Electronic Supplementary Material (ESI) for Dalton Transactions.

Supplementary Information

One-step Synthesis of Amorphous Nickel Iron Phosphide Hierarchical Nanostructures for Water Electrolysis with Superb Stability at High Current Density

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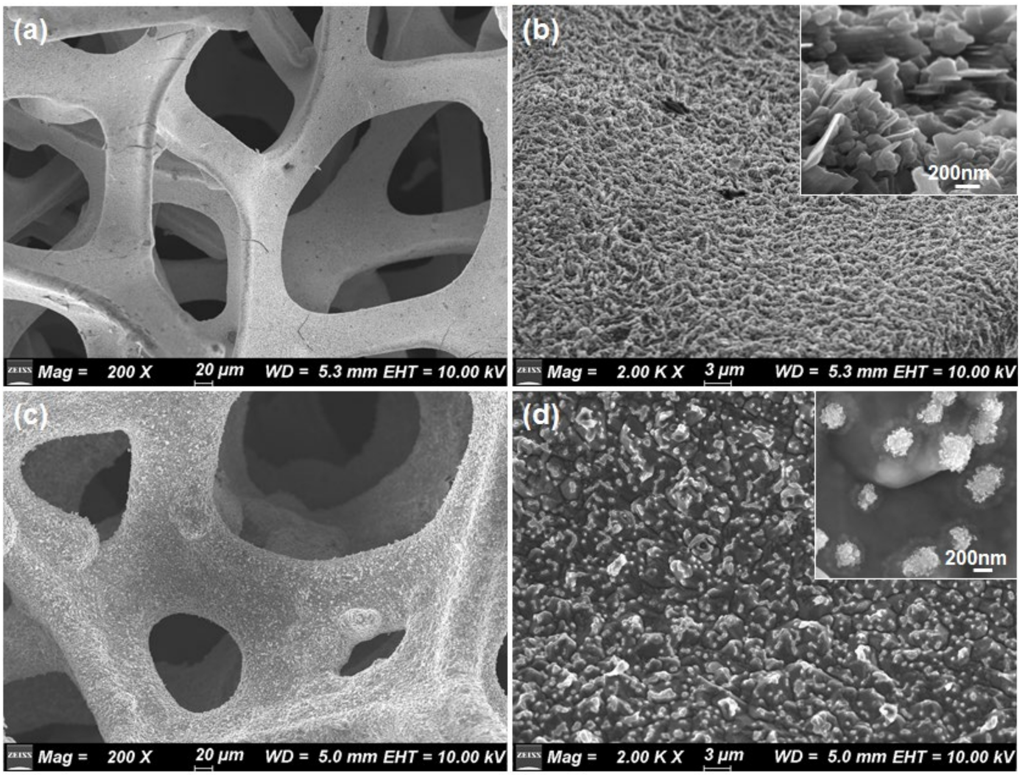

Fig. S1 SEM images of Ni_2P/NF (a,b) and Fe_2P/FF (c,d).

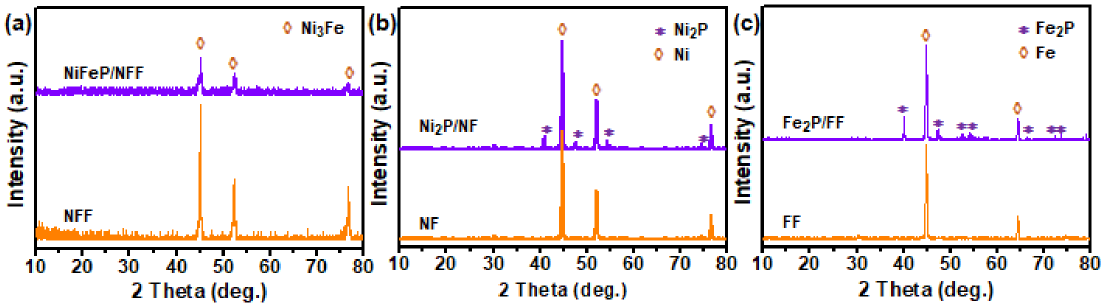

Fig. S2 XRD patterns of the as-prepared samples.

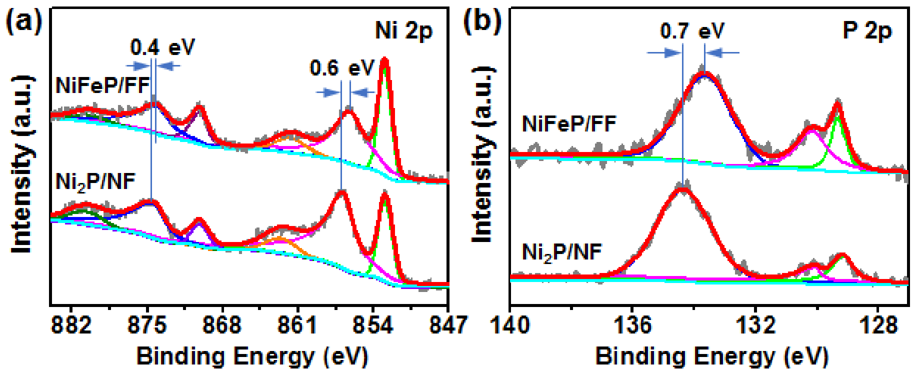

Fig. S3 Comparison of the high resolution Ni 2p (a) and P 2p (b) XPS spectra in the NiFeP/NFF and Ni_2P/NF samples.

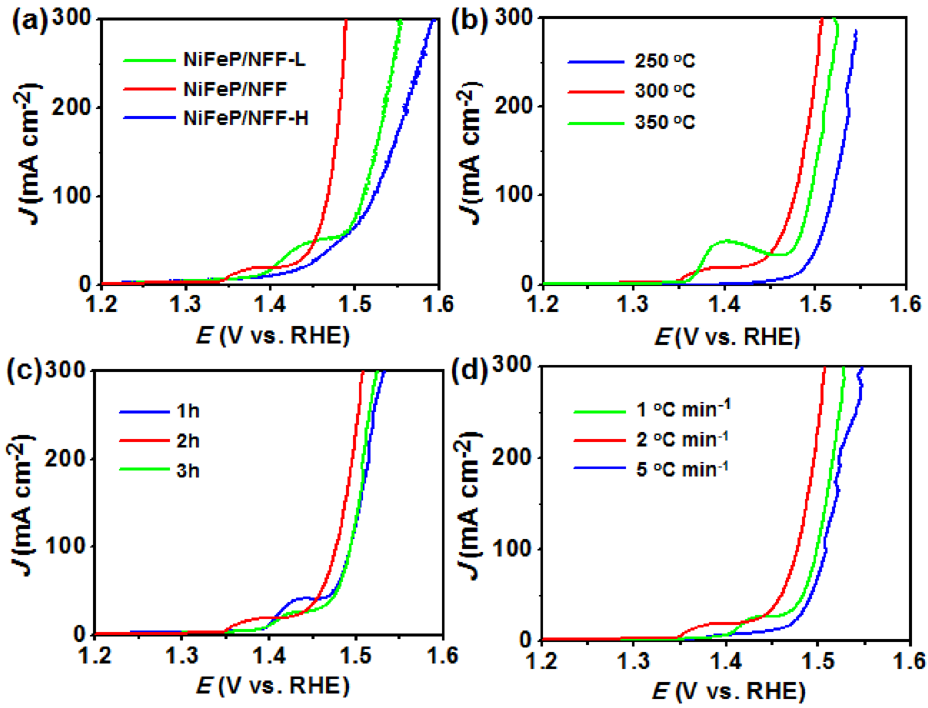

Fig. S4 Influence of the amount of NaH_2PO_2 (a), phosphidation temperature (b), phosphidation time (c) and heating rate (d) on the OER catalytic performance of the samples. NiFeP/NFF-L and NiFeP/NFF-H were obtained through the same procedure for preparation of NiFeP/NFF by adjusting the amount of NaH_2PO_2 to be 0.3 and 0.5 g, respectively.

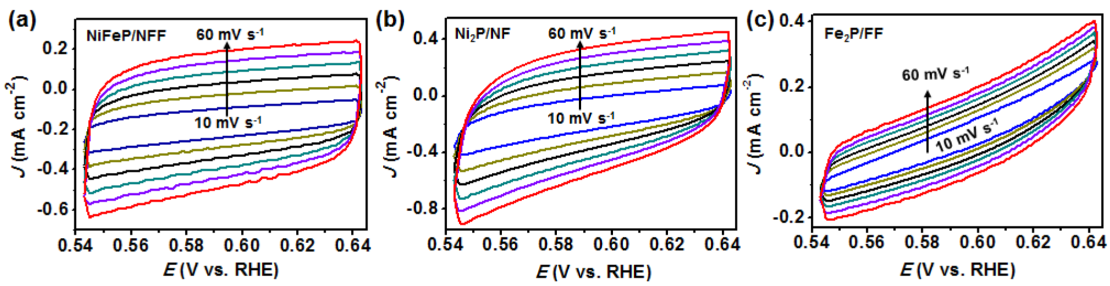

Fig. S5 CV curves of the samples at various scan rates during OER process.

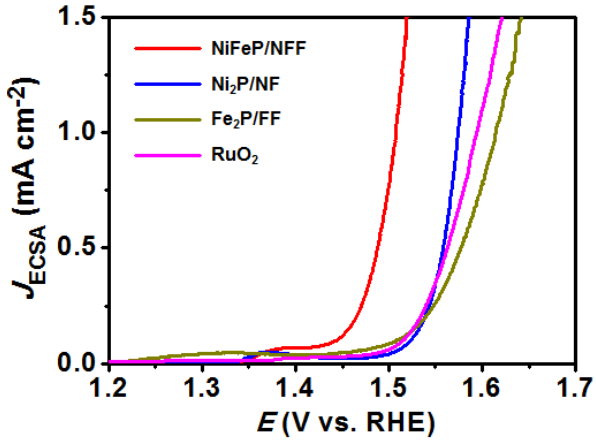

Fig. S6 ECSA-normalized LSV curves of different catalysts.

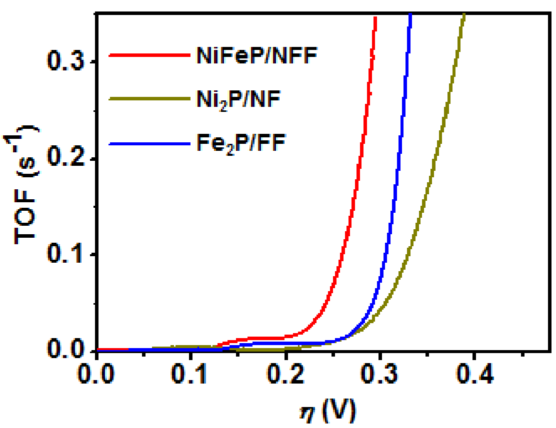

Fig. S7 TOF plots as a function of overpotential of different catalysts during OER process.

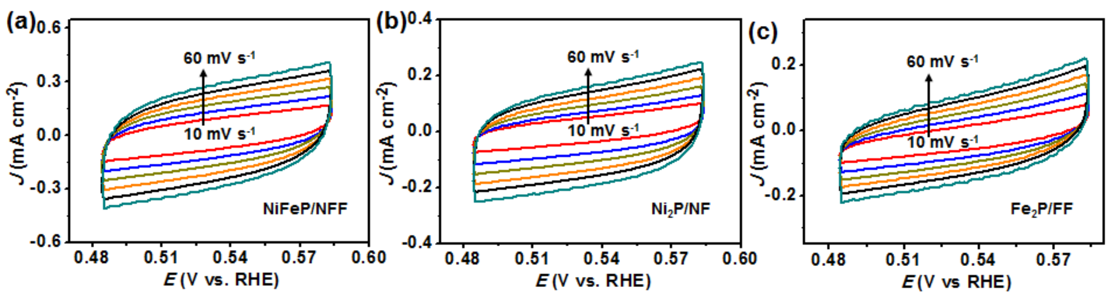

Fig. S8 CV curves of the samples at various scan rates during the HER process.

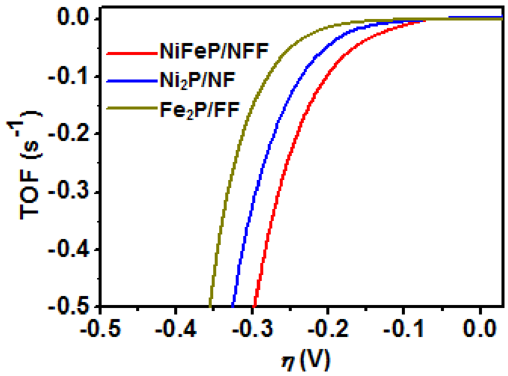

Fig. S9 TOF plots as a function of overpotential of different catalysts during HER process.

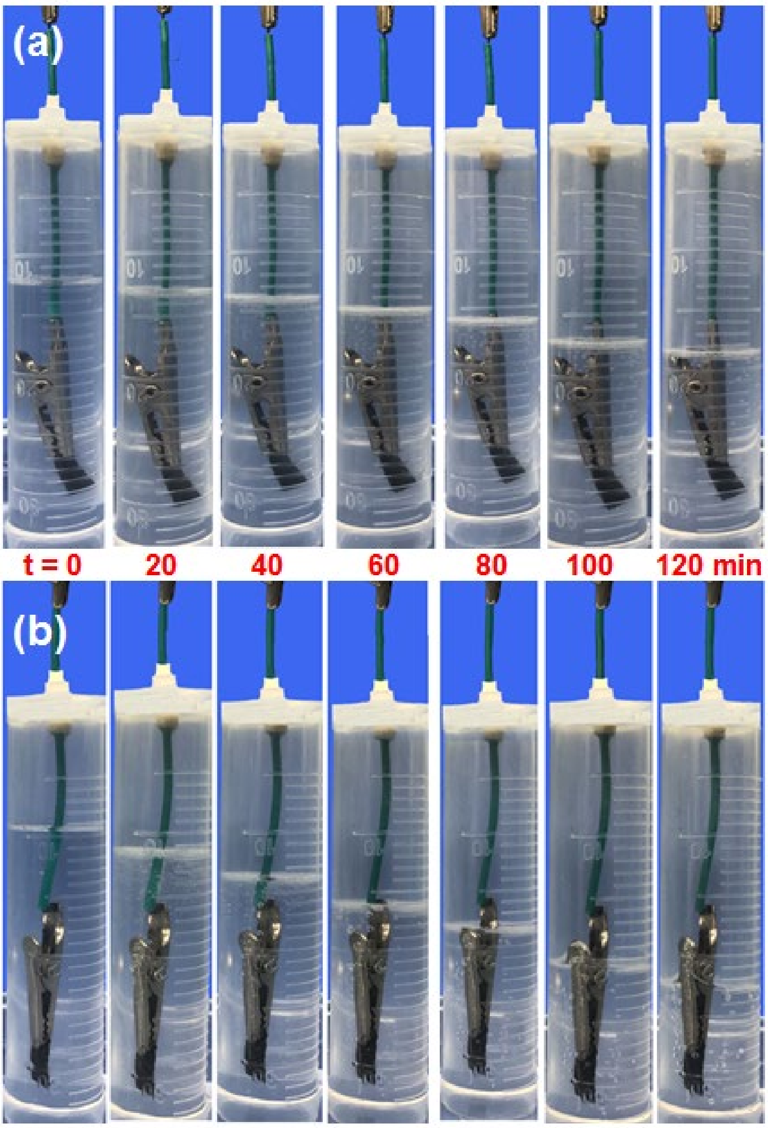

Fig. S10 Collection of oxygen (a) and hydrogen (b) evolved from water electrolysis at a current density of 30 mA cm^{-2} by water drainage method.

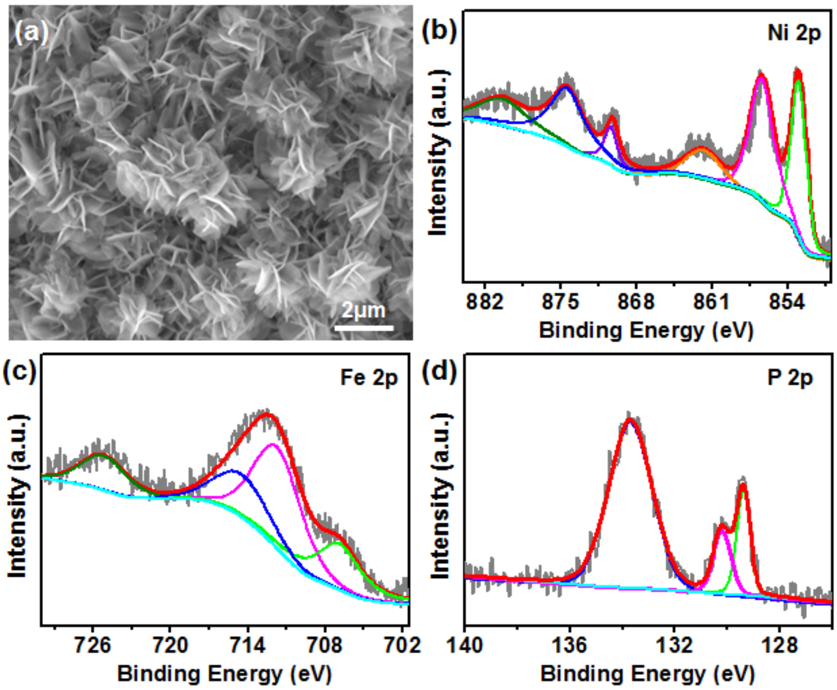

Fig. S11 SEM image (a) and high resolution XPS spectra (b-d) of the NiFeP/NFF cathode after overall water splitting test over 1000 h.

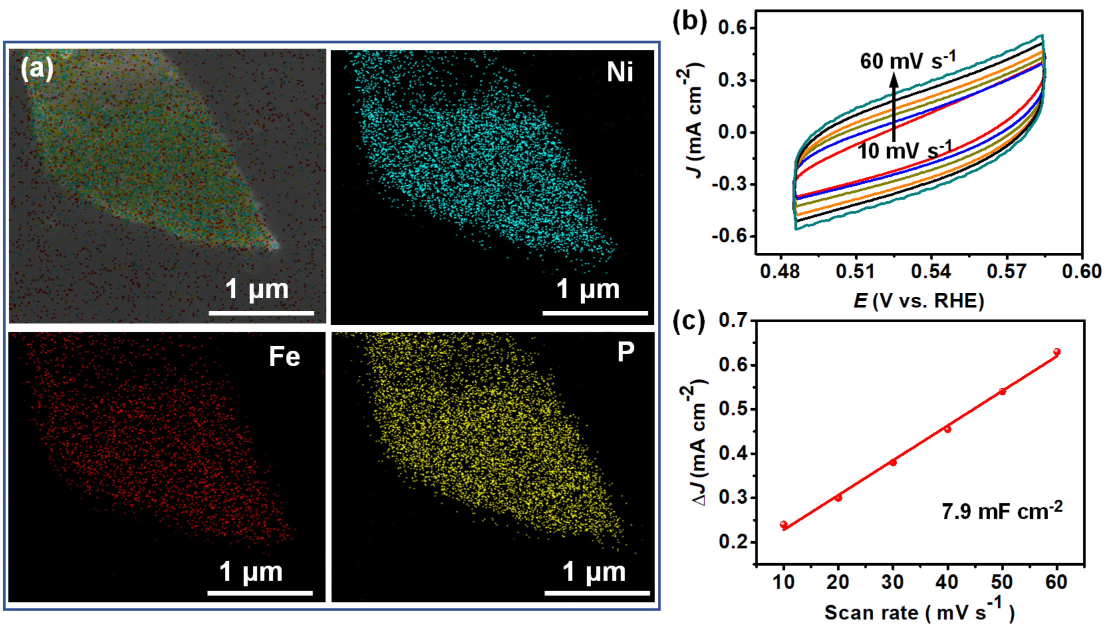

Fig. S12 EDS mapping image (a), CV curves (b) and the non-Faradaic capacitive currents against the scan rates (c) of the NiFeP/NFF cathode after overall water splitting test over 1000 h.

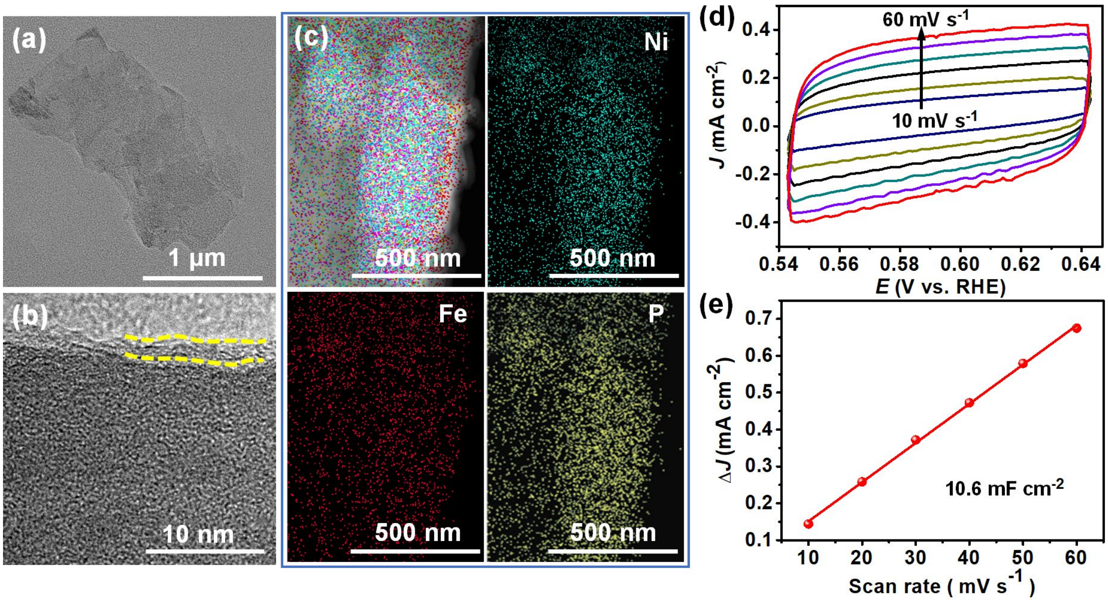

Fig. S13 TEM images (a,b), EDS mapping image (c), CV curves (d) and the non-Faradaic capacitive currents against the scan rates (e) of the NiFeP/NFF anode after overall water splitting test over 1000 h.

Table S1 Comparison of the OER performance of NiFeP/NFF with other reported non-precious electrocatalysts in 1 M KOH.

Catalyst	**Substrate**	η_{20} **(mV)**	**Tafel slope (mV dec^{-1})**	**Ref.**
(Fe-Ni)P@CC@PC-E-15	graphite electrode	215	38	1
Ni-Fe-P/Ni/CS(f.1)	copper sheet	232	60	2
$Fe_{0.5}Ni_{1.5}P$/PC	glassy carbon	254	76	3
Co/Ce-Ni_3S_2/NF	Ni foam	286	71.7	4
NiFeP@NPC	glass carbon	398	78	5
3DOM Ni_3Fe-P	glassy carbon	248	40	6
NiFeP	carbon cloth	281	74	7
$Ni_{0.9}Co_{0.1}$P@NNCs	Cu	236	54	8
$Ni_2P/(NiFe)_2P(O)$NAs	Ni foam	181	60	9
NiFe LDH/$Co_{1-x}S$	Ni foam	267	41.67	10
Ni_2P-Fe_2P/NF	Ni foam	230	58	11
$Fe_{35}Ni_{35}Co_{10}P_{20}$	self- supported	302	38	12
hcp-NiFe@NC	carbon cloth	245	41	13
CoP-FeP/CC	carbon cloth	300	131	14
Mo-doped Ni_2P	glassy carbon	270	68.5	15
C-(Fe-Ni)P@PC/(Ni-Co)P@CC	graphite	266	56	16
FeNi-P/NF	Ni foam	257	72	17
FeP-Ni/NF	Ni foam	241	60	18
FeNiP-NP	Ni foam	199	76	19
Ni-Fe-P-B	glassy carbon	283	38	20
NiFeP/NFF	Ni-Fe foam	189	37.2	This work

Table S2 Comparison of the HER performance of NiFeP/NFF with other reported non-precious electrocatalysts in 1 M KOH.

Catalyst	**Substrate**	**η_{10} (mV)**	**Tafel slope (mV dec^{-1})**	**Ref.**
NiFeP	glassy carbon	690	116	21
Cr-doped FeNi-P/NCN	glassy carbon	190	68.51	22
NiFeP@C	glassy carbon	160	75.8	23
$Fe_{0.5}Ni_{1.5}P$/PC	glassy carbon	200	\	3
FeCoNiP@NC	glassy carbon	187	52.2	24
NiFeP	glassy carbon	182	69	25
Ni-Fe-P-B	glassy carbon	220	63	20
Ni-Fe-P-300	Ni foam	192	142.2	26
NiFeOF	self-supported	253	96	27
NiFe LDH@NiCoP/NF	Ni foam	120	88.2	28
FeNiSe-NS/EG	graphene foil	187	65	29
NiCoP/rGO	carbon fiber paper	209	124.1	30
NiFe LDH@CoP/NiP_3	Ni foam	151	74	31
Fe-Ni_3C-2%	glassy carbon	244	41.3	32
3DOM Ni_3Fe-P	glassy carbon	120	61	6
CoFe@NiFe-200/NF	Ni foam	240	88.88	33
Ni_3S_2/NF	Ni foam	189	89.3	34
Ni_2P-Fe_2P/NF	Ni foam	128	86	11
$Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC	glassy carbon	175	168	35
$CoFeN_x$-500 HNAs/NF	Ni foam	200	66.04	36
NiFeP/NFF	Ni-Fe foam	155	67.8	This work

Table S3 Comparison of the overall water splitting performance of NiFeP/NFF with other reported bifunctional electrocatalysts in 1 M KOH.

Catalyst	**Substrate**	**Voltage at J_{10} (V)**	**Durability (h) @ J (mA cm^{-2})**	**Ref.**
$NiSe_2$/3DSNG/NF	Ni foam	1.59	50 @ 20	37
FeNi/PNGs	polyamide film	1.67	17 @ 10	38
$Fe_{0.5}Ni_{1.5}P$/PC	glassy carbon	1.63	16 @ 10	3
$MnCo_2O_4$@ Ni_2P	Ni foam	1.63	30 @ 10	39
Ni/Ni$(OH)_2$	carbon paper	1.59	20 @ 10	40
$Fe_{0.29}Co_{0.71}P$/NF	Ni foam	1.59	10 @ 180	41
NiFe LDH@CoP/NiP_3	Ni foam	1.64	275 @ 100	31
NiFeSP/NF	Ni foam	1.58	20 @ 10	42
NiFe-NCNT@MoS_2-12	Ni foam	1.6	12 @ 10	43
Fe, Al-$NiSe_2$/rGO	Ni foam	1.7	22 @ 10	44
Ni_2P-Fe_2P/NF	Ni foam	1.561	43@ 500	11
C-(Fe-Ni)P@PC/(Ni-Co)P	graphite	1.63	24 @ 10	16
np-NiFeCoP	self-supported	1.62	20 @ 10	45
$CoFeN_x$-500 HNAs/NF	Ni foam	1.592	40 @ 10	36
Pt/NiO/Ni/CNT-3	carbon paper	1.61	10 @ 10	46
FeCoNiP@NC	Ni foam	1.73	10 @ 10	24
Co/CNFs(1000)	self-supported	1.69	10 @ 10	47
FeP-Ni/NF	Ni foam	1.62	28 @ 20	18
Co/β-Mo_2C@N-CNTs	Ni foam	1.64	24 @ 10	48
CoP/NCNHP	carbon paper	1.64	26 @ 20	49
Ni-Fe-P-B	CFP	1.58	12 @ 100	20
np-$(Ni_{0.67}Fe_{0.33})_4P_5$	self-supported	1.62	20 @ 10	50
NiCoP/rGO	CFP	1.59	75 @ 10	30
3DOM Ni_3Fe-P	glassy carbon	1.65	20 @ 10	6
NiFe NTAs-NF	Ni foam	1.62	20 @ 10	51
$Ni_{1.85}Fe_{0.15}P$ NSAs/NF	Ni foam	1.61	22 @ 40	52
FeNi/N-doped graphene	graphite	1.701	10 @ 10	53
E-Mo–NiCoP-3	carbon cloth	1.61	12 @ 50	54
$Ni_{0.7}Fe_{0.3}PS_3$@MXene	Ni foam	1.65	50 @ 10	55
NiFeP/NFF	Ni-Fe foam	1.58	1000 @ 500	This work

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