Supplementary Information

Nanoflower electrocatalysts derived from mixed metal (Fe/Co/Ni) organic framework for electrochemical oxygen evolution reaction

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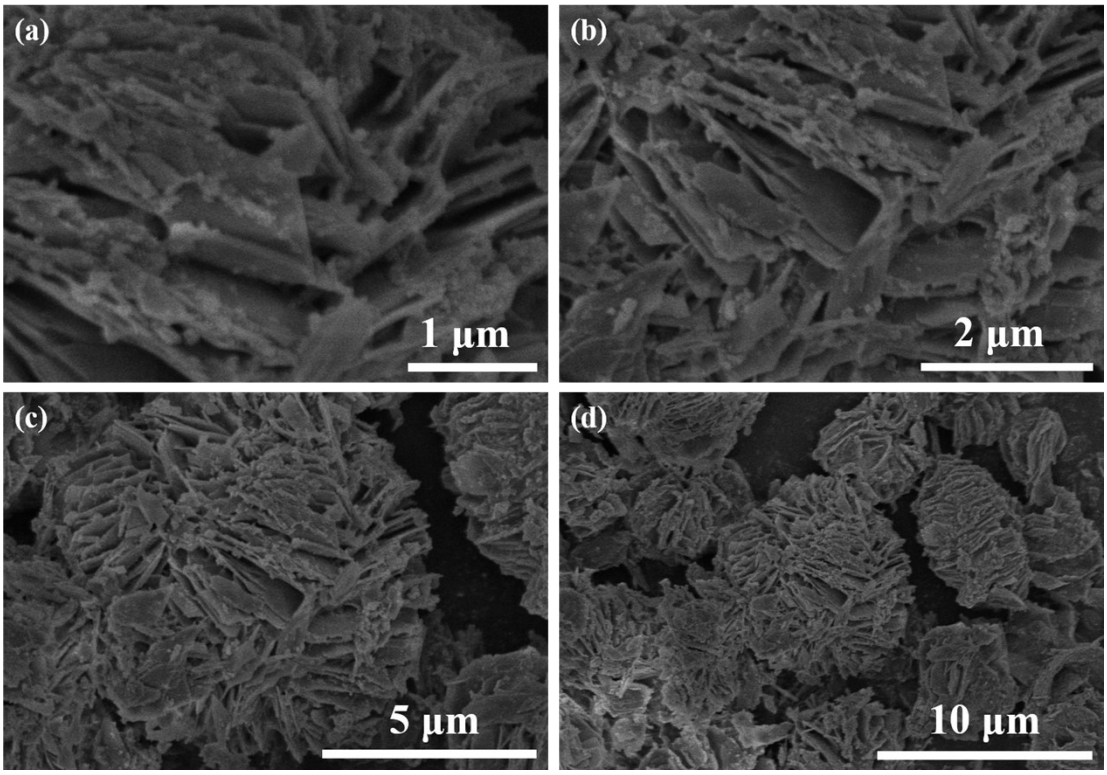

Fig. S1 SEM images of **NiCoFe-MOF-1** in different sizes.

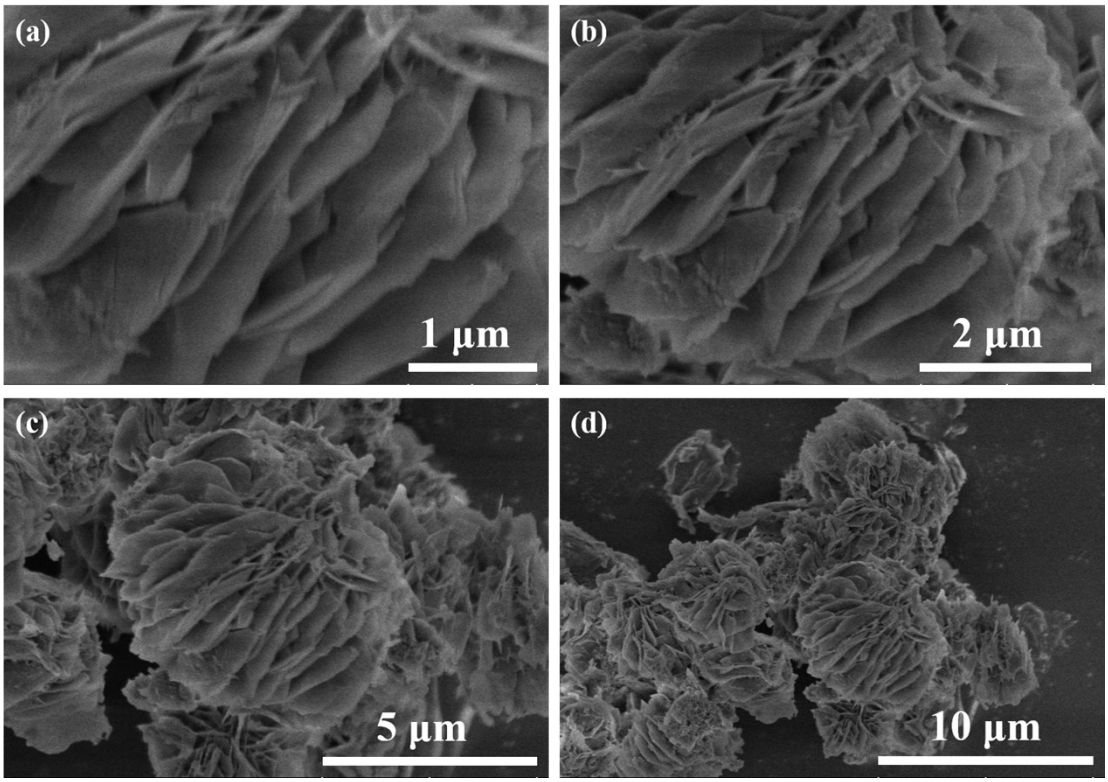

Fig. S2 SEM images of **NiCoFe-MOF-3** in different sizes.

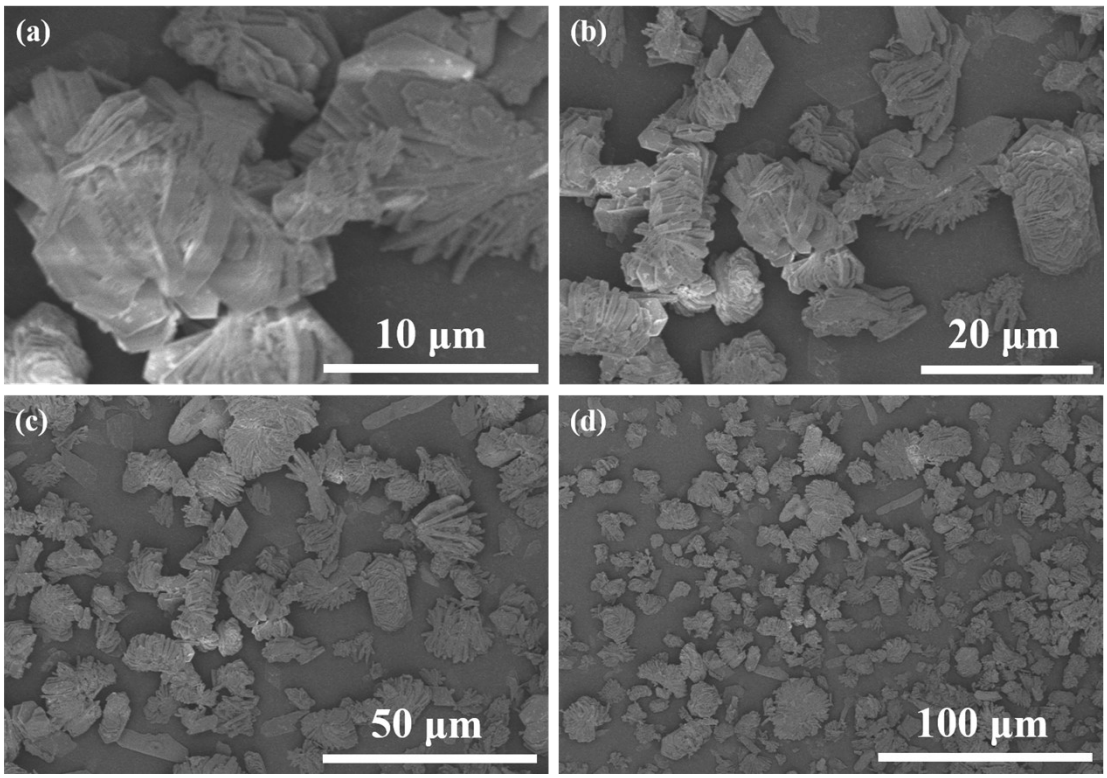

Fig. S3 SEM images of **NiFe-MOF-1** in different sizes.

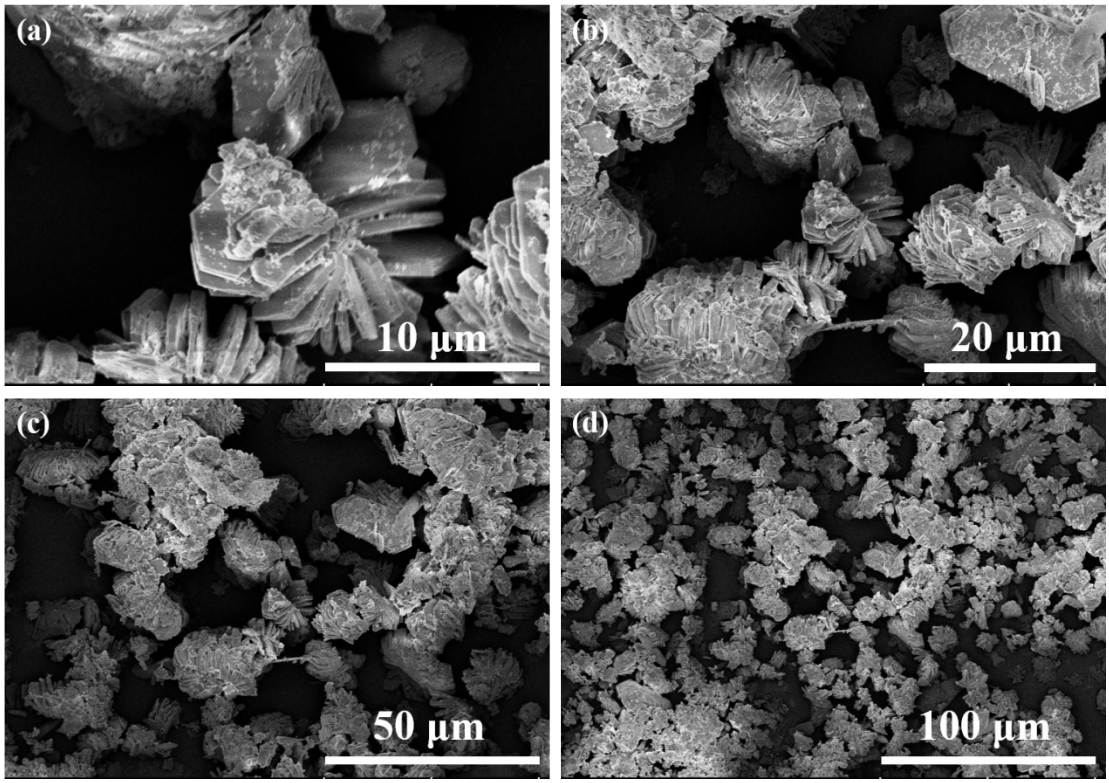

Fig. S4 SEM images of **NiFe-MOF-2** in different sizes.

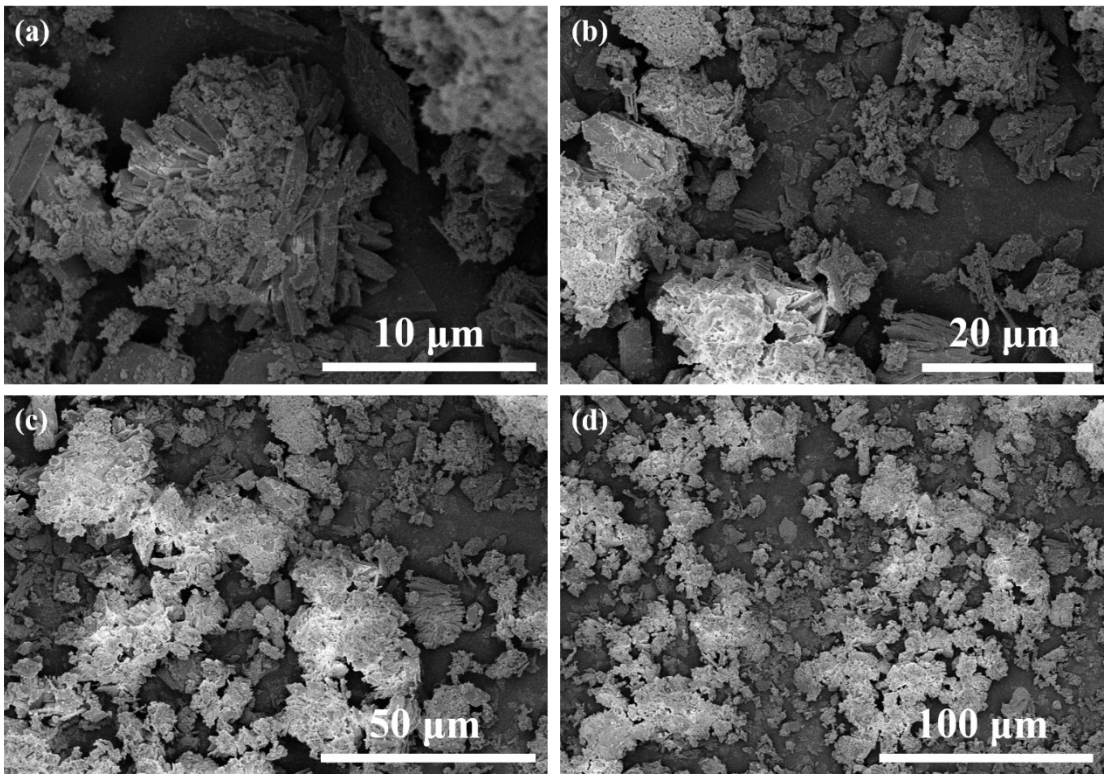

Fig. S5 SEM images of **NiFe-MOF-3** in different sizes.

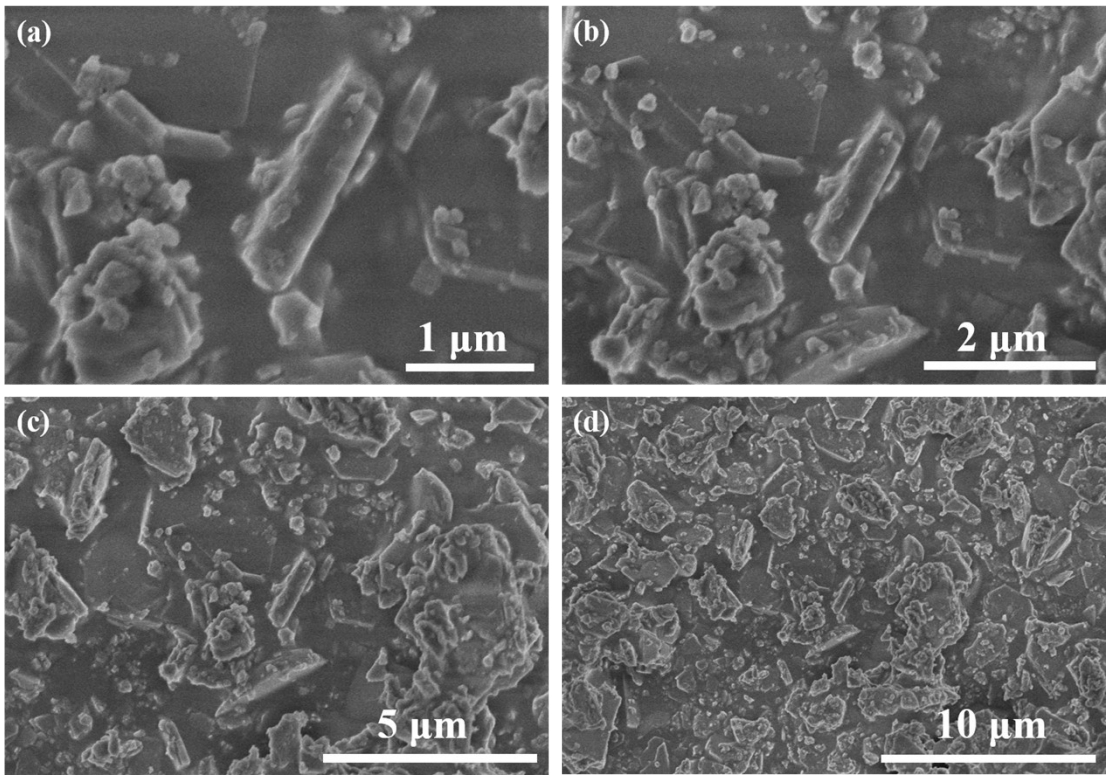

Fig. S6 SEM images of **Ni-MOF** in different sizes.

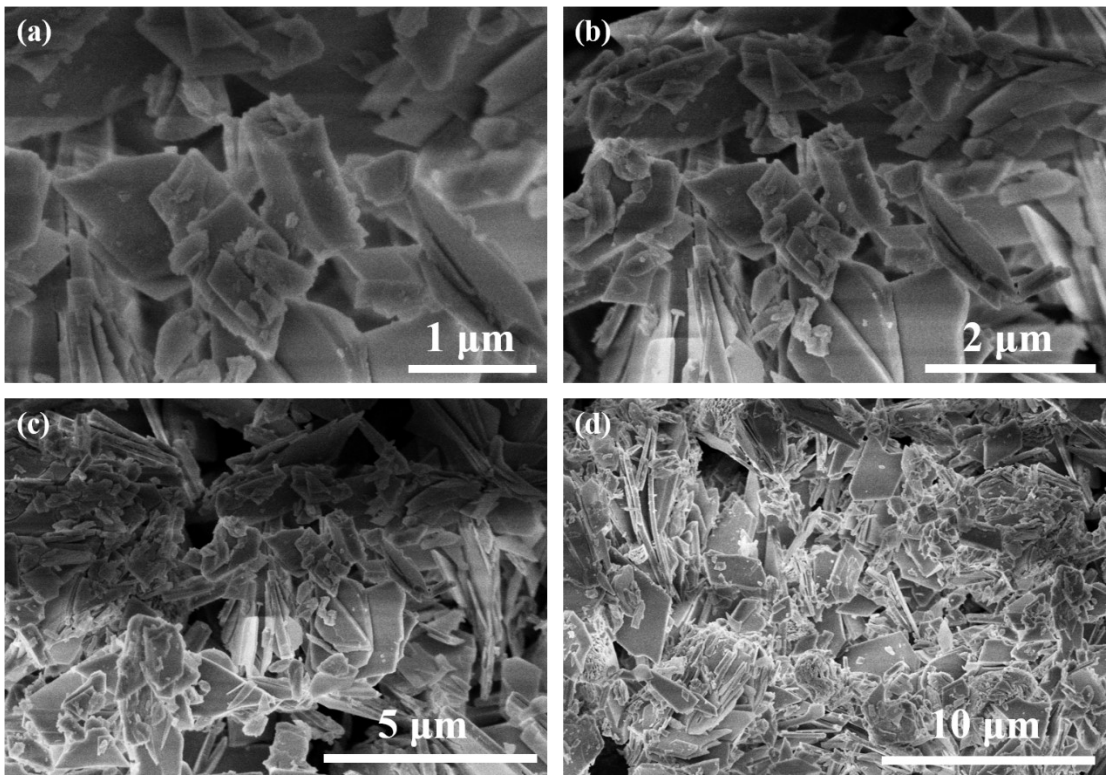

Fig. S7 SEM images of **Co-MOF** in different sizes.

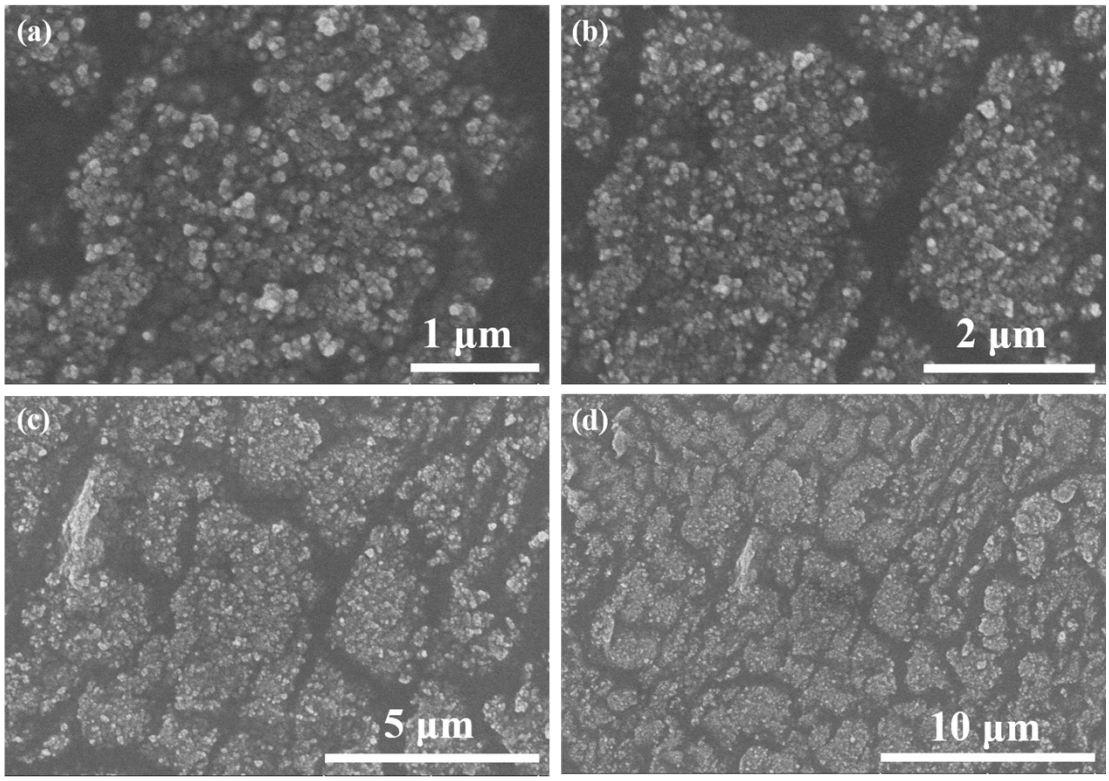

Fig. S8 SEM images of **Fe-MOF** in different sizes.

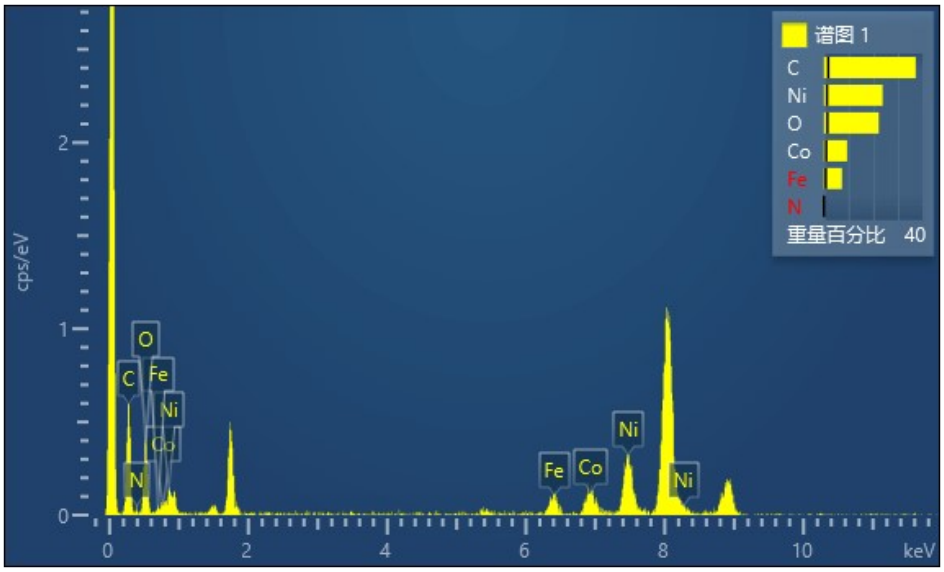

Fig. S9 EDS of **NiCoFe-MOF-2**.

Table S1 The mass percent of three elements in **NiCoFe-MOF-2** measured by ICP.

element species	mass percent	mole
Ni	11.90 wt%	0.015600
Co	5.79 wt%	0.007554
Fe	5.30 wt%	0.007259

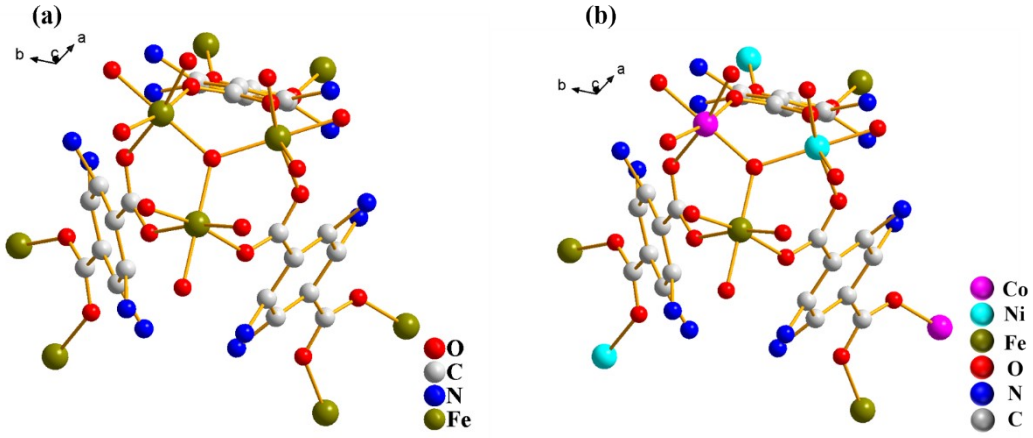

Fig. S10 (a) Structural unit of **NH_2-Fe-MIL-88b**; (b) Ideal structural unit of **NiCoFe-MOF-2**.

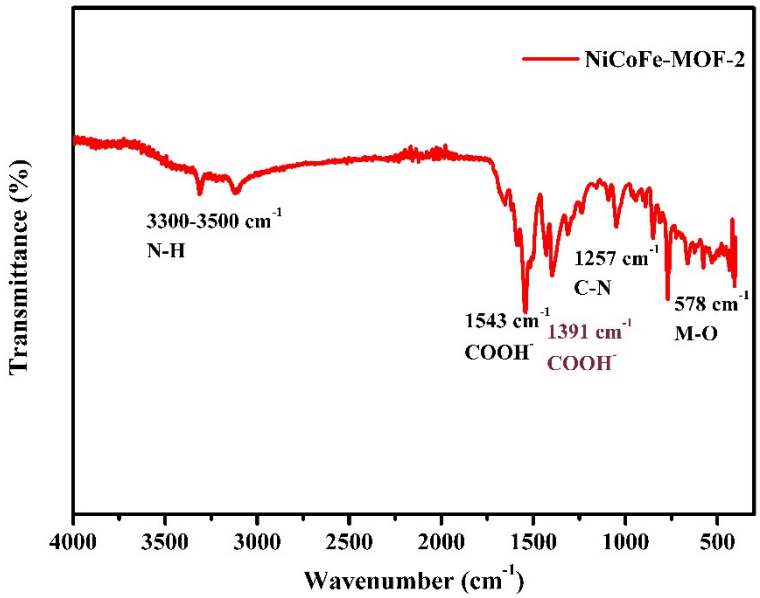

Fig. S11 FTIR spectra of **NiCoFe-MOF-2**.

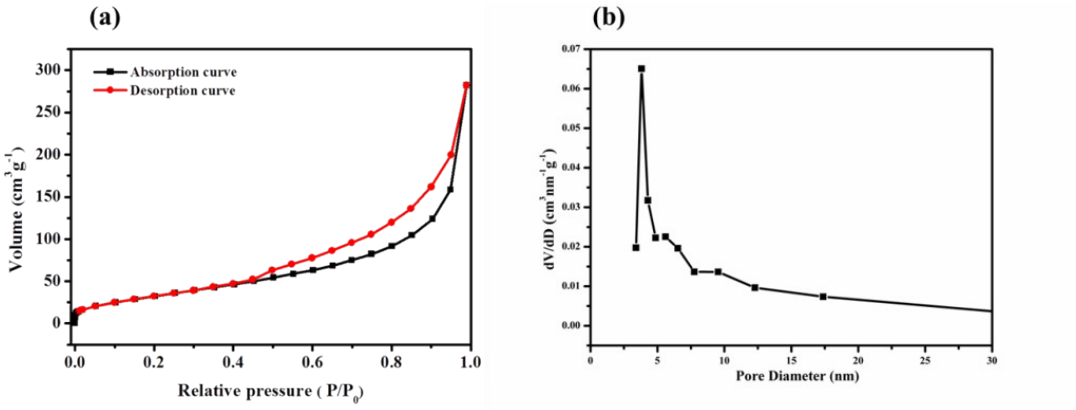

Fig. S12 (a) Nitrogen adsorption and desorption isothermals of **NiCoFe-MOF-2**; (b) Barrett-Joyner-Halenda desorption pore-size distributions for **NiCoFe-MOF-2**.

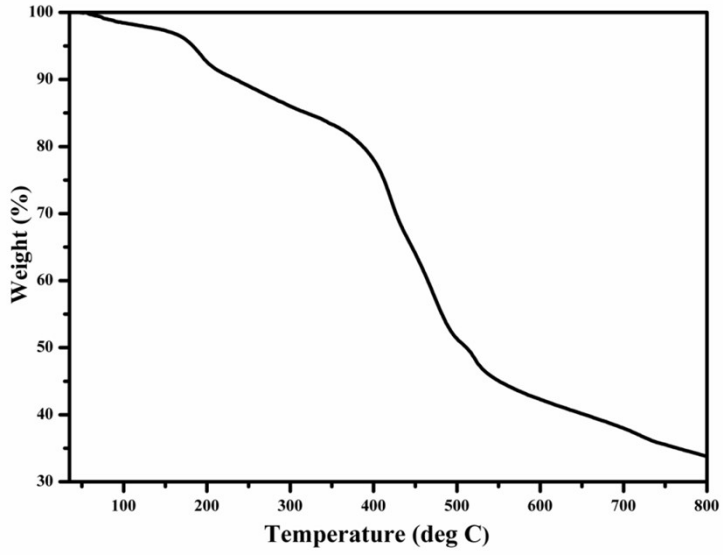

Fig. S13 The TGA of **NiCoFe-MOF-2** in Nitrogen atmosphere.

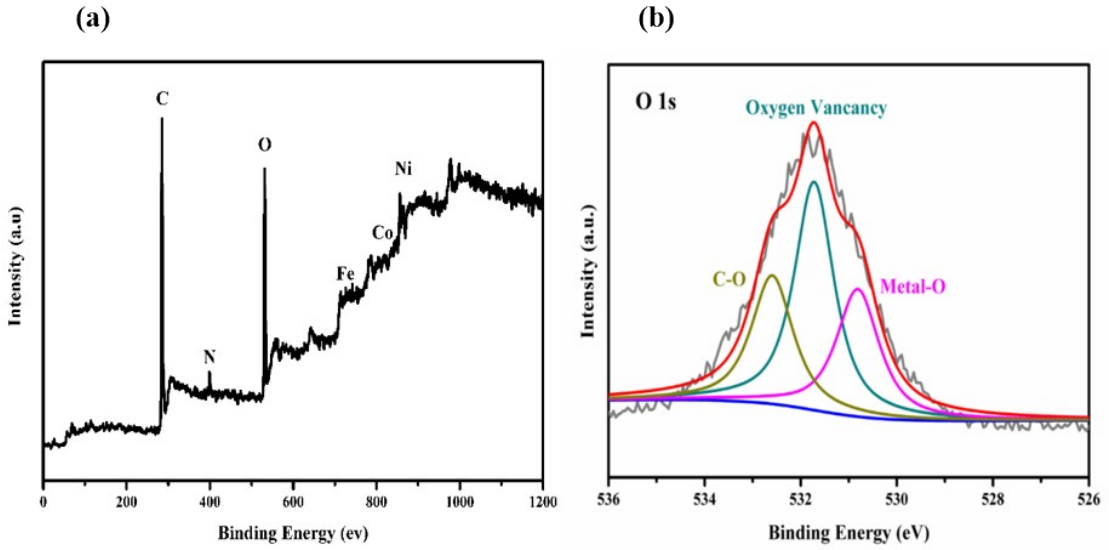

Fig. S14 (a) XPS full survey spectrum of **NiCoFe-MOF-2**; (b) High resolution XPS spectra for O 1s.

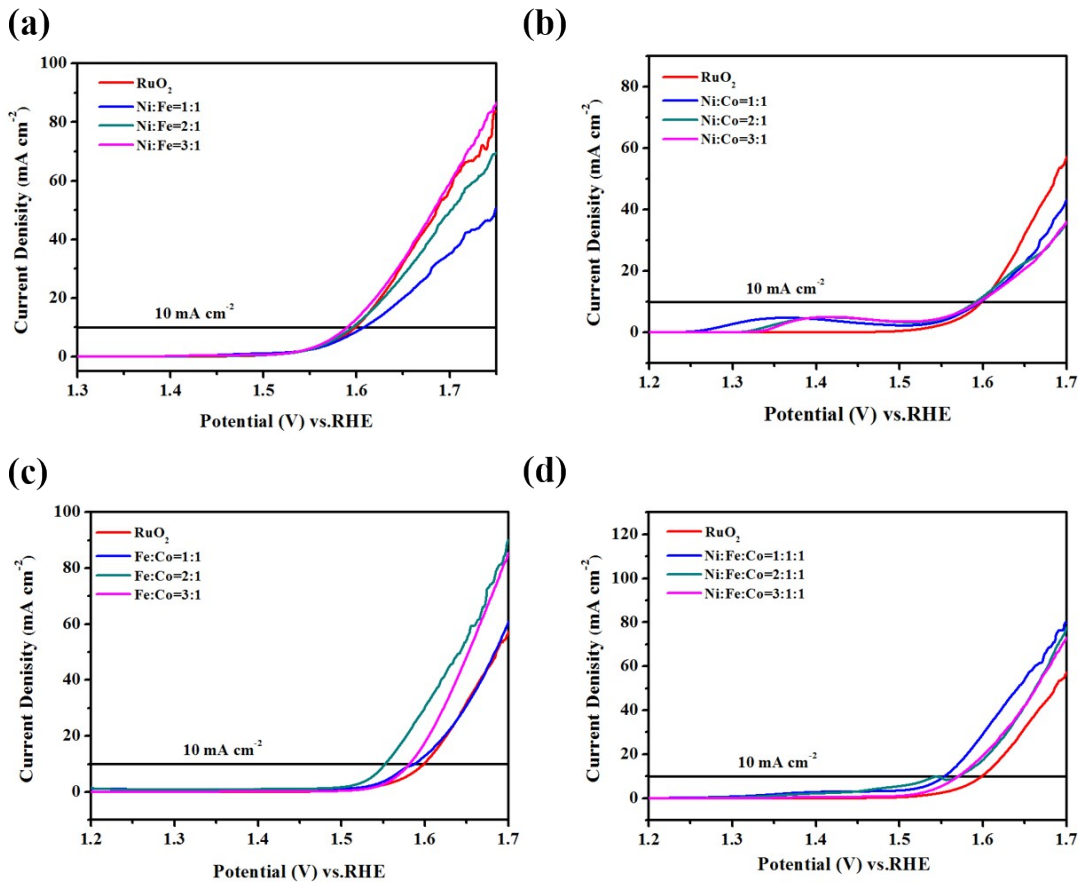

Fig. S15 LSV curves toward OER of different samples.

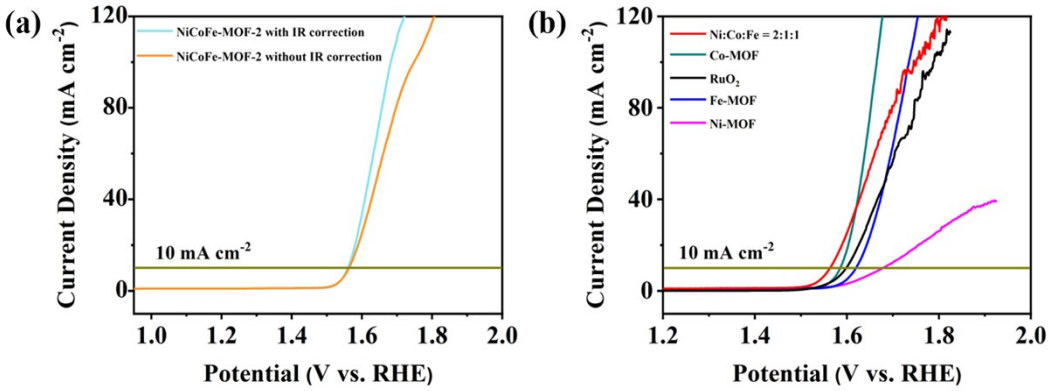

Fig. S16 (a) The LSV curves of **NiCoFe-MOF-2** with and without IR correction; (b) LSV curves toward OER of different samples.

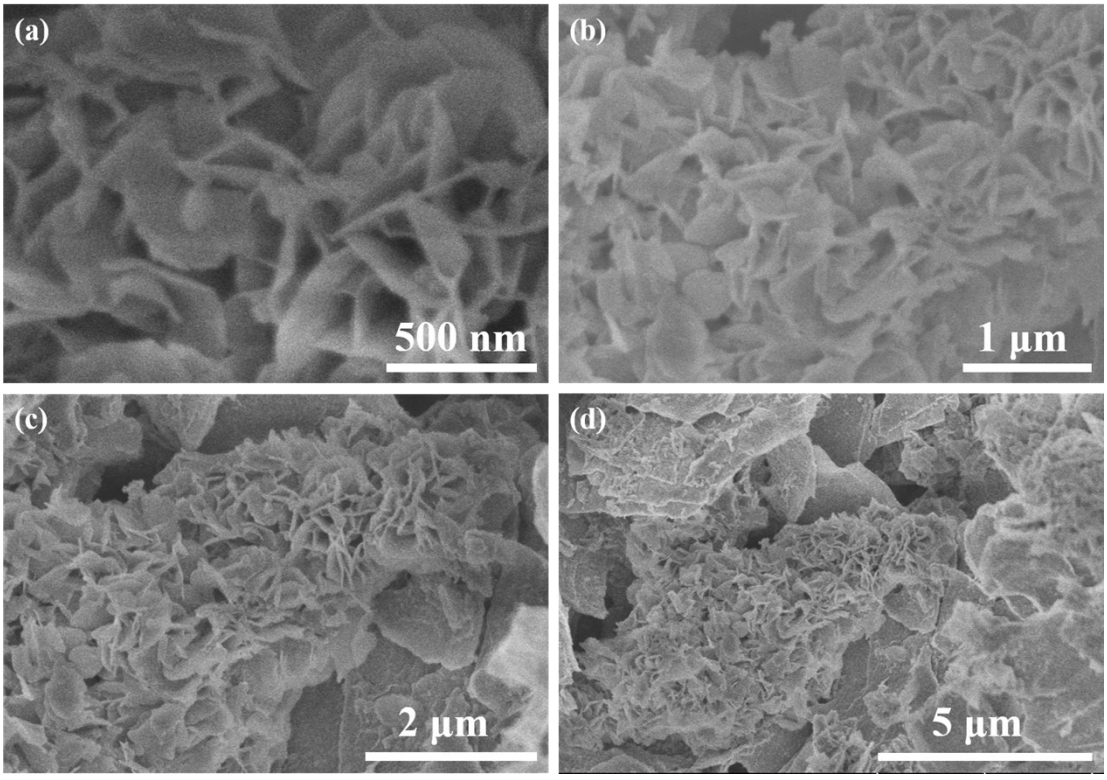

Fig. S17 SEM images of **NiCoFe-MOF-2** in different sizes after OER stability test.

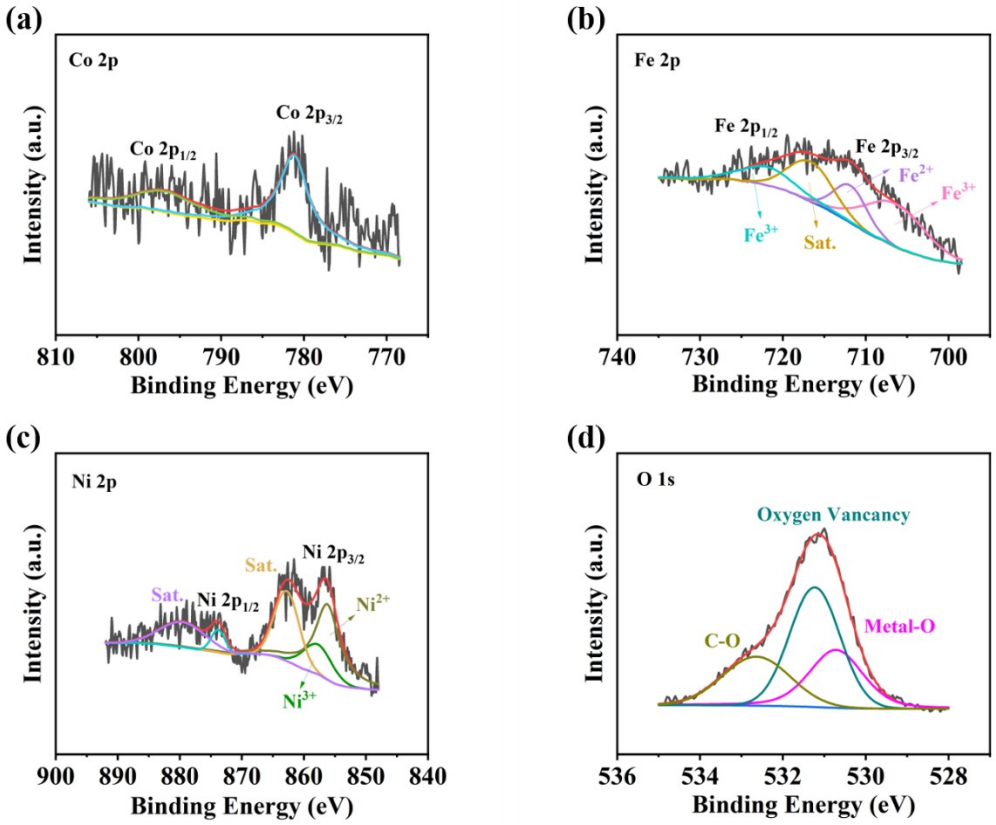

Fig. S18 (a-d) High-resolution XPS spectra of Co 2p, Fe 2p, Ni 2p and O 1s after OER stability test.

Table S2. Comparison of OER performance of some recently reported MOFs electrocatalysts in alkaline electrolyte solution.

Material	Electrolyte	$E_{j=10}$ (mV) vs. RHE	Tafel slop (mV dec^{-1})	Reference
NiCoFe-MOF-2	**1.0 M KOH**	**321**	**48**	**This work**
Fe-Co-MOF (1:3)	1.0 M KOH	328	37	1
FeNi@CNF	1.0 M KOH	356	62.6	2
CoFe-MOF-OH	1.0 M KOH	265	44	3
2D CoZIF-9(III) sheets	0.1 M KOH	380	55	4
MOF-(Fe_1-Co_3)550N	0.1 M KOH	390	72.9	5
ZIF-8-C (C4&C6)	0.1 M KOH	476	78.5	6
FeCo&FeCoNi	1.0 M KOH	288	60	7
CoNi@OCNP	1.0 M KOH	373	75	8

Electrochemical measurements

The electrochemical properties of the materials were evaluated in a three-electrode system on a CHI-760E electrochemical workstation (Chenhua instrument co., LTD., Shanghai) at room temperature. In a standard three-electrode system, different samples are coated on the glassy carbon electrode and used directly as the working electrode, and then the Hg/HgO electrode and the Pt electrode are used as the reference electrode and the counter electrode, respectively. All measured potentials were calibrated to the reversible hydrogen electrode (RHE) based on the Nernst equation: $E_{RHE} = E_{Hg/HgO}$ + 0.059 pH + 0.098. The steady-state linear sweep voltammetry (LSV) curves were obtained at a scan rate of 5 mV s^{-1} in 1.0 M KOH solution. The measurements of electrochemical impedance spectroscopies (EIS) were conducted at a frequency range from 0.01 Hz to 100000 Hz. The overpotential (η) is calculated according to the formula $\eta = E_{RHE} - 1.23$. The Tafel slope is calculated according to the Tafel equation, namely $\eta = b\ log(\frac{j}{j_0})$, where η represents the overpotential, b represents the Tafel slope, j is the current density, j_0 represents the exchange current density. In order to determine the electrochemical active surface area (ECSA), the double layer capacitance (C_{dl}) of the electrode can be obtained by carrying out the CV measurement and the ECSA can be calculated by C_{dl} using the formula: ECSA = C_{dl} / C_s (C_s is assuming as 0.040 mF cm^{-2})[9]. To evaluate the ECSA of the catalyst, the C_{dl} of the catalyst is calculated. The CV test with sweep speed of 20 mV s^{-1}-100 mV s^{-1} is carried out in non-Faraday voltage region. C_{dl} is a linear fitting of sweep speed between 20 mV s^{-1}-100 mV s^{-1} by current density at potential 1.025 V, and the slope obtained is the value of C_{dl}.

Reference

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