@HPS，post-HER and post-OER.

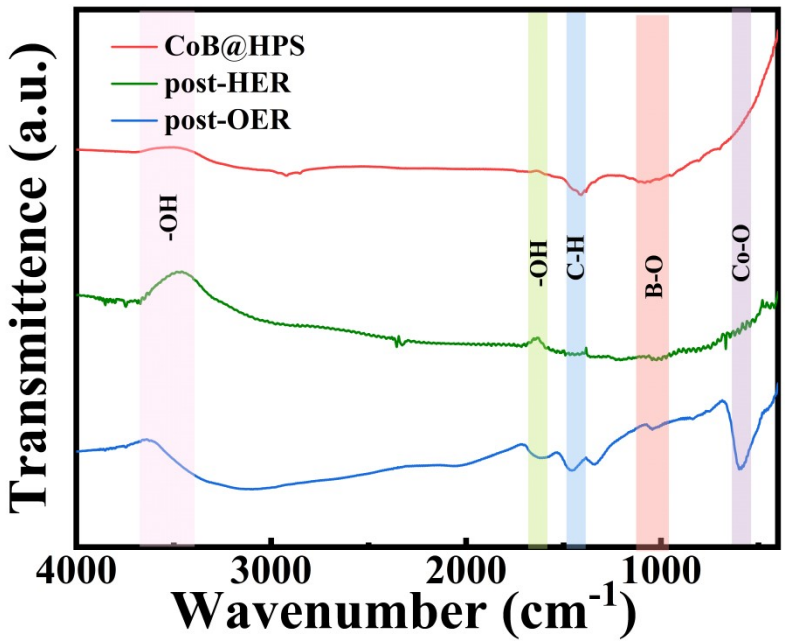

Figure S20. FT-IR spectra of initial sample, post-HER, and post-OER.

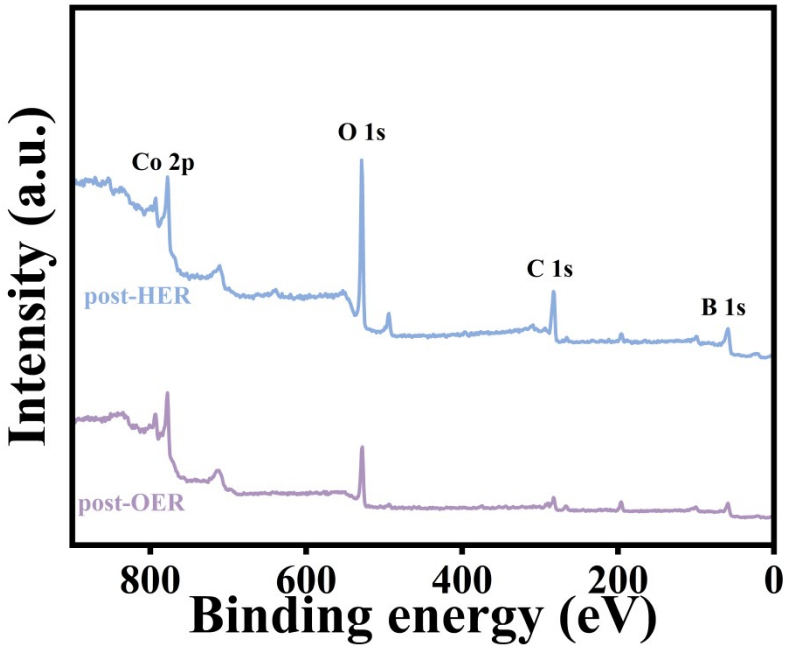

Figure S21. Full XPS survey spectra of post-HER and post-OER.

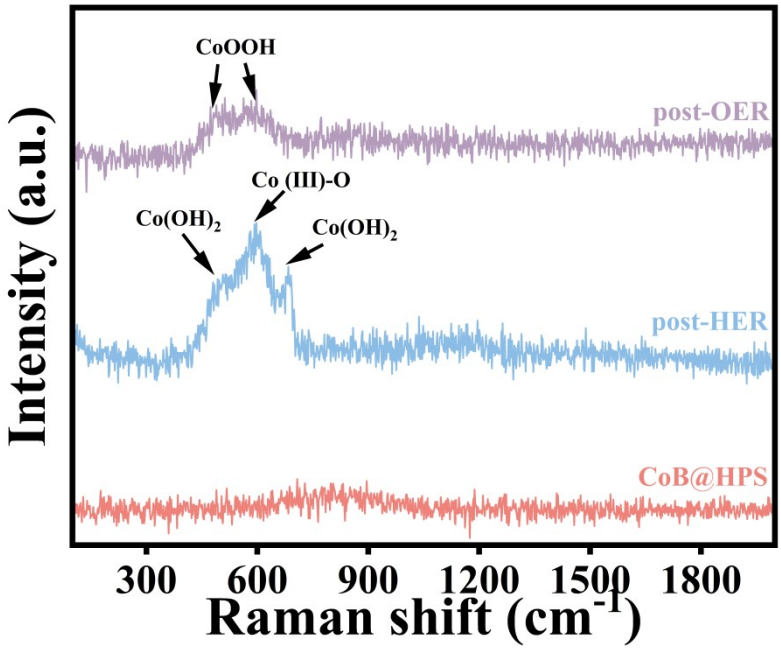

Figure S22. Raman spectrum of initial sample, post-HER, and post-OER.

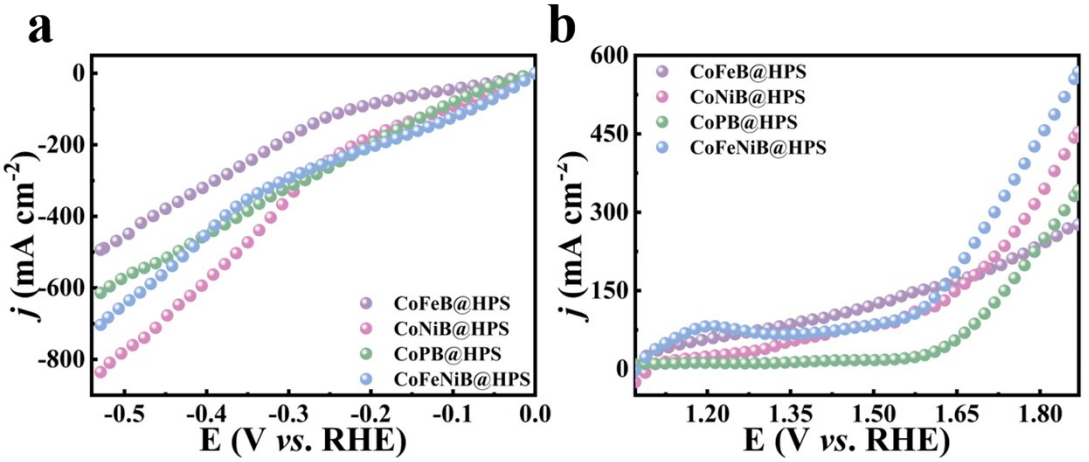

Figure S23. Uncorrected infrared LSV curves of CoFeB@HPS, CoNiB@HPS, CoPB@HPS, and CoFeNiB@HPS for HER (a) and OER (b) processes.

Table S1. Comparison of costs between HPS and other metal substrates

Substrate	**Size (cm^2)**	**Price ($)**	**Price per unit area ($ cm^{-2})**
HPS	100*100	1.73	0.00017
Iron foam	10*10	8.13	0.0813
Nickel foam	20*30	3.91	0.0065
Cobalt foam	10*10	130.84	1.308
Copper foam	10*10	5.07	0.0507
Titanium foam	10*10	72.42	0.7242

Table S2. Comparison the HER performance of CoB@HPS with other electrocatalysts.

Catalyst	Overpotential (η_{10}, mV)	Electrolyte	References
CoB@HPS	**19**	**1.0 M KOH + 0 .5 M NaCl**	**This work**
Ru@FeCo-Ni$(OH)_2$	40	1.0 M KOH + se awater	1
Cr-Co_xP	100	1.0 M KOH	2
MnCo/NiSe/NF	22.1	1.0 M KOH	3
Co_3Mo_3N/Co_4N/Co	78	1.0 M KOH	4
Co,P-MoS_2@NiO/CC	54.3	1.0 M KOH	5
P-Co/Co$(OH)_2$	36.7	1.0 M KOH	6
PHCo/MoO_2@C	59	1.0 M KOH	7
CoN/VN@NF	55	1.0 M KOH	8
RuSAs@NiCoP/NF	8	1.0 M KOH	9
CoP/rGO@Ti	103	1.0 M KOH	10
B-Os	7	1.0 M KOH + seawater	11
B-Co_xP	11	1.0 M KOH + 0.5 M NaCl	12
Ru-BO_x-OH-300	22	1.0 M KOH	13
NixB/$Mo_{0.8}B_3$ (NMB)	15	1.0 M KOH	14
$IrB_{1.15}$	12	0.5 M H2SO4	15
FeCoNiCuMoB HEA	26	1.0 M KOH	16
B-Rh@NC	26	1.0 M KOH	17
Ni-Fe-Ce-B/MS	40	1.0 M KOH + 0.5 M NaCl	18
Co-W-B	97	1 M KOH	19

Table S3. Comparison the OER performance of Co-B@HPS with other electrocatalysts in 1.0 M KOH + 0.5 M NaCl

Catalyst	Overpotential (η_{10}, mV)	Electrolyte	References
CoB@HPS	**199**	**1.0 M KOH + 0.5 M NaCl**	**This work**
Ru@FeCo–$Ni(OH)_2$	266	1.0 M KOH + seawater	1
MoO_3@CoO/CC	298	1.0 M KOH + 0.5 M NaCl	20
MnCo/NiSe/NF	225.8	1.0 M KOH	3
Co_3Mo_3N/Co_4N/Co	220	1.0 M KOH	4
Co,P-MoS_2@NiO/CC	160	1.0 M KOH	5
CeO_2/Fe-$Co(OH)_2$	189	1.0 M KOH	21
CoFePBA/Co_2P	257	1.0 M NaOH + 0.5 M NaCl	22
CoOOH/Co_9S_8	240	1.0 M KOH	23
RuSAs@NiCoP/NF	222	1.0 M KOH	9
CFMO-2	217	1.0 M KOH	24
Fe_3Co_7-B/CNT	265	1.0 M KOH	25
BMO-750	297	1.0 M KOH	26
Ru-BO_x-OH-300	235	1.0 M KOH	13
NixB/$Mo_{0.8}B_3$ (NMB)	170	1.0 M KOH	14
$IrB_{1.1}$	248	1.0 M KOH	27
FeCoNiCuMoB HEA	201	1.0 M KOH	16
B-(Ni,Fe)OOH/Ni_3N/NF	213	1.0 M KOH+ seawater	28
Ni-Fe-Ce-B/MS	208	1.0 M KOH + 0.5 M NaCl	18
MEB	248	1.0 M KOH + 0.5 M NaCl	29

Table S4. The OWS performance for Co-B@HPS electrode and other electrocatalysts in 1.0 M KOH + 0.5 M NaCl

Catalyst	Voltage (V_{100},V)	Electrolyte	References
CoB@HPS||CoB@HPS	**1.60**	**1.0 M KOH + 0.5 M NaCl**	**This work**
Ru@FeCo–$Ni(OH)_2$|| Ru@FeCo–$Ni(OH)_2$	1.68	1.0 M KOH + seawater	1
Cr-Co_xP||Cr-Co_xP	1.85	1.0 M KOH + seawater	2
MnCo/NiSe/NF||MnCo/NiSe/NF	1.86	1.0 M KOH + seawater	3
Ni_4Mo/MoO_2/Ni||NiFeCr-aee/bee	1.51	1.0 M KOH	30
Fe-P-CMO||Fe-P-CMO	1.59	1.0 M KOH	31
Pt@NiFeCo-E||Pt@NiFeCo-E	1.71	1.0 M KOH + 0.5 M NaCl	32
NiMoN/Ni_3S_2||NiMoN/Ni_3S_2	1.63	1.0 M KOH + seawater	33
NiTe@FeOOH||NiTe@FeOOH	1.79	1.0 M KOH + seawater	34
RuSAs@NiCoP/NF||RuSAs@NiCoP/NF	1.57	1.0 M KOH	9
Mo-NiP@NF||Mo-NiP@NF	1.63	1.0 M KOH + 0.5 M NaCl	35
Ni_4Mo/MoO_2/C||Ni_4Mo/MoO_2/C	1.76	1.0 M KOH + seawater	36
Ni-Fe-Ce-B/MS||Ni-Fe-Ce-B/MS	1.64	1.0 M KOH + 0.5 M NaCl	18
FeNiCoCrRu||FeNiCoCrRu	1.81	1.0 M KOH + 0.5 M NaCl	37
CoFe-Ni_2P||CoFe-Ni_2P	1.72	1.0 M KOH + seawater	38

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