

Supporting Information

Highly dispersed secondary building unit-stabilized binary metal center on hierarchical porous carbon matrix for enhanced oxygen evolution reaction

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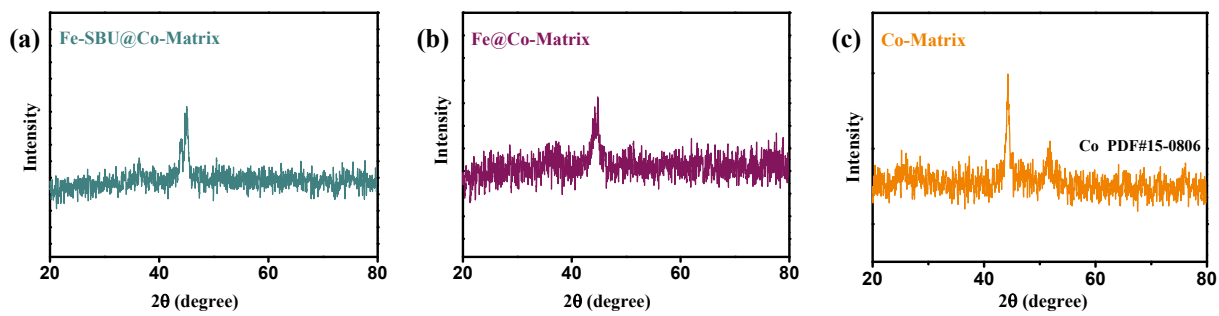


Fig. S1 XRD patterns of (a) Fe-SBU@Co-Matrix, (b) Fe@Co-Matrix, and (c) Co-Matrix with the corresponding PDF cards.

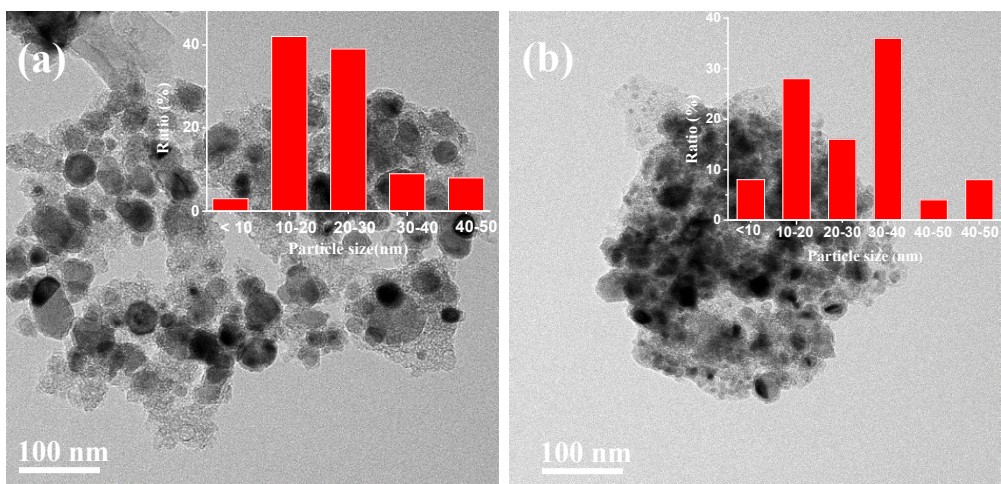


Fig. S2 TEM images of Fe-SBU@Co-Matrix (a) and Fe@Co-Matrix (b).

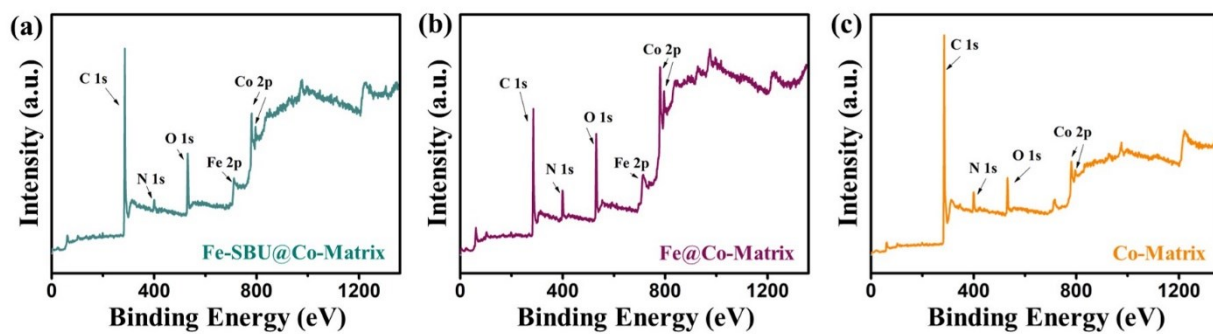


Fig. S3 XPS survey spectra of (a) Fe-SBU@Co-Matrix, (b) Fe@Co-Matrix, and (c) Co-Matrix.

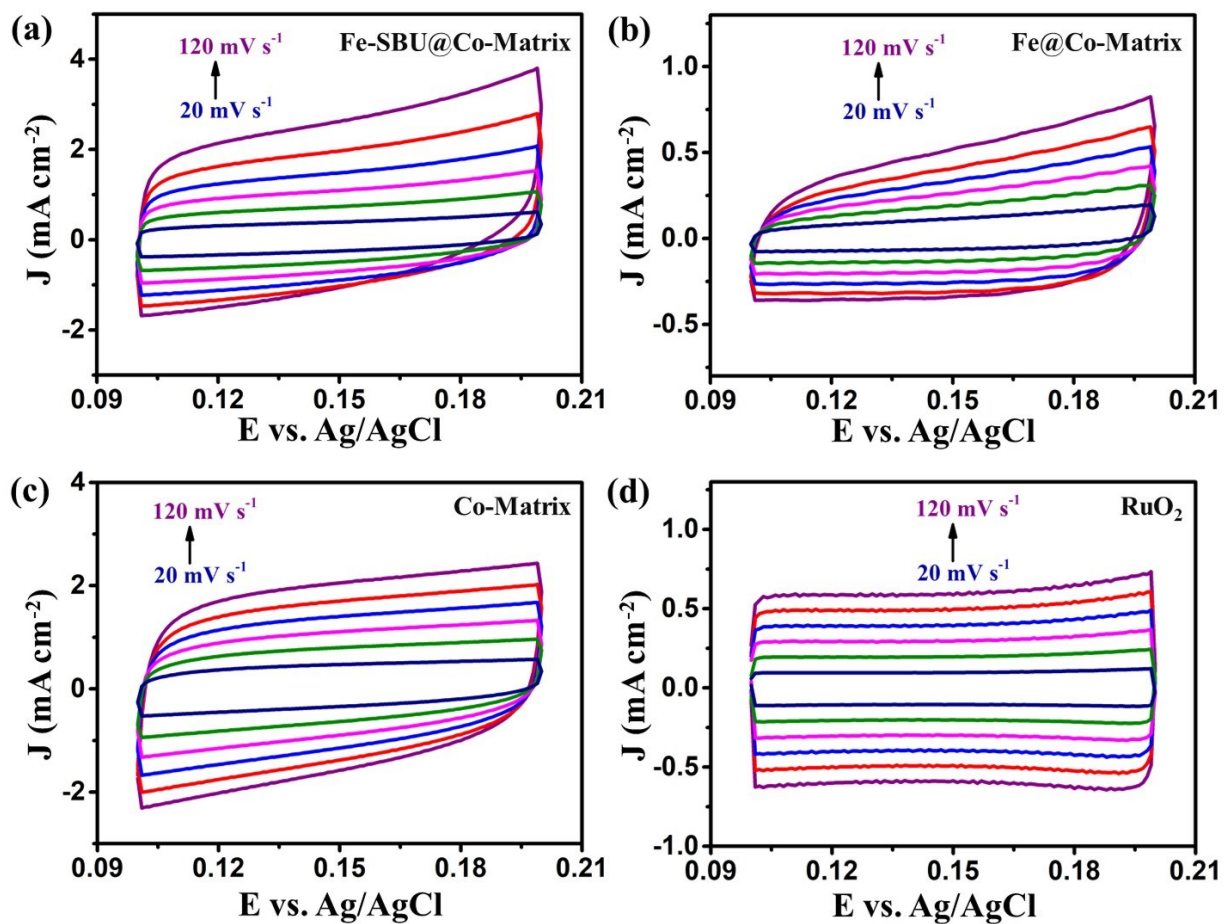


Fig. S4 Cyclic voltammogram (CV) curves of (a) Fe-SBU@Co-Matrix, (b) Fe@Co-Matrix, (c) Co-Matrix, and (d) RuO₂.

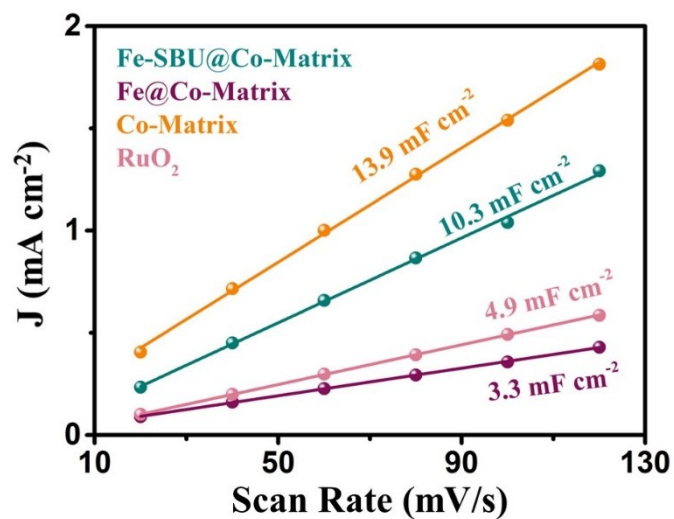


Fig. S5 Capacitive currents as a function of sweep rate of Fe-SBU@Co-Matrix, Fe@Co-Matrix, Co-Matrix, and RuO₂ electrodes measured at 0.15 V. The double-layer capacitances are calculated from the slope of the linear fitting to the data.

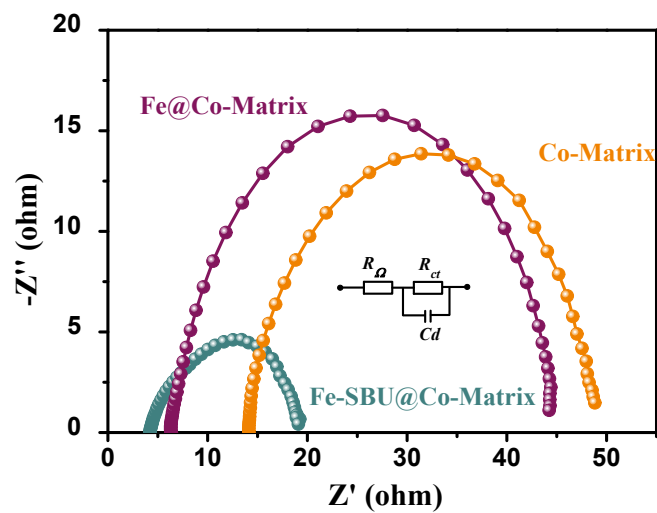


Fig. S6 The electrochemical impedance (EIS) spectra and equivalent electrical circuit fitting Nyquist plots.

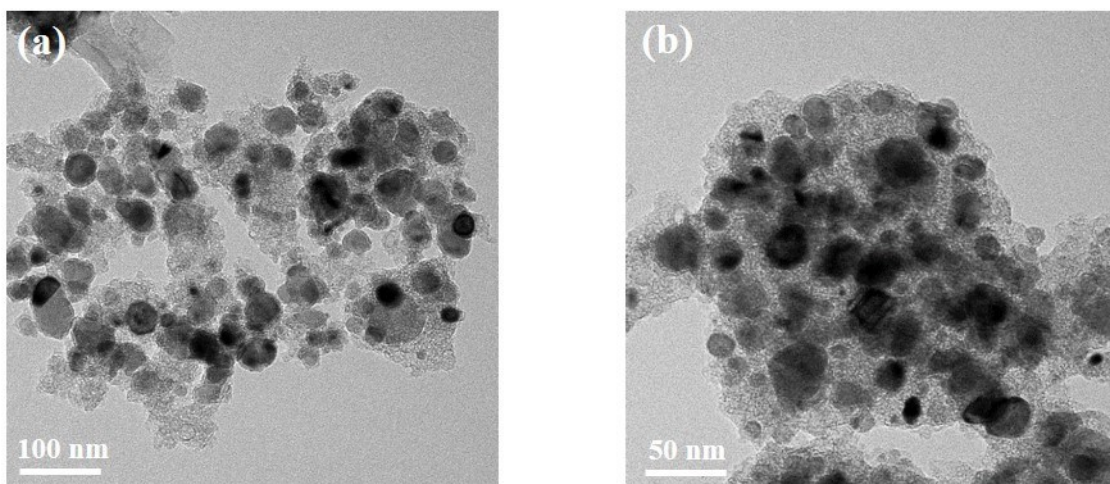


Fig. S7 TEM pictures of Fe-SBU@Co-Matrix before (a) and after (b) the OER stability test.

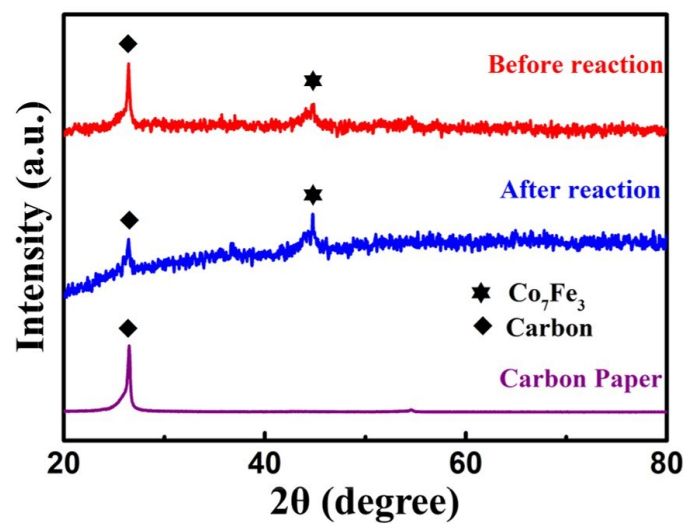


Fig. S8 XRD patterns of Fe-SBU@Co-Matrix before and after the OER stability test for 40 h in 1.0 M KOH.

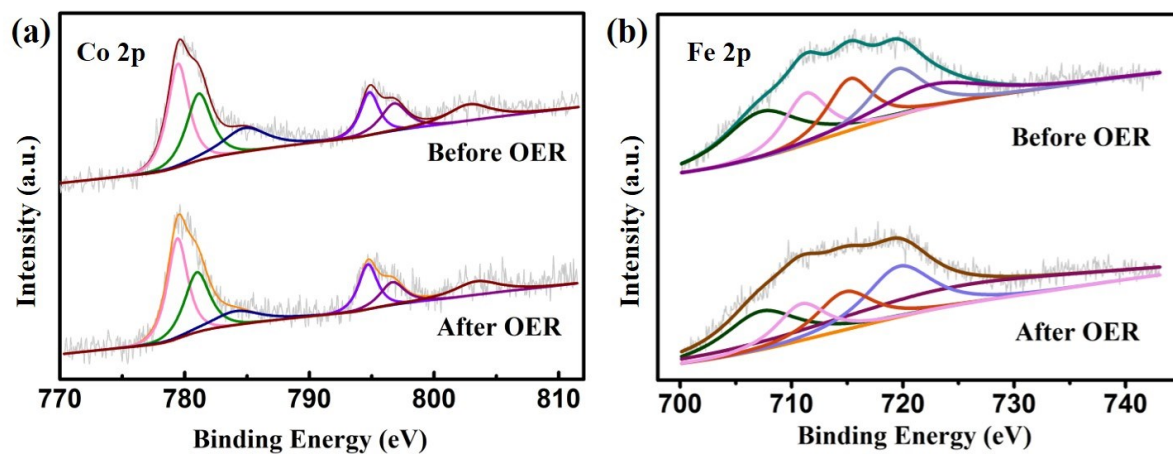


Fig. S9 High-resolution XPS spectra of Fe-SBU@Co-Matrix before and after the OER stability test for 40 h in 1.0 M KOH: (a) Co 2p and (b) Fe 2p

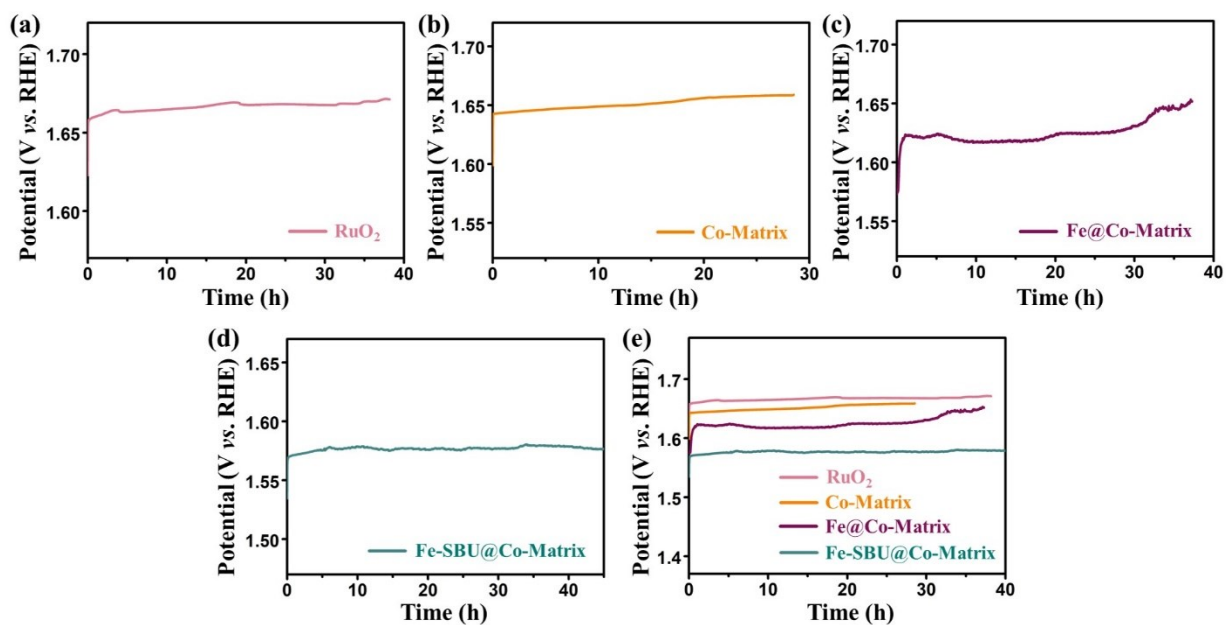


Fig. S10 Electrochemical stability tests of Fe-SBU@Co-Matrix, Fe@Co-Matrix, Co-Matrix, and RuO₂ in 1.0 M KOH at 20 mA cm⁻².

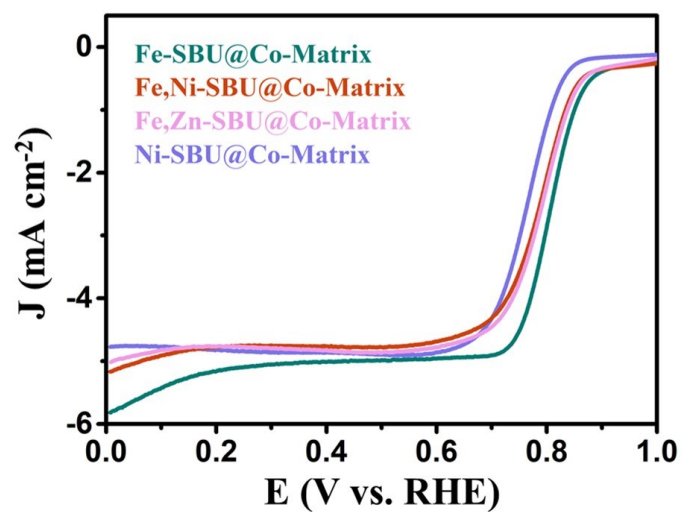


Fig. S11 Electrochemical performance of Co-Matrix electrocatalysts stabilized with different metal constituents toward ORR in 0.1 M KOH.

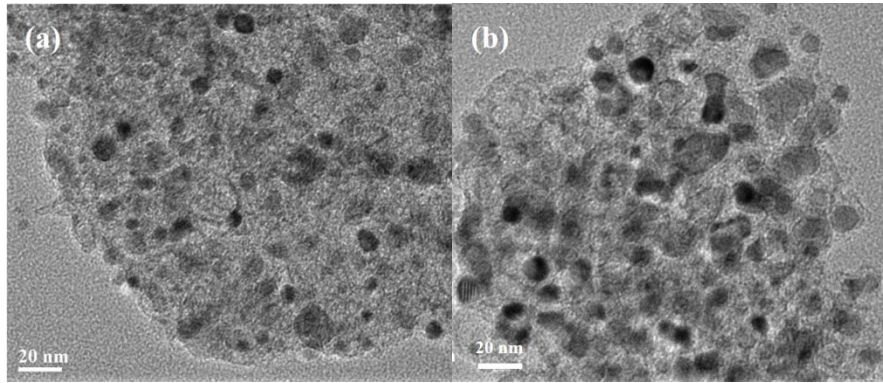


Fig.S12 TEM after acid etching (a) Fe-SBU@Co-Matrix, (b) Fe@Co-Matrix

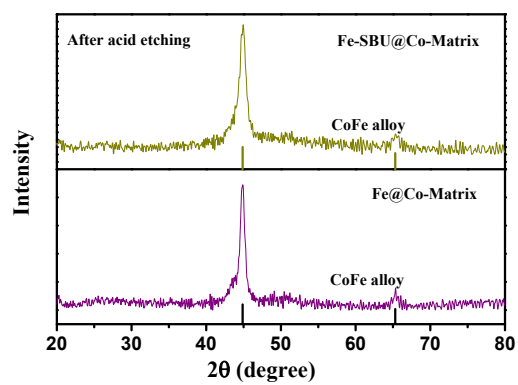


Fig. S13 XRD patterns after acid etching of Fe-SBU@Co-Matrix and Fe@Co-Matrix

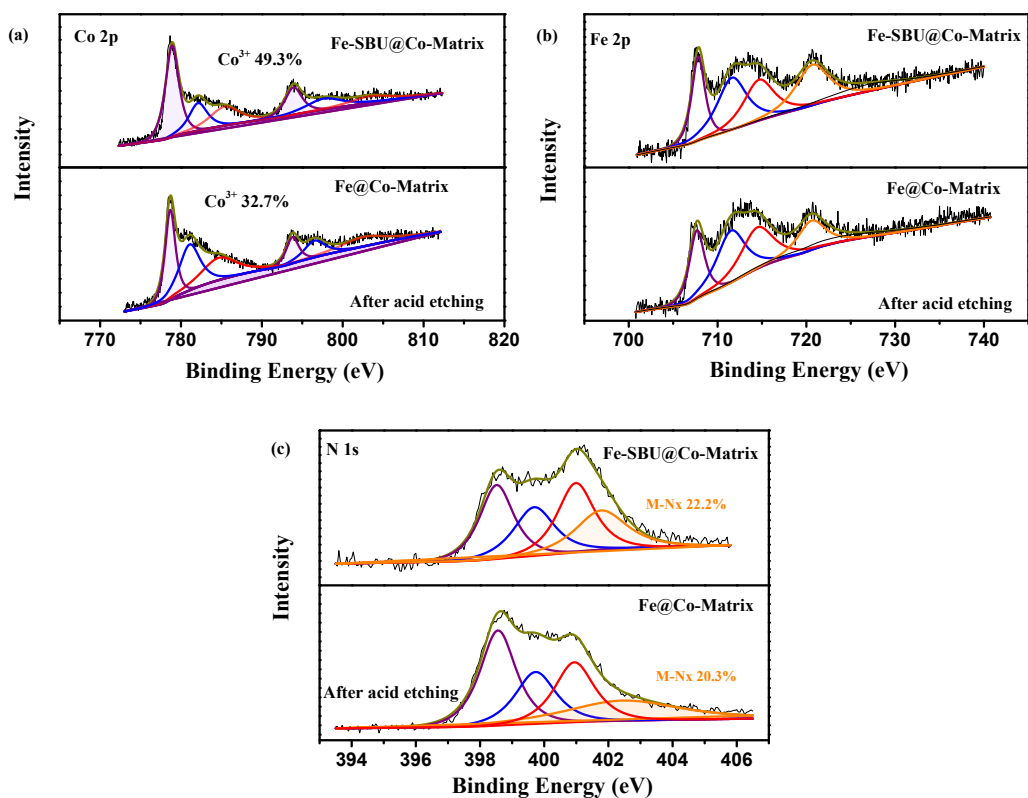


Fig. S14 XPS spectra after acid etching of Fe-SBU@Co-Matrix and Fe@Co-Matrix (a) Co 2p, (b) Fe 2p, (c) N 1s

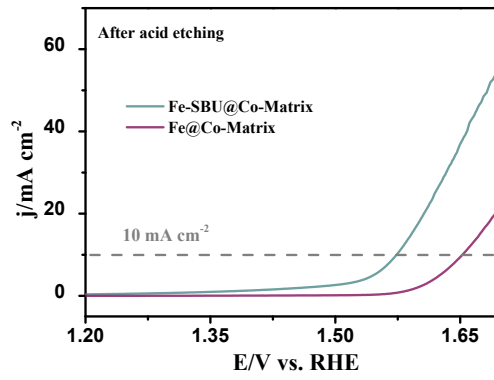


Fig. S15 Polarization curves of different electrocatalyst at scan rate 5 mV s^{-1} of Fe-SBU@Co-Matrix and Fe@Co-Matrix after acid etching.

Table S1 BET surface area of different catalysts.

Catalyst	BET surface area (m ² /g)
Fe-SBU@Co-Matrix	201
Fe@Co-Matrix	177
Co-Matrix	263

Table S2 The overpotentials and Tafel plots of different electrocatalysts for OER.

Catalyst	η_{10} (mV)	Tafel slope (mV dec ⁻¹)
Fe-SBU@Co-Matrix	250	59
Fe@Co-Matrix	380	72
Co-Matrix	350	100
RuO ₂	330	77

Table S3 Electrochemical performances of Co-Matrix electrocatalysts stabilized with different metal SBUs for OER and ORR

Catalyst	η_{10} (mV)	Half-wave potential (V)
Fe-SBU@Co-Matrix	250	0.81
Ni-SBU@Co-Matrix	336	0.76
Fe,Zn-SBU@Co-Matrix	291	0.79
Fe,Ni-SBU@Co-Matrix	297	0.79

Table S4 Comparison of the OER performance of Fe-SBU@Co-Matrix with other reported non-precious metal-based electrocatalysts for OER in alkaline media. Note: All reference electrodes were calibrated to the RHE. η_{10} : overpotential at a current density of 10 mA cm⁻².

Catalyst	η_{10}	Loading (mg cm ⁻²)	Tafel (mV dec ⁻¹)	Electrolyte	Reference
Fe-SBU@Co-Matrix	250	0.40	59.0	1.0 M KOH	This work
FeCoNi alloy	400	1.38	72.0	0.5 M KOH	1
Fe-Co-P alloy	252	0.20	33.0	1.0 M KOH	2
NiFe-MoO _x	276	0.20	55.0	1.0 M KOH	3
m-NiFe/CN _x	220	0.51	59.1	0.1 M KOH	4
CoFe-MWCNTs	300	1.00	87.0	1.0 M KOH	5
Ni-Co alloy	305	N/A	63.0	1.0 M KOH	6
Fe-Ni/NC(1/2)-800	273	0.45	37.8	1.0 M KOH	7
FeNi _{4,34} @FeNi	283	N/A	53.0	1.0 M KOH	8
CoFe ₂ O ₄ /PANI-MWCNT _{1:20}	314	0.29	30.7	1.0 M KOH	9
CoFe-LDH	325	0.20	43.0	0.1 M KOH	10
M-CoO/CoFe LDHs	254	0.20	34.0	1.0 M KOH	11
Co ₃ FeS _{1.5} (OH) ₆	358	0.50	79.0	0.1 M KOH	12
H ₂ O-plasma exfoliated LDHs /NF	232	0.40	36.0	1.0 M KOH	13
CoFe LDHs-Ar	266	0.20	37.9	1.0 M KOH	14
CoFe-H	280	N/A	28.0	1.0 M KOH	15
N-CoFe LDHs	281	0.20	40.0	1.0 M KOH	16

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