Amorphous/Crystalline Nanostructured Co-FeOOH/CoCe-MOF/NF Heterojunctions for Efficient Electrocatalytic Overall Water Splitting

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Materials and Reagents

The cobalt nitrate hexahydrate ($Co(NO_3)_2·6H_2O$), Cerium nitrate hexahydrate ($Ce(NO_3)_3·6H_2O$), Ferric nitrate hexahydrate (Fe $(NO_3)_3·9H_2O$) and sodium carbonate ($NaNO_3$) were obtained from Sinopharm Chemical Reagent Co. Ltd. The 2-aminoterephthalic acid (2-NH_2-BDC) was purchased from Sigma-Aldrich Co. ltd. The potassium hydroxide (KOH) and N,N dimethylformamide (DMF) were purchased from Shanghai Maclean Biochemical Technology Co., ltd. Besides, ultrapure water (18.2 MΩ) was utilized throughout the whole experiment. The purity of all reagents more than 99%.

Materials characterization

The morphologies and microstructures of the prepared products were tested by scanning electron microscope (SEM, JSM-6360LA, Japan) and transmission electron microscopy (TEM, JEM-2010, Japan). The X-ray diffraction (XRD) was used to identify the crystal phases of products on the Max-2000 (Rigaku Co., Ltd., Japan) and X-ray photoelectron spectroscopy (XPS) can be used to analyze the elemental chemical states of the catalyst materials on the AXIS-Ultra DLD (Shimazu, Japan).

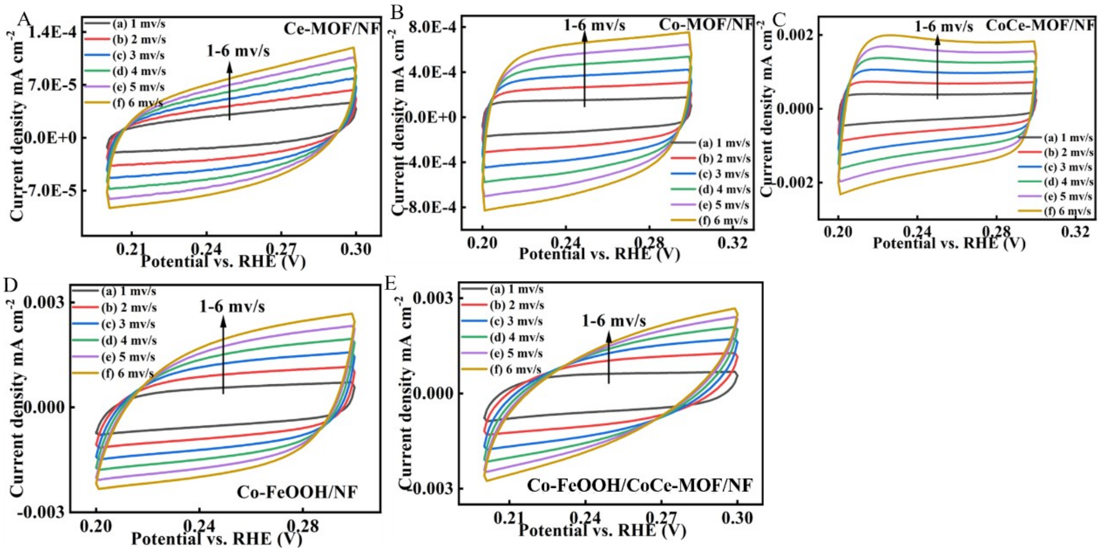

Fig. S1. CV curves of various electrodes in the potential window from 0.20 to 0.30 V (vs. RHE) at 1, 2, 3, 4, 5 and 6 mV s^{-1}: (A) Ce-MOF/NF, (B) Co-MOF/NF, (C) CoFe-MOF/NF, (D)Co-FeOOH/NF and (E) Co-FeOOH/CoCe-MOF/NF.

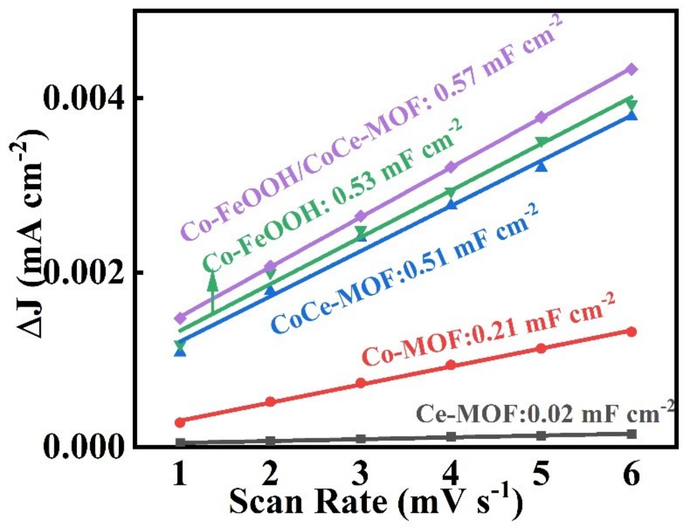

Fig. S2. Double-layer capacitances (C_{dl}) of the four samples derived from the cyclic voltammograms.

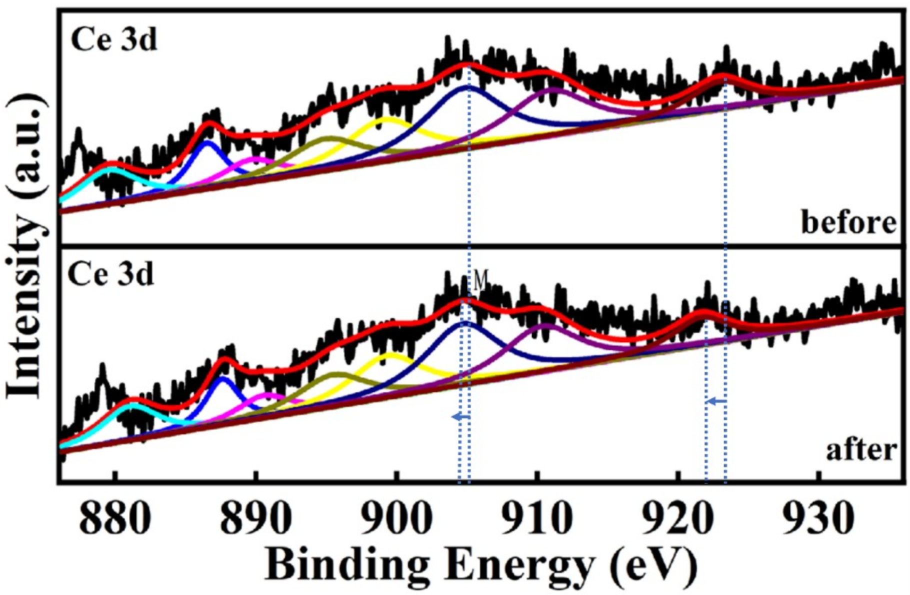

Fig. S3 High-resolution XPS patterns of Ce 3d of Co-FeOOH/CoCe-MOF/NF before and after stability test.

Table S1. Comparison of OER activity at 10 mA cm^{-2} and stability of various MOF-based catalysts.

Catalyst	η_{10}/mV	Tafel slope/ mV dec^{-1}	Electrolyte	Reference
Co-FeOOH/CoCe-MOF/NF	**226**	**29.1**	**1M KOH**	**This work**
Fe-Co-Ni MOF	254	51.3	1M KOH	[1]
Ce-MOF@Pt-0.15	340	47.9	1M KOH	[2]
Mxene@Ce-MOF	270	163.8	1M KOH	[3]
CoCe-MOF	267	96.1	1M KOH	[4]
Co-Ni@HPA-MOF	320	58	1M KOH	[5]
Co/Fe-MOF	309	41	1M KOH	[6]
NiCo-MOF@Fe-MOF	275	54	1M KOH	[1]

Table S2. Comparison of HER activity at 10 mA cm^{-2} and stability of various MOF-based catalysts

Catalyst	η_{10}/mV	Tafel slope/ mV dec^{-1}	Electrolyte	Reference
Co-FeOOH/CoCe-MOF/NF	**74**	**70.1**	**1M KOH**	**This work**
Ce-MOF@Pt-0.15	208	188.1	1M KOH	[2]
Mxene@Ce-MOF	220	149.9	1M KOH	[3]
NiCo-MOF@NiSb@GB	164	33	1M KOH	[7]
NiFe-MOF@FeOOH	137	160	1M KOH	[8]
Co/Fe-MOF	286	75	1M KOH	[6]
MOF-$CoSe_2$@$MoSe_2$	109	68.9	1M KOH	[9]
Fe-MOF@MoS_2	118	68	1M KOH	[10]

Table S3. Comparison of Overall water splitting at 10 mA cm^{-2} and stability of various MOF-based catalysts.

Catalyst	Volatage/ V	Electrolyte	Reference
Co-FeOOH/CoCe-MOF/NF	**1.55**	**1M KOH**	**This work**
NiFe-MOF-5	1.57	1M KOH	[11]
Fe-Co-Ni-MOF	1.60	1M KOH	[1]
Co/Fe-MOF	1.69	1M KOH	[6]
VFe-MOF@NF	1.61	1M KOH	[12]
FeCoMnNi-MOF-74/NF	1.62	1M KOH	[13]
Co,Fe-MOF-74/Co/CC	1.65	1M KOH	[14]

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