Corrosive Engineering Assisted to In-situ Construct Fe-Ni-based Compound for Industrial Overall Water-splitting Under Large-current Density in Alkaline Fresh water and Seawater Media

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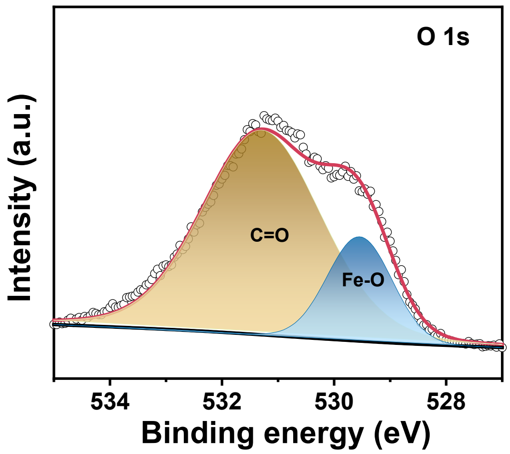

Fig. S1 High-resolution XPS spectra of O 1s.

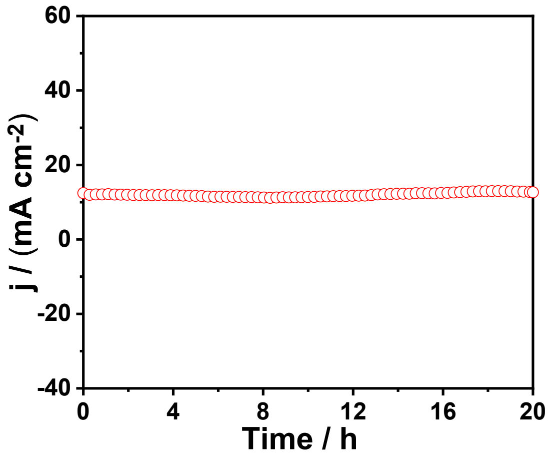

Fig. S2 Long-term stability testing at current densities of 10 mA cm^{-2} for Fe-Ni-O-N.

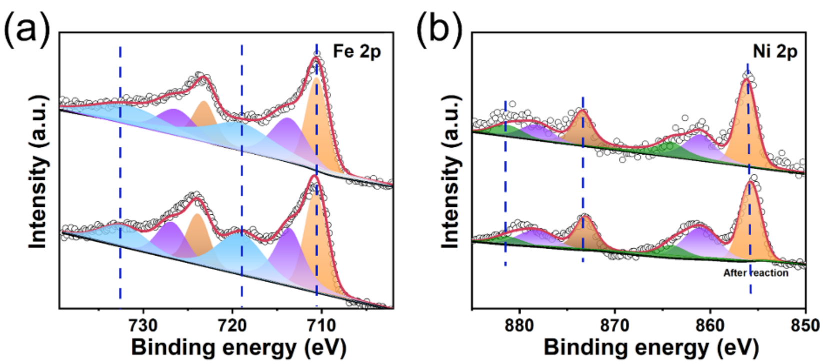

Fig. S3 XPS spectra of Fe-Ni-N-O before and after the test for 70 h at a current density of 500 mA cm^{-2} (a) Fe, and (b) Ni in 1M KOH.

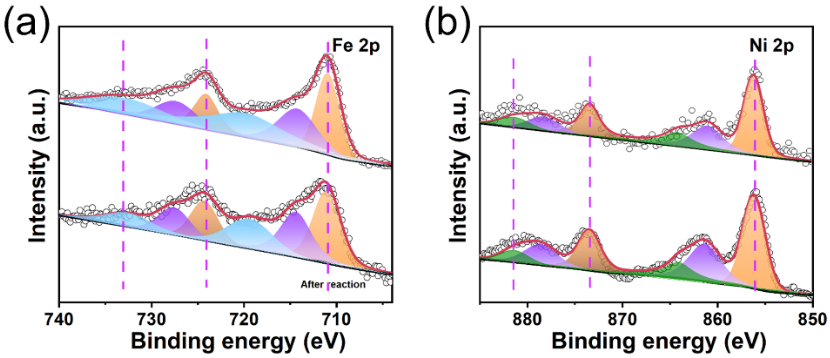

Fig. S4 XPS spectra of Fe-Ni-N-O before and after the test for 40 h at a current density of 500 mA cm^{-2} (a) Fe, and (b) Ni in 1M KOH + seawater.

Fig. S5 Test results of ClO^- formation in 1 M KOH seawater electrolyte after the corresponding OER stability tests.

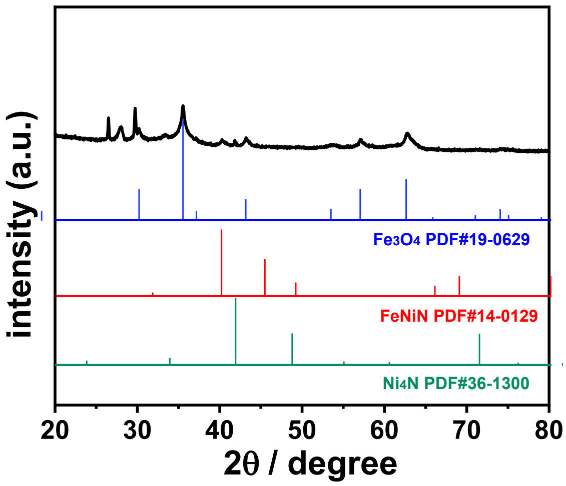

Fig. S6 XRD patterns of Ru/Fe-Ni-O-N.

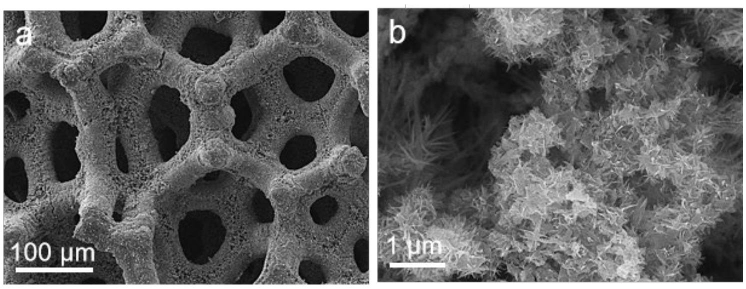

Fig. S7 SEM images of Ru/Fe-Ni-O-N.

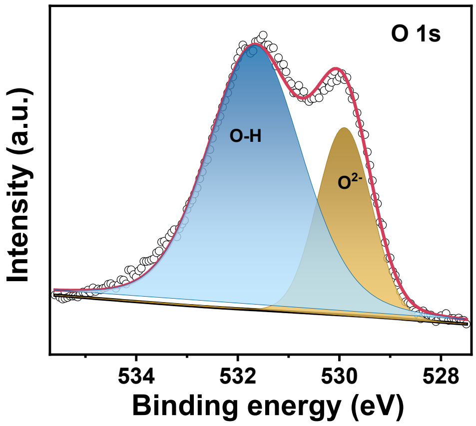

Fig. S8 High-resolution XPS spectra of (a) O 1s.

The binding energy at 531.6 eV is attributed to the O–H bond derived from the surface or internal and 529.9 eV is often associated with the O^{2-} ion of metal–oxide bonds [1, 2].

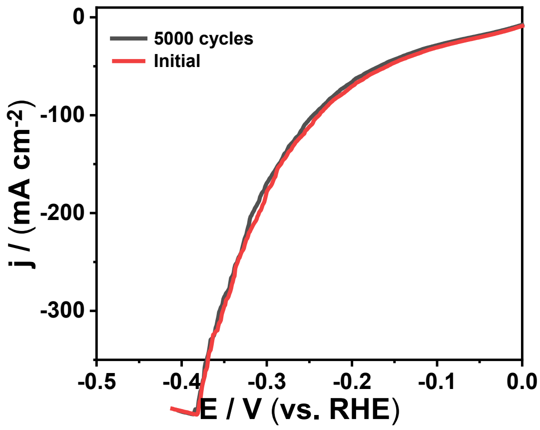

Fig. S9 LSV curves were recorded before and after 5000 CV scans for HER.

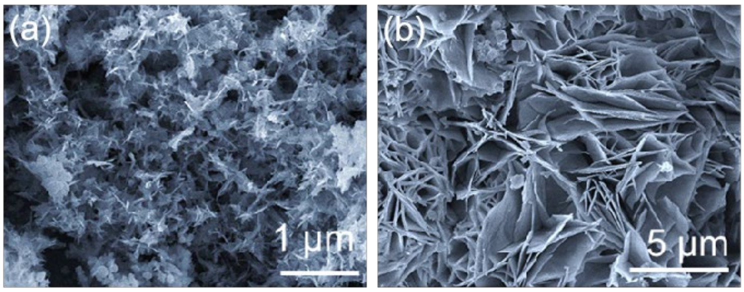

Fig. S10 SEM images of (a) Fe-Ni-N-O, and (b) Ru/Fe-Ni-O-N after long stabilization at 500 mA cm^{-2} current density in 6 M KOH, 60 °C.

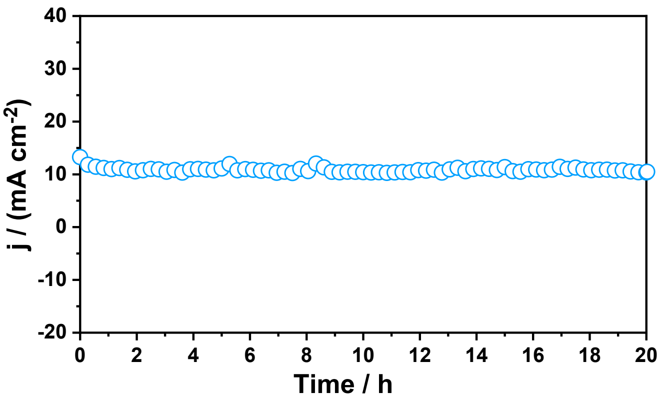

Fig. S11 Long-term stability testing at current densities of Ru/Fe-Ni-O-N || Fe-Ni-O-N at 10 mA cm^{-2} in 1 M KOH + seawater.

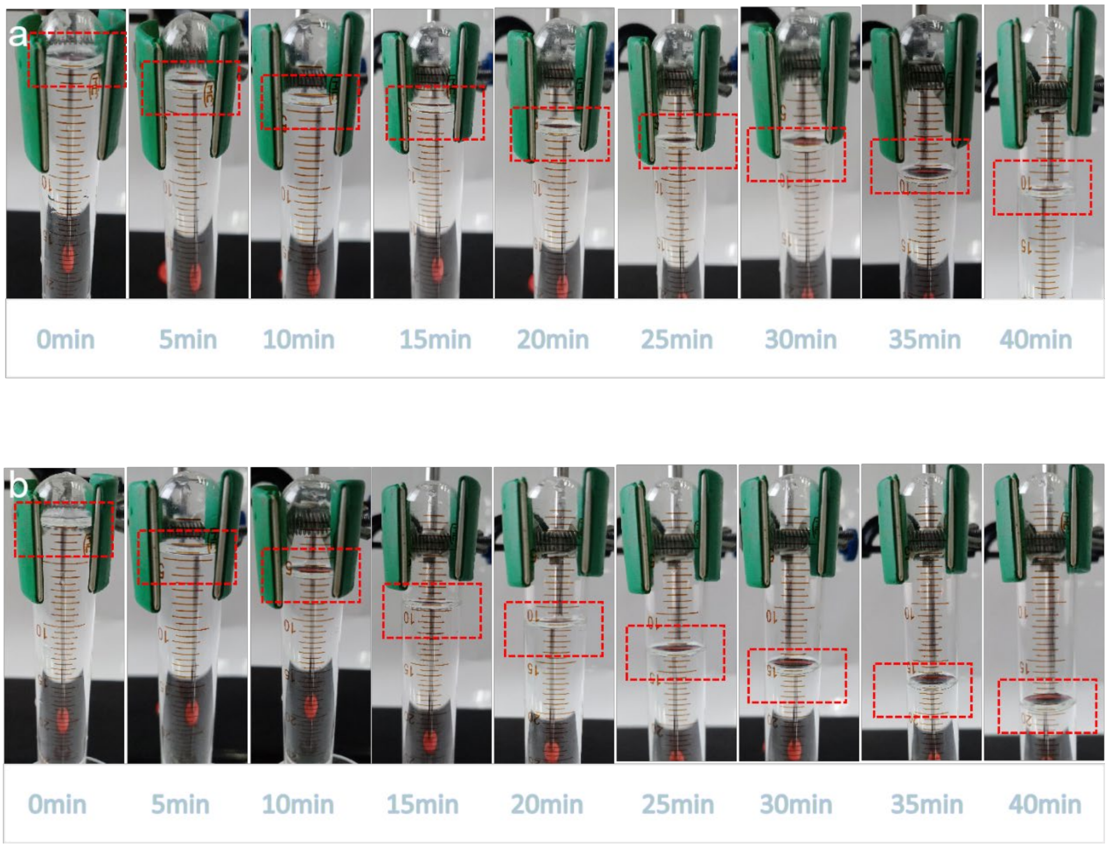

Fig. S12 Photographs of (a) OER and (b) HER collected at different times.

Table S1 Comparison of the overpotentials of Fe-Ni-O-N, NiFe LDH, NiFe and RuO_2 catalysts at different current densities in 1M KOH and 1M KOH + seawater.

Catalysts	Electrolytes	Overpotential (mV)@10mAcm^{-2}	Overpotential (mV)@50mAcm^{-2}	Overpotential (mV)@500mA cm^{-2}	Overpotential (mV)@1000mA cm^{-2}
Fe-Ni-O-N	1M KOH	189	206	260	280
NiFe LDH		280	313	320	350
RuO_2		307	352	420	450
NiFe		348	408	460	510
Fe-Ni-O-N	1M KOH+ seawater	190	235	270	289
NiFe LDH		227	289	296	338
RuO_2		294	360	389	410
NiFe		358	445	450	550

Table S2 Comparison of the OER performances reported of other previously reported electrocatalysts in 1 M KOH.

Catalysts	Tafel slope (mV dec^{-1})	Potential (mV) @ 10mA cm^{-2}	References
Fe-Ni-N-O	25	1.419	This work
CoMoNx-500 NSAs/NF	88.2	1.461	[3]
NSP-Ni_3FeN	40	1.453	[4]
$FeNi_3N$/NF	40	1.435	[5]
CVN-NH_3/CC	40	1.493	[6]
Fe_2Ni_2N NPA	34	1.47	[7]
Co-Mo-N@Ag	54	1.464	[8]
Mo_2N-CoxN	105	1.477	[9]
Ni_3FeN-NPs	59	1.471	[10]
NiMoN-550	94	1.525	[11]
Ru-NiFe-P	73.6	1.471	[12]

Table S3 Comparison of the OER performances reported of other previously reported electrocatalysts in 1 M KOH + seawater.

Catalysts	Overpotential (mV) @ 10mA cm^{-2}	References
Fe-Ni-N-O	190	This work
NiFe LDH	296	[13]
S, P-(Ni,Mo,Fe)OOH/NiMoP	297	[14]
CoP x @FeOOH	337	[15]
Ni_3S_2 @NiFe PBA	336	[16]
NixB/B_4C/B-CPR/NF	350	[17]
NiMoN	369	[18]
B-Co_2Fe LDH	376	[19]
S-(Ni,Fe)OOH	398	[20]
S-Cu_2O-CuO	420	[21]

Table S4 Comparison of the HER performances of reported other previously reported electrocatalysts in 1 M KOH.

Catalysts	Tafel slope (mVdec^{-1})	Overpotential (mV) @ 10mA cm^{-2}	References
Ru/Fe-Ni-N-O	91	42	This work
CoMoNx-500 NSAs/NF	133.5	91	[3]
$FeNi_3N$/NF	98	75	[5]
CVN-NH_3/CC	98	118	[6]
Fe_2Ni_2N-NPA	101	110	[7]
Co-Mo-N@Ag	73	90	[8]
N-NiCoP/NCF	46	238	[9]
Ni_3FeN-NPs	58.3	29	[10]
NiMoN-550	79	89	[11]

Table S5 Comparison of the water splitting performances in 1 M KOH solution.

Cathodic catalysts	**Anodic catalysts**	**Current density / mA cm^{-2}**	**Voltages / V**	**References**
Ru/Fe-Ni-N-O	Fe-Ni-N-O	10	1.50	This work
CVN-NH_3/CC	CVN-NH_3/CC	10	1.64	[6]
Fe_2Ni_2N NPA	Fe_2Ni_2N NPA	10	1.65	[7]
$CoMoO_4$/NF	$CoMoO_4$/NF	10	1.86	[22]
$NiCo_2S_4$ NW-NF	$NiCo_2S_4$ NW-NF	10	1.68	[23]
$NiCo_2N$	$NiCo_2N$	10	1.70	[24]
NiMoN-550	NiMoN-550	10	1.596	[11]
Co-Mo_2N	Co-Mo_2N	10	1.576	[25]
Co-Mo_2C@NC	Co-Mo_2C@NC	10	1.830	[26]
Ni_3FeN-NPs	Ni_3FeN-NPs	10	1.81	[10]
$NiCo_2S_4$@NiFe LDH	$NiCo_2S_4$@NiFe LDH	10	1.61	[27]

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