Supporting Information

Ultrathin Fe-MOF modified by Fe_9S_{10} for highly efficient oxygen evolution reaction

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1. Calculation formulas

The calculation formulas used in this paper were showed as follows:

Overpotential: $\eta=E_{RHE}-1.23$ V, $E_{RHE}=E_{Ag/AgCl}+0.059*pH+0.197$ V

where E_{RHE} referred to reversible hydrogen electrode potential.

Tafel slope: $\eta=b \log j + a$,

where b was the Tafel slope. It was derived from the LSV curve, log j (j was the current density) as the abscissa and η as the ordinate, and the resulting slope was called the Tafel slope.

$2C_{dl}$ is estimated by plotting $\Delta J=(Ja-Jc)$ at 0.94 V against the scan rates.

Faradic efficiency: $FE=(V/V_m)/n$,

Where V represents the actual volume of O_2 collected, V_m represents the molar volume of gas at the corresponding temperature at the time of the test. n represents the number of molars of gas theoretically released.

Turnover Number: $TON = n_{O_2}/n_{cat}$, where n_{O_2} is the number of molars of generated O_2, n_{cat} is the number of molars of catalyst.

Turnover Frequency: TOF=TON/t, where t is time

2. Chemical

Urea (CH_4N_2O, ≥99.0%), ammonium fluoride (NH_4F, ≥98.0%), iron nitrate nonahydrate ($Fe(NO_3)_3\cdot 9H_2O$, ≥99.9%), sodium sulfide nonahydrate ($Na_2S\cdot 9H_2O$, ≥98.0%), 1,4-benzenedicarboxylic acid ($C_8H_6O_4$, ≥99.0%), sodium hydroxide (NaOH, ≥97.0%), and N,N-dimethylformamide (DMF, ≥99.5%) were purchased from Aladdin (Shanghai). Hydrochloric acid

(HCl, 36%~38%) and ethanol (C_2H_5OH, ≥99.5%) were bought from Sinopharm Chemical Reagent Co., Ltd (Shanghai). Ultrapure water and nickel foam (NF) were bought from Crystal chemical (Nanjing). The above chemical was used directly without further treatment.

3. The preparation of NF

Due to the presence of dirt and oxidation layers on the surface of NF, it was necessary to clean before using. The NF purchased was cut to the size of 1*1.5 cm^2, and then it was immersed in the3 M HCl solution prepared in advance. Cleaning with an ultrasonic cleaner for 20 minutes was employed. Then deionized water and ethanol were used for ultrasonic cleaning for 10min respectively, and then the NF was dried under vacuum at 60 °C for 12 h.

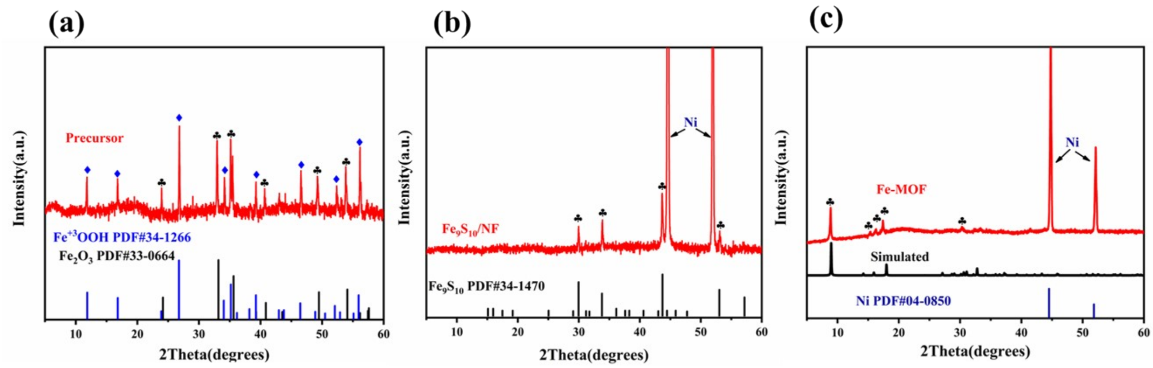

Fig. S1. XRD patterns of a) precursor, b) Fe_9S_{10}/NF and c) Fe-MOF/NF

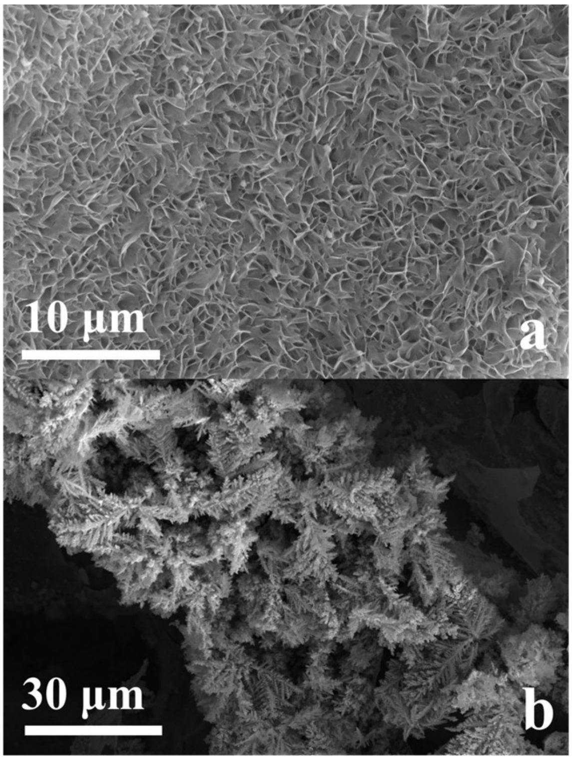

Fig. S2. SEM images of a,) Fe-MOF/NF, b) Fe_9S_{10}/NF

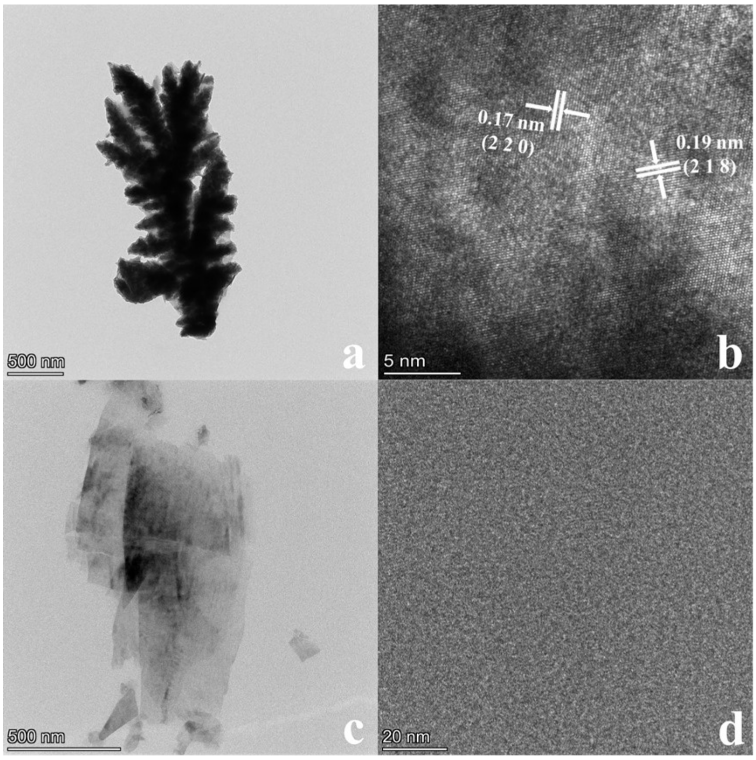

Fig. S3. TEM images of a, b) Fe_9S_{10}/NF, c, d) Fe-MOF/NF

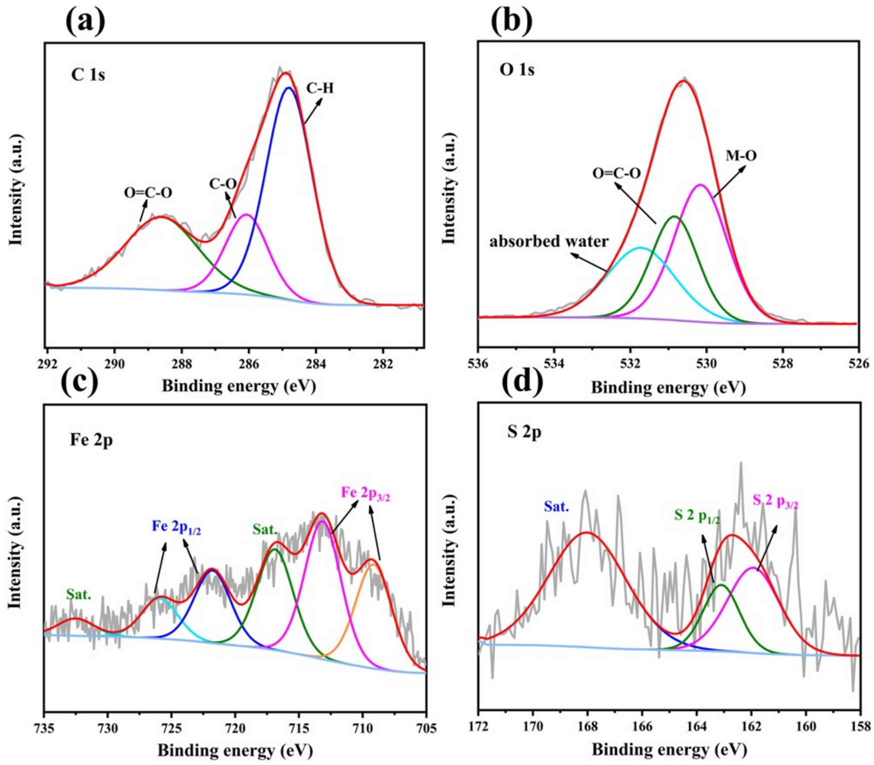

Fig. S4. XPS spectra of C1s, O1s, Fe2p, S2p in Fe_9S_{10}/Fe-MOF/NF-2 before OER

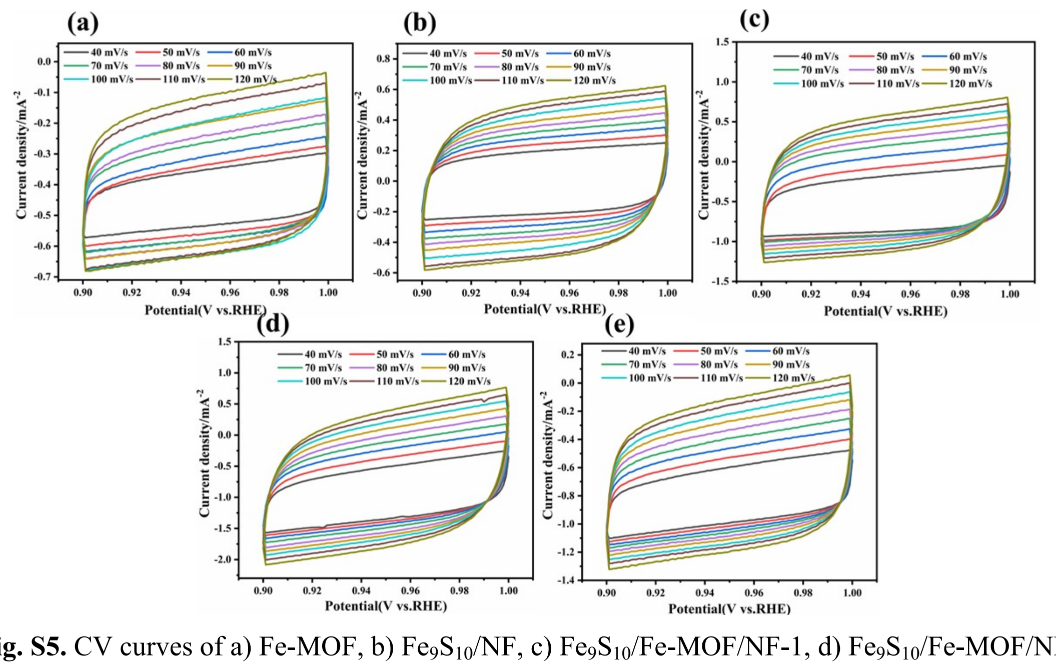

Fig. S5. CV curves of a) Fe-MOF, b) Fe_9S_{10}/NF, c) Fe_9S_{10}/Fe-MOF/NF-1, d) Fe_9S_{10}/Fe-MOF/NF-2, e) Fe_9S_{10}/Fe-MOF/NF-3 at different scan rates

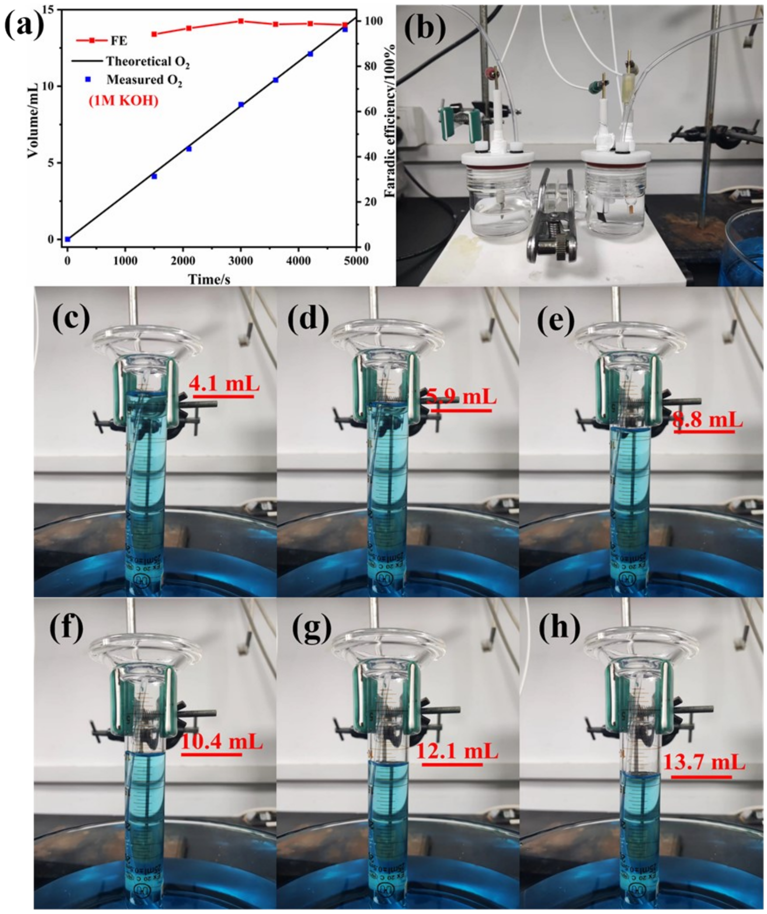

Fig. S6 a) Faradic efficiency, b) the device of drainage gas collection method, c-h) the volume of oxygen collected over time in 1 M KOH

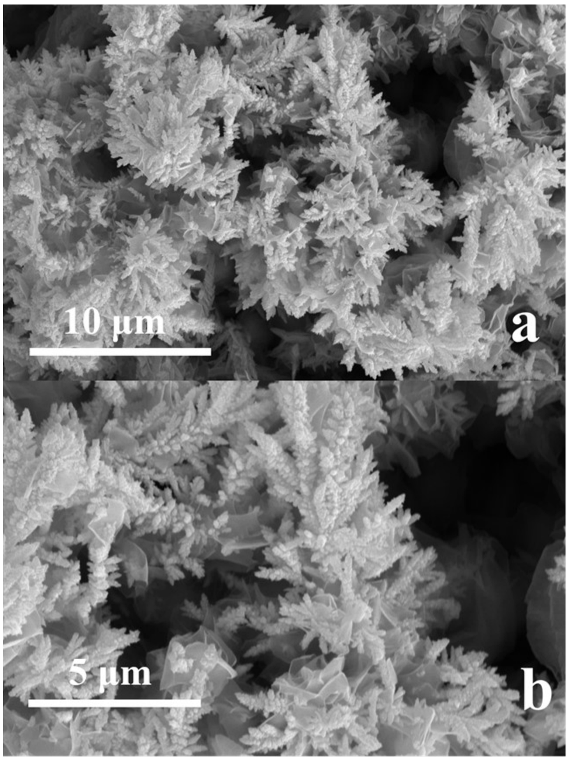

Fig. S7. SEM images of Fe_9S_{10}/Fe-MOF/NF-2 after OER

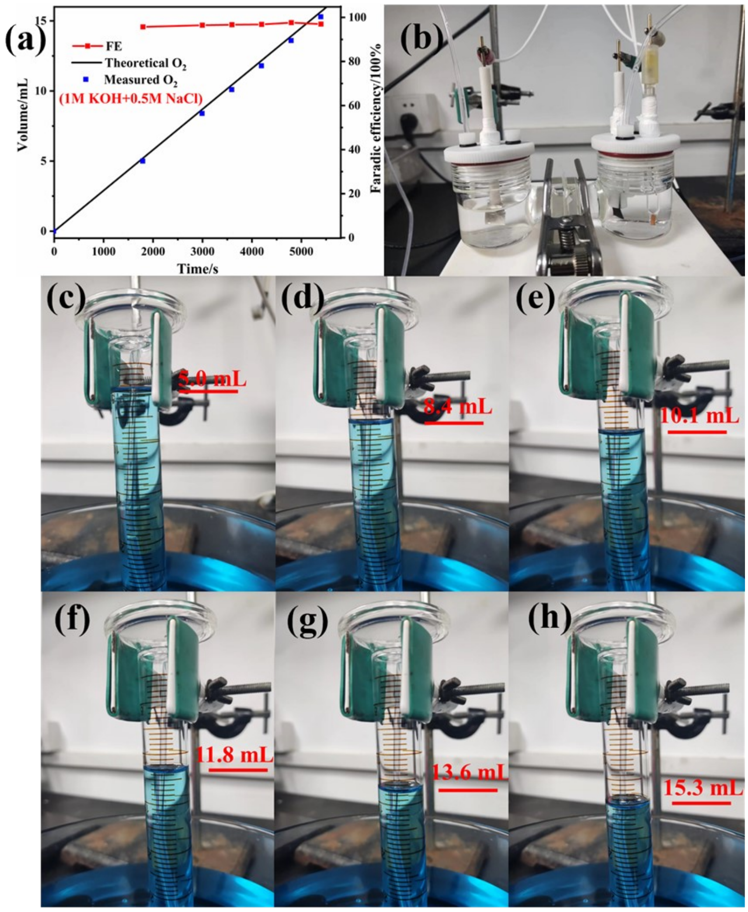

Fig S8 a) Faradic efficiency, b) the device of drainage gas collection method, c-h) the volume of oxygen collected over time in 1 M KOH+0.5M NaCl

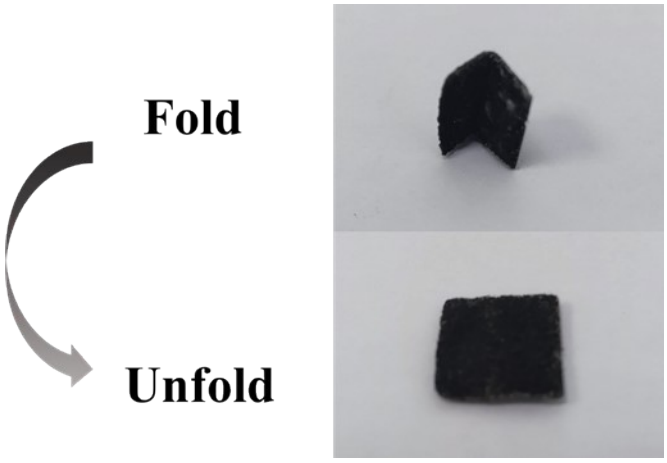

Fig. S9. Photos of Fe_9S_{10}/Fe-MOF/NF-2 when folded and unfolded

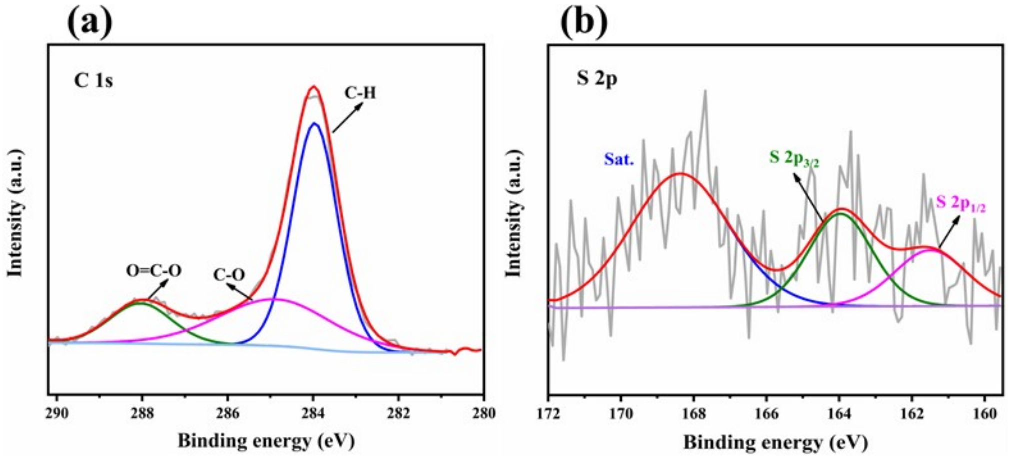

Fig. S10. XPS spectra of C1s, O1s in Fe_9S_{10}/Fe-MOF/NF-2 before OER

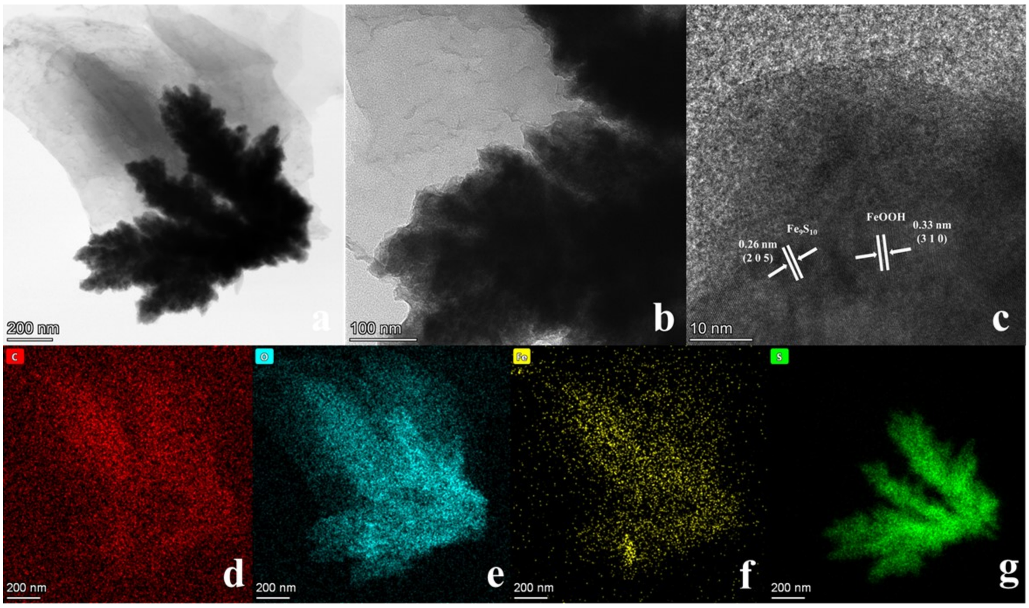

Fig. S11. a, b) TEM images, c) HRTEM images, d, e, f, g) elemental mapping of Fe_9S_{10}/Fe-MOF/NF after OER

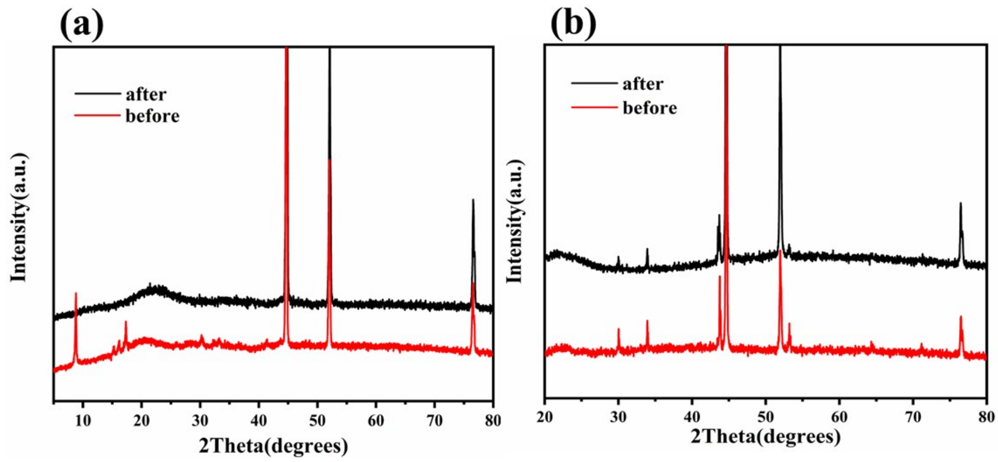

Fig. S12. XRD patterns of a) Fe-MOF/NF, b) Fe_9S_{10}/NF before and after reaction

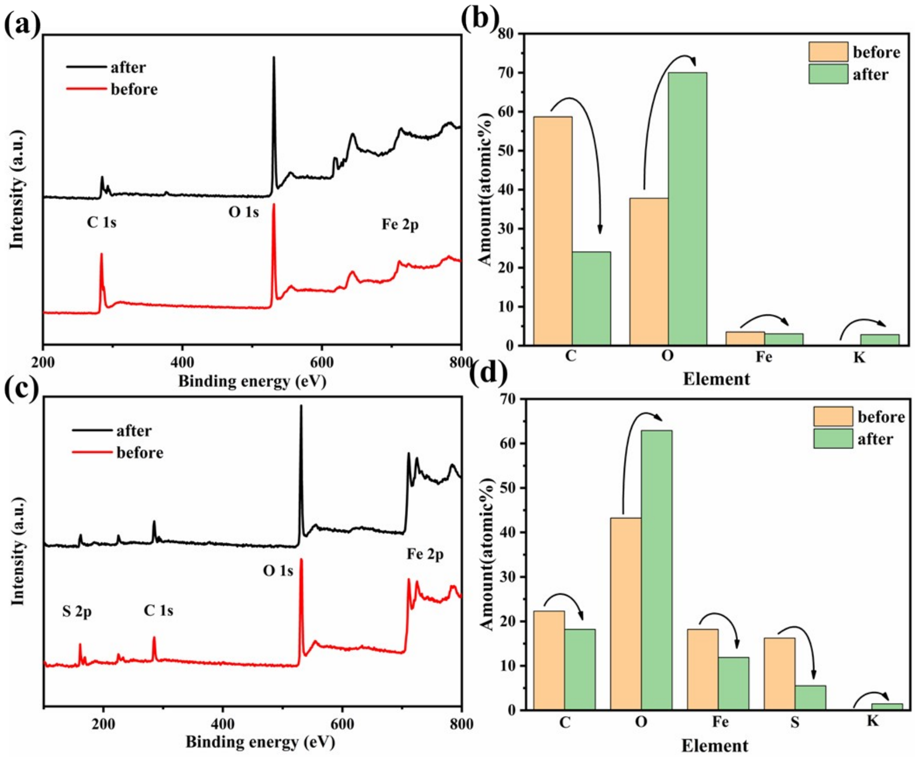

Fig. S13. survey spectrum of a) Fe-MOF/NF, c) Fe_9S_{10}/NF, and the changes in the content of elements of b) Fe-MOF/NF, d) Fe_9S_{10}/NF before and after OER test

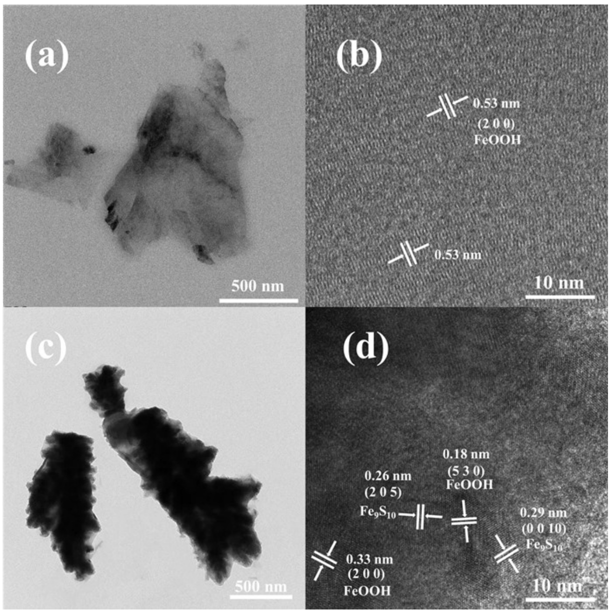

Fig. S14. TEM images of a) Fe-MOF/NF, c) Fe_9S_{10}/NF and HRTTM images of b) Fe-MOF/NF, d) Fe_9S_{10}/NF after reaction

Table S1. Comparison of OER performance in this work with recently reported materials introduced into S by the postprocessing of precursors electrocatalysts

Catalysts	Overpotential (mV)/ current density (mA cm^{-2})	Tafel slope (mV/dec)	Stability time (h)	Support	Reference

Fe_9S_{10}/Fe-MOF/NF-2	**202/10, 225/50**	**34**	**90**	**NF**	**This work**
Ni_3S_2/MIL-53(Fe)	214	33.8	23	NF	[1]
$CoMoO_4$/Fe-MOF	238	49	30	NF	[2]
$NiMoO_4$/Ni-MOF/NF	218	68	20	NF	[3]
Co_3O_4@Co-MOF	277	79	-	GC	[4]
NM50-Ni_3S_4/NF	257	67	300	NF	[5]
S-NiFe$(CN)_5$NO-500	274	54	30	GC	[6]
$Fe_{0.5}Ni_{0.5}Co_2$-S/NF	251/50	73	25	NF	[7]
$NiCo_2S_4$/CC	290/50	139	10	CC	[8]
CoS_2-MoS_2 HNAs/Ti	266	104	24	TF	[9]
Cr-NiS_2/C@NF	207	43	80	NF	[10]
PBA-SA	261	38	15	RD	[11]
$FeNi_2$-400-S	214	80	12	GC	[12]
$Co_9S_8/Zn_{0.8}Co_{0.2}S$@C	292	52	5.5	GC	[13]
$NiCo_2S_4$/FeOOH	200	71	20	CC	[14]

NF: Ni Foam

CC: Carbon Cloth

GC: Glassy Carbon

TF: Ti Foil

RD: Rotating Disk

Table S2 The TON and TOF of catalysts

Catalysts	**TON**	**TOF (s^{-1})**
Fe_9S_{10}/Fe-MOF/NF-2	122.4	0.034
Fe-MOF/NF	3.6	0.0011
Fe_9S_{10}/NF	25.2	0.0072

Reference

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