Crystalline nanoparticle-decorated amorphous nanosheet CoEr@ErFeP@$CoMo_2S_4$ heterostructures electrocatalyst for highly efficient overall water splitting

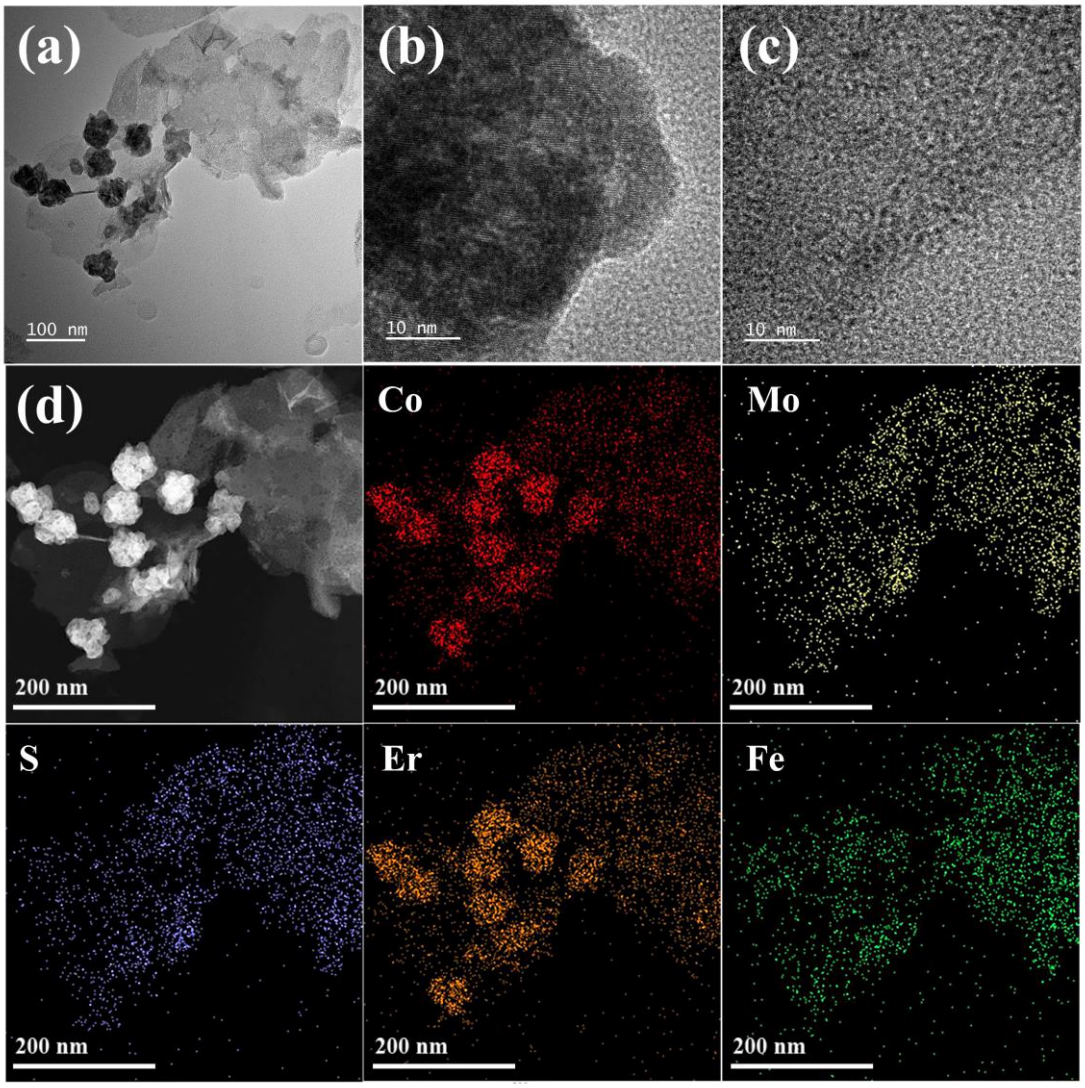


Fig. S1. TEM images of (a) ErFe-LDH@$CoMo_2S_4$/NF; (b-c) HRTEM images of ErFe-LDH @$CoMo_2S_4$/NF; (d)TEM-EDS elemental mapping of ErFe-LDH @$CoMo_2S_4$/NF

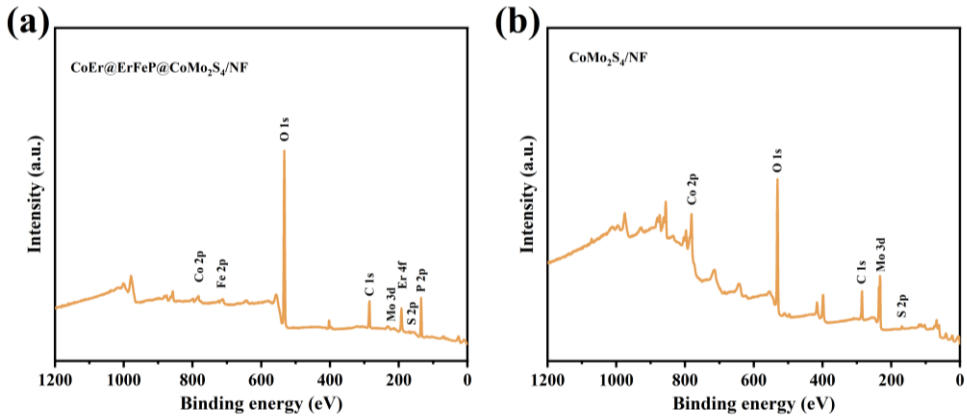


Fig. S2. XPS survey spectrum of (a) CoEr@ErFeP@$CoMo_2S_4$/NF, (b)$CoMo_2S_4$/NF.

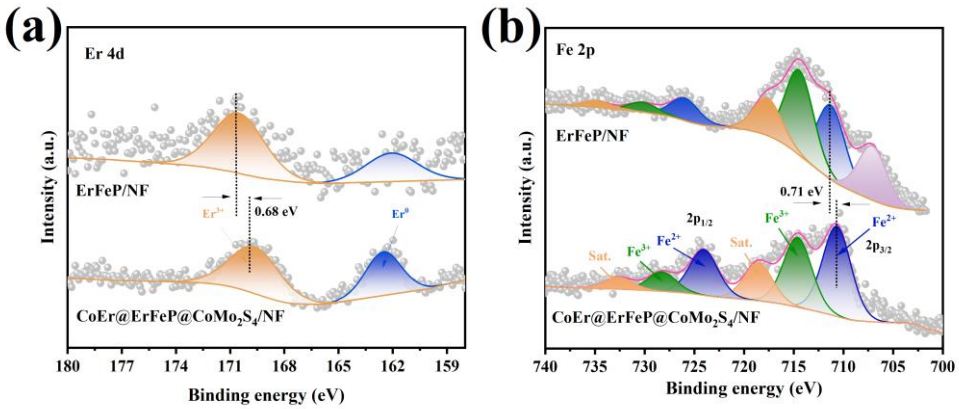


Fig. S3. XPS spectra for the (a) Er 4d, (b) Fe 2p in ErFeP/NF

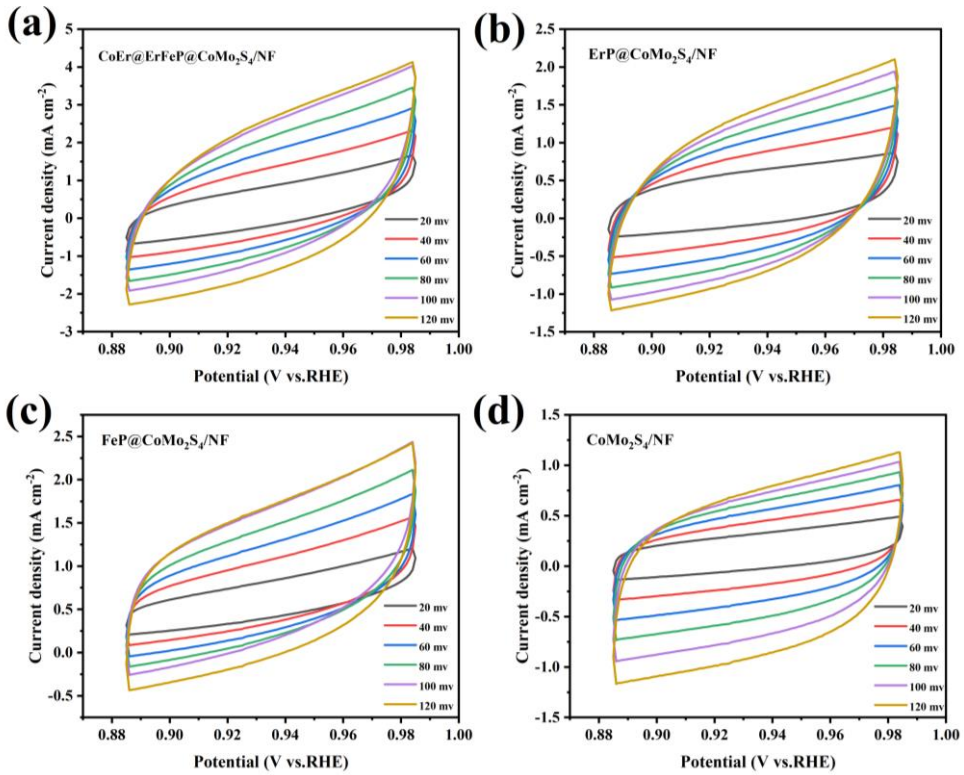
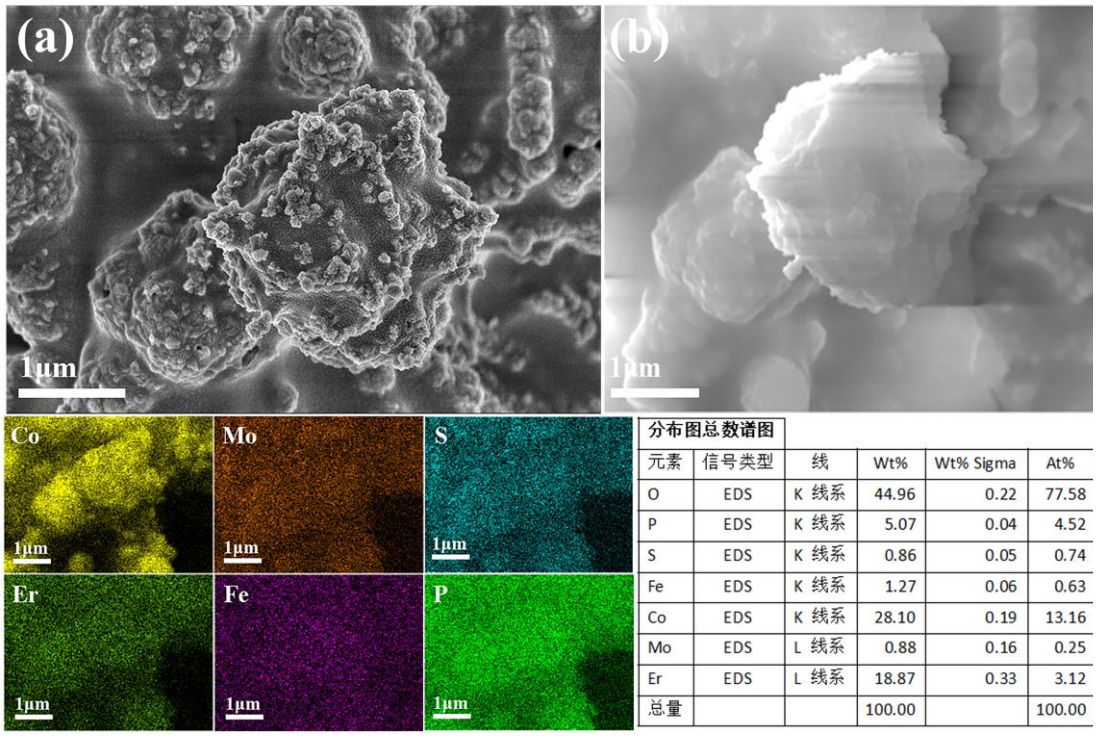


Fig. S4. Cyclic voltammetry curves of (a) CoEr@ErFeP@$CoMo_2S_4$/NF, (b) ErP@$CoMo_2S_4$/NF, (c) FeP@$CoMo_2S_4$/NF, (d) $CoMo_2S_4$/NF at different sweeping speeds (20, 40, 60, 80, 100 and 120 mV s^{-1}) for OER.



分布图总数谱图					
元素	信号类型	线	Wt%	Wt% Sigma	At%
O	EDS	K 线系	44.96	0.22	77.58
P	EDS	K 线系	5.07	0.04	4.52
S	EDS	K 线系	0.86	0.05	0.74
Fe	EDS	K 线系	1.27	0.06	0.63
Co	EDS	K 线系	28.10	0.19	13.16
Mo	EDS	L 线系	0.88	0.16	0.25
Er	EDS	L 线系	18.87	0.33	3.12
总量			100.00		100.00

Fig. S5. (a) SEM images, (b) SEM-EDS images and EDX spectrum of CoEr@ErFeP@$CoMo_2S_4$/NF after OER stability test.

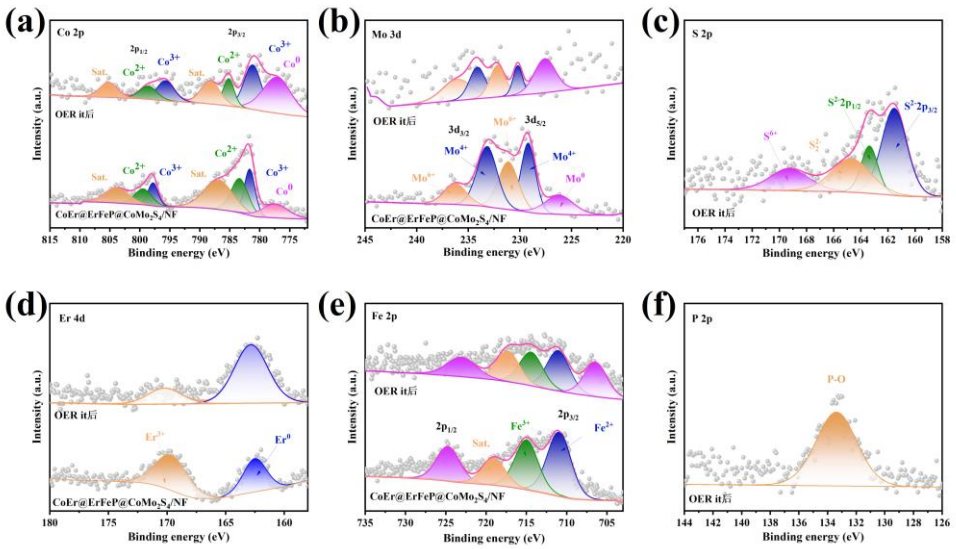


Fig. S6. XPS spectrum of CoEr@ErFeP@$CoMo_2S_4$/NF after OER stability test.

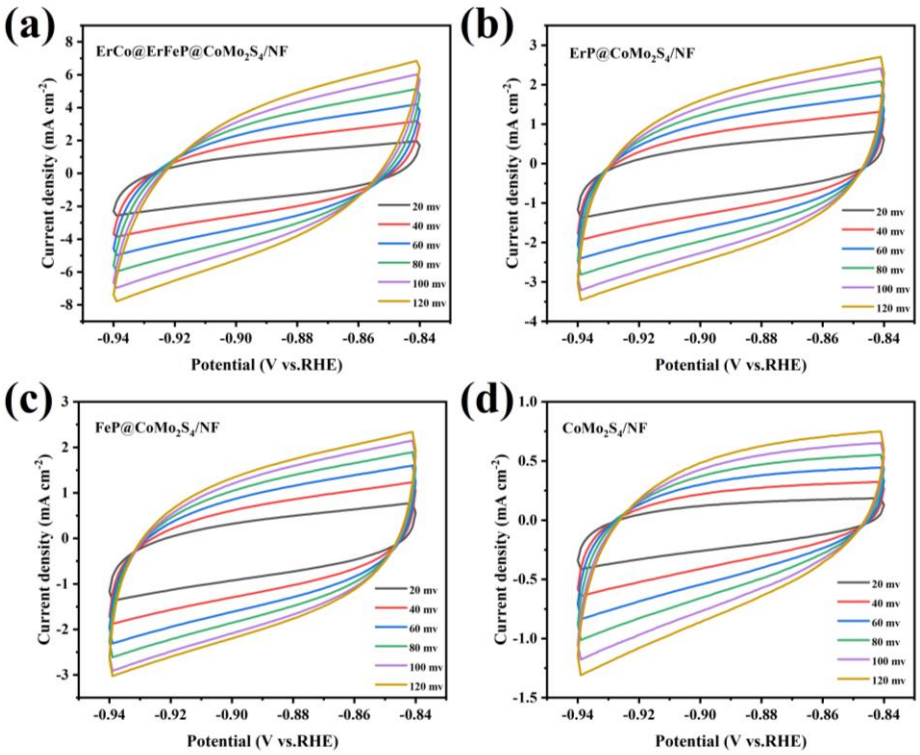
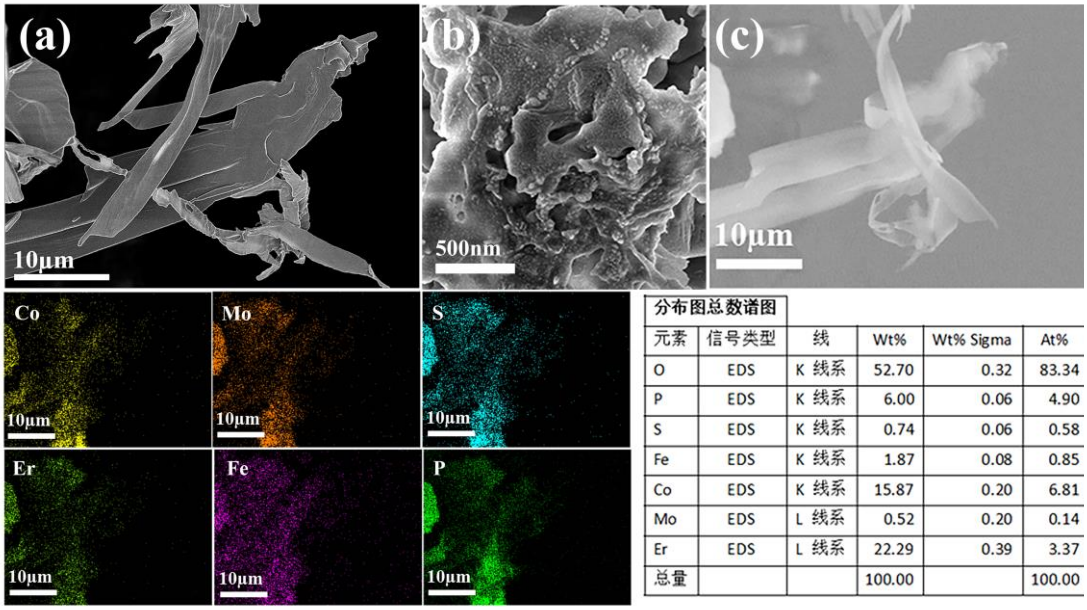


Fig. S7. Cyclic voltammetry curves of (a) CoEr@ErFeP@$CoMo_2S_4$/NF, (b) ErP@$CoMo_2S_4$/NF, (c) FeP@$CoMo_2S_4$/NF, (d) $CoMo_2S_4$/NF at different sweeping speeds (20, 40, 60, 80, 100 and 120 mV s^{-1}) for HER.



分布图总数谱图

元素	信号类型	线	Wt%	Wt% Sigma	At%
O	EDS	K 线系	52.70	0.32	83.34
P	EDS	K 线系	6.00	0.06	4.90
S	EDS	K 线系	0.74	0.06	0.58
Fe	EDS	K 线系	1.87	0.08	0.85
Co	EDS	K 线系	15.87	0.20	6.81
Mo	EDS	L 线系	0.52	0.20	0.14
Er	EDS	L 线系	22.29	0.39	3.37
总量			100.00		100.00

Fig. S8. (a, b) SEM images, (c) SEM-EDS images and EDX spectrum of CoEr@ErFeP@$CoMo_2S_4$/NF after HER stability test.

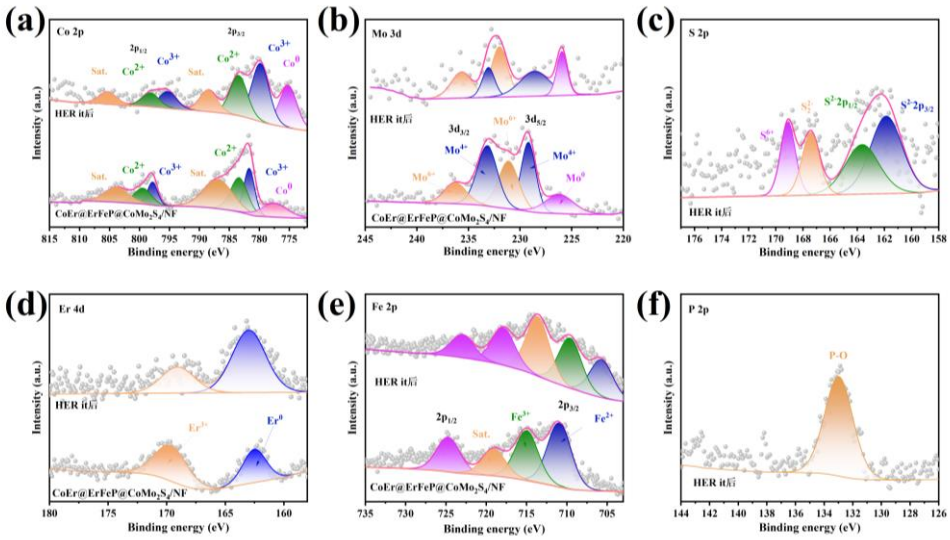


Fig. S9. XPS spectrum of CoEr@ErFeP@$CoMo_2S_4$/NF after HER stability test.

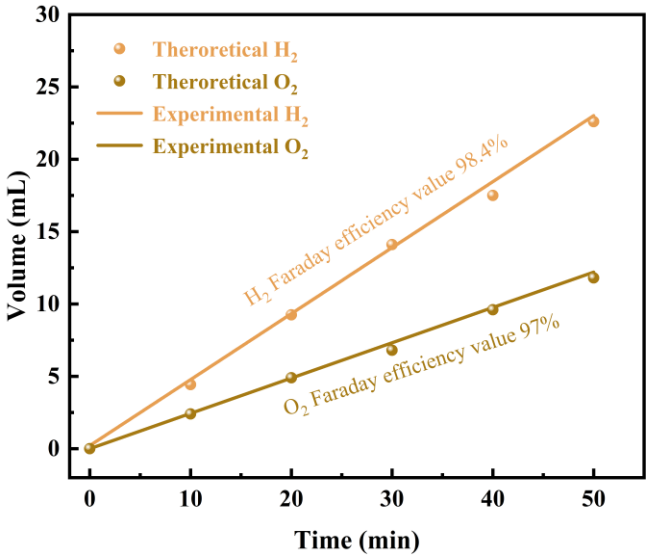


Fig. S10. Faradaic efficiency plots of CoEr@ErFeP@$CoMo_2S_4$/NF || CoEr@ErFeP@$CoMo_2S_4$/NF.

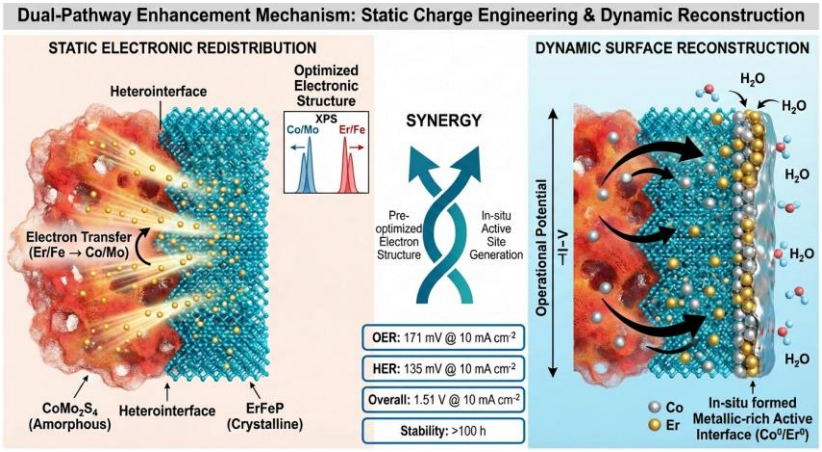


Fig. S11. CoEr@ErFeP@$CoMo_2S_4$/NF Mechanism Model

Table S1. Elemental analysis of CoEr@ErFeP@$CoMo_2S_4$/NF through ICP-OES measurement.

Element	Ratio of element content in the sample
Co (at%)	15.1838%
Mo (at%)	24.4202%
S (at%)	7.4491%
Er (at%)	22.9712%
Fe (at%)	3.6178%
P (at%)	26.3579%

Table. S2. Comparison of OER activities of CoEr@ErFeP@$CoMo_2S_4$/NF with other transition metal sulfide in 1.0 M KOH

Electrocatalyst	η (mV, j10)	Reference
CoEr@ErFeP@$CoMo_2S_4$/NF	171	This work
Co_9S_8-$CoMo_2S_4$/NSC	280	[1]
CoFe/CoMoP/NF	214	[2]
$CoMo_2S_4/FeS_2$	307	[3]
Er-CoP	256	[4]
CoS-MoS_2/Ni_3S_2/NF	225	[5]
Mxene@CoS/FeS_2	278	[6]
Er-MOF/Fe_2O_4	216	[7]
Co_8FeS_8/CoS	278	[8]
CoMo@BC	279	[9]
CoMo/CoMoP	246	[10]

Table. S3. Comparison of HER activities of CoEr@ErFeP@$CoMo_2S_4$/NF with other transition metal sulfide in 1.0 M KOH

Electrocatalyst	η (mV, j10)	Reference
CoEr@ErFeP@$CoMo_2S_4$/NF	135	This work
NiCoP/$NiCo_2S_4$	195	[11]
CoMo-LDH/NF	115	[12]
CdS@$CoMo_2S_4$/MoS_2	172	[13]
$CoMoO_4$ NWA/Ti	81	[14]
FeCoP/C	95	[15]
FeP@NPC	109	[16]
Co_3O_4@Co/NCNT	171	[17]
Mo-CoP	118	[18]
M-S_v-MoS_2	101	[19]
N-CoMo-M	112	[20]

Table. S4. Comparison of the overall water splitting performance of $CoEr@ErFeP@CoMo_2S_4/NF$ with other transition metal sulfide in 1.0 M KOH

Electrocatalyst	E (V, j10)	Reference
$CoEr@ErFeP@CoMo_2S_4/NF$	1.51	This work
La-CoMoP	1.56	[21]
MoCo-NiSe	1.66	[22]
$CoS_2/MoS_2@PPy/NF$	1.52	[23]
Er-CoP	1.58	[24]
$CoMn_2O_4/CoFe_2O_4/NF$	1.55	[25]
$a\text{-}CoMoO_3/Cu$	1.50	[26]
Fe-Co-Mo-S	1.605	[27]
CoP/FeP/CP	1.62	[28]
$Ni_{1-x}Mn_xCo_2O_4$	1.51	[29]
$Co_2P/CoMoP_2$	1.59	[30]

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