Supporting Information

One-Step Synthesis of Nickel Phosphide Nanowires Array Supported on Nickel Foam with Enhanced Electrocatalytic Water Splitting Performance

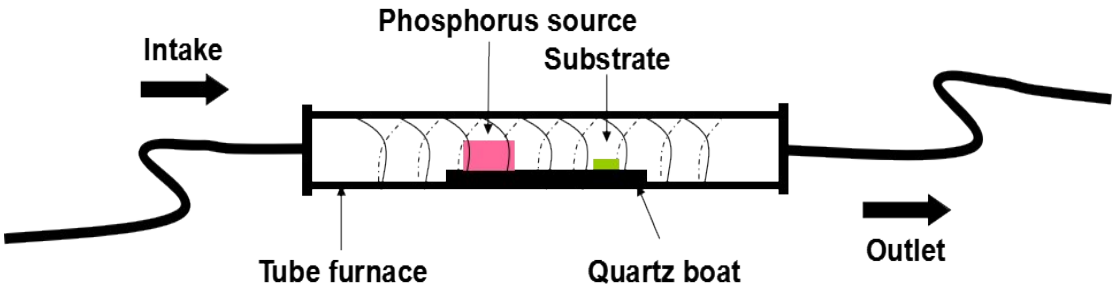
Jian Xiao[†, #], Qiying Lv[†, #], Yan Zhang[†], Zheye Zhang[†], Shuai Wang[†, §, *]

[†] State Key Laboratory of Digital Manufacturing Equipment and Technology. Key laboratory of Material Chemistry for Energy Conversion and Storage, Ministry of Education. School of Chemistry and Chemical Engineering, Huazhong University of Science and Technology, Wuhan 430074, P. R. China

[§] Flexible Electronics Research Center（FERC), School of Mechanical Science and Engineering, Huazhong University of Science and Technology, Wuhan 430074, P. R. China

[#] These authors contributed equally to this work.

E-mail: chmsamuel@mail.hust.edu.cn; Tel: +86 87792464



Scheme S1. Illustration of the one-step synthesis of Ni-P NA/NF

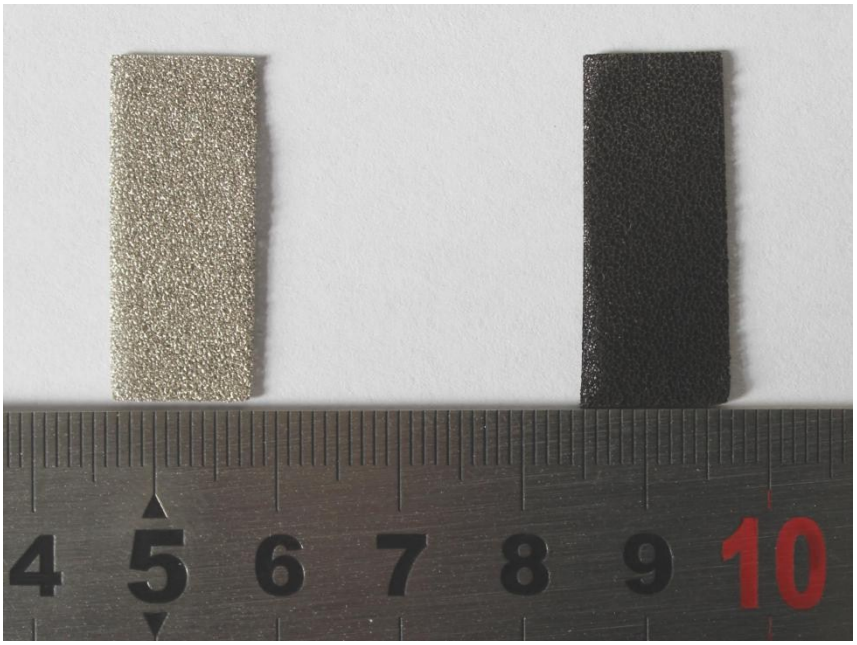


Figure S1. photograph of Ni foam before (left) and after (right) phosphorization treatment

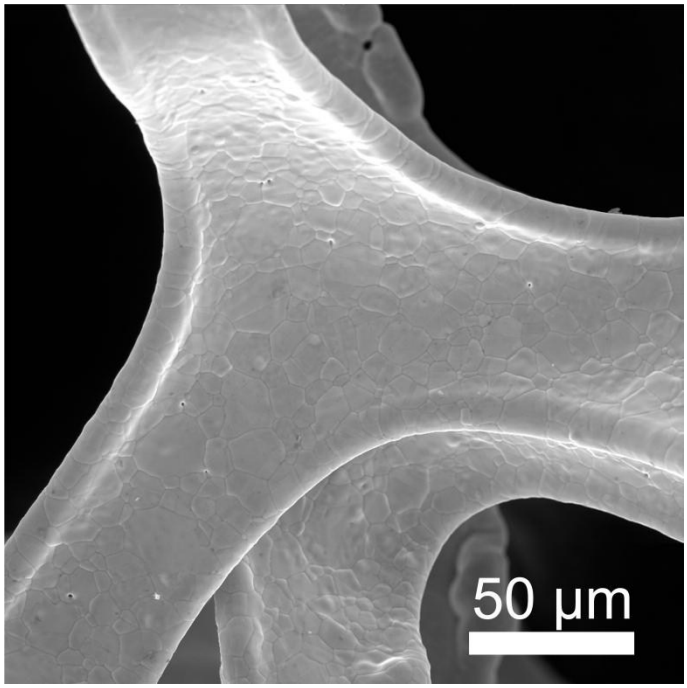


Figure S2. SEM image of the bare Ni foam

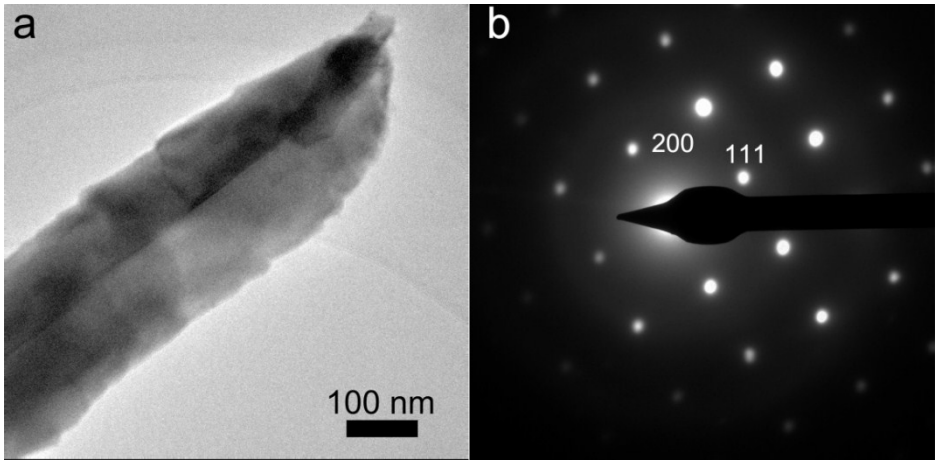


Figure S3. (a) TEM and (b) SAED pattern of the single nickel phosphide nanowire

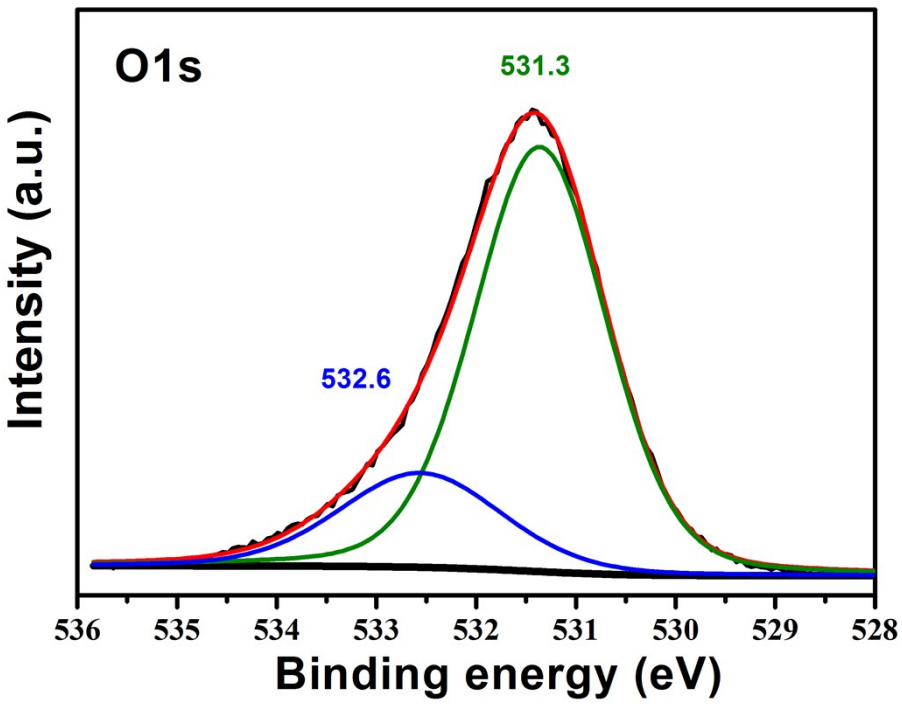


Figure S4. XPS in the region of O 1s orbit for Ni-P NA/NF electrode.

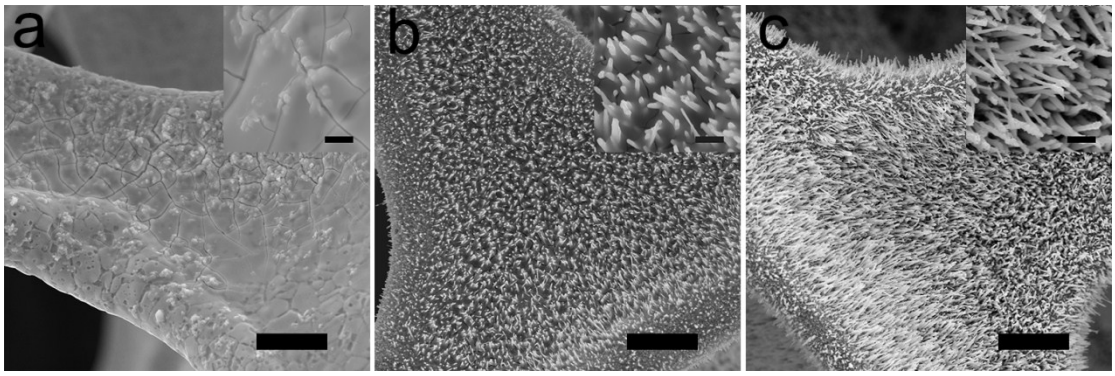


Figure S5. SEM images of the Ni foam phosphated for different time: (a) 6 min, (b) 15 min and (c) 30 min, all bars are 20 μm. (Inset: the corresponding enlargement, all bars are 2 μm)

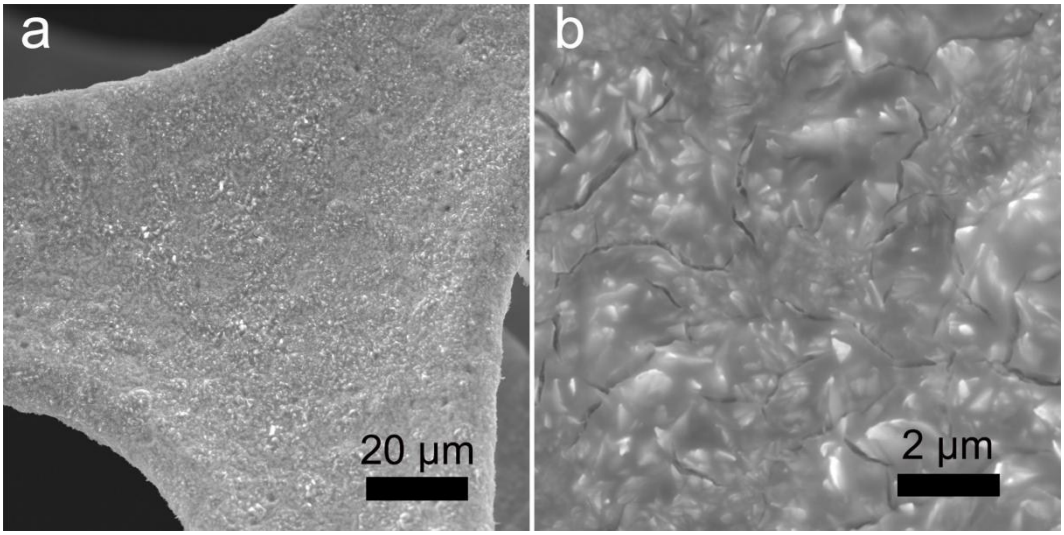


Figure S6. (a, b) SEM images of the Ni foam phosphated after oxidizing at 600 ^{o}C for 2 h in air atmosphere

Table S1. Comparison of electrocatalytic activity of some non-noble metal HER catalysts reported in the literature.

Catalyst	**Electrolyte**	**η_{10} (mV vs. RHE)**	**j_0 (mA cm^{-2})**	**Tafel slope (mV dec^{-1})**	**Ref.**
Ni-P NA/NF	0.5 M H_2SO_4	73	0.85	70.8	**This work**
	1.0 M KOH	148	0.51	115.2	
Co_2B	1.0 M KOH	106		92.4	13
Ni_5P_4 Film	0.5 M H_2SO_4	140		40	14

	1.0 M KOH	150		53	
Ni_5P_4-Ni_2P nanosheet	0.5 M H_2SO_4	120	0.116	79.1	15
CP@Ni-P	0.5 M H_2SO_4	98	0.24	58.8	16
	1.0 M KOH	117		85.4	
NiP_2 NS/CC	0.5 M H_2SO_4	75	0.26	51	17
Ni_2P nanoparticle	0.5 M H_2SO_4	126	0.033	46	22
peapod-like Ni_2P	0.5 M H_2SO_4	87		54	25
Ni-doped graphene	0.5 M H_2SO_4	152	0.053	45	32
CoNi@NC	0.1 M H_2SO_4	142		105	33
Core-shell MoO_3-MoS_2	0.5 M H_2SO_4	255	0.082	55	34
Co-NG	0.5 M H_2SO_4	147	0.125	82	36
$MoSe_2$/RGO	0.5 M H_2SO_4	151		101	37
WN NA/CC	0.5 M H_2SO_4	198		92	38
	1.0 M H_2SO_4	285		170	
CP/CTs/Co-S	1.0 M KOH	190	0.39	131	48

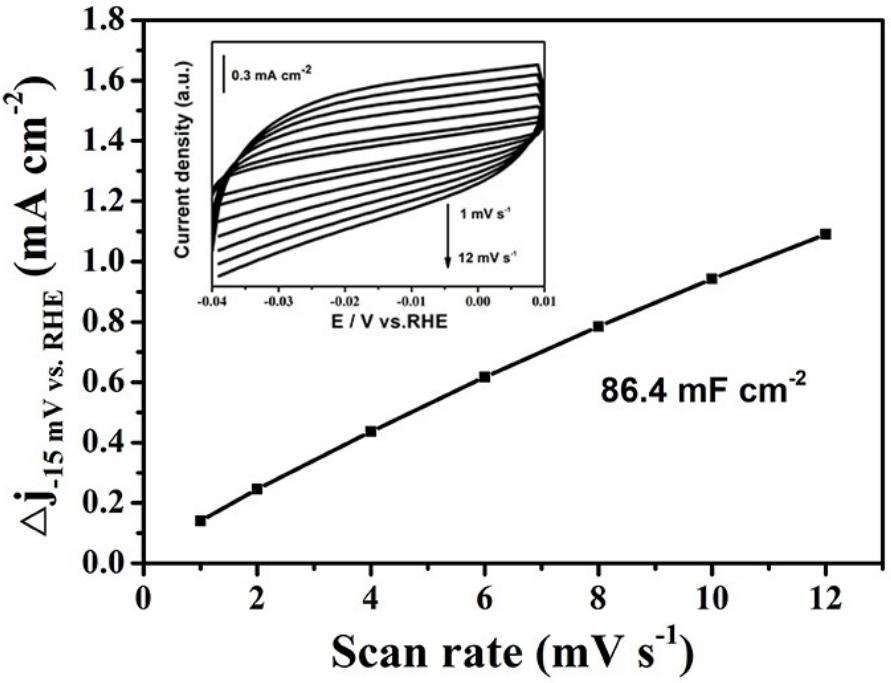


Figure S7. Plots of the current density versus the scan rate for Ni-P NA/NF (inset: cyclic voltammetry of Ni-P NA/NF measured at different scan rates from 1 to 12 mV s^{-1})

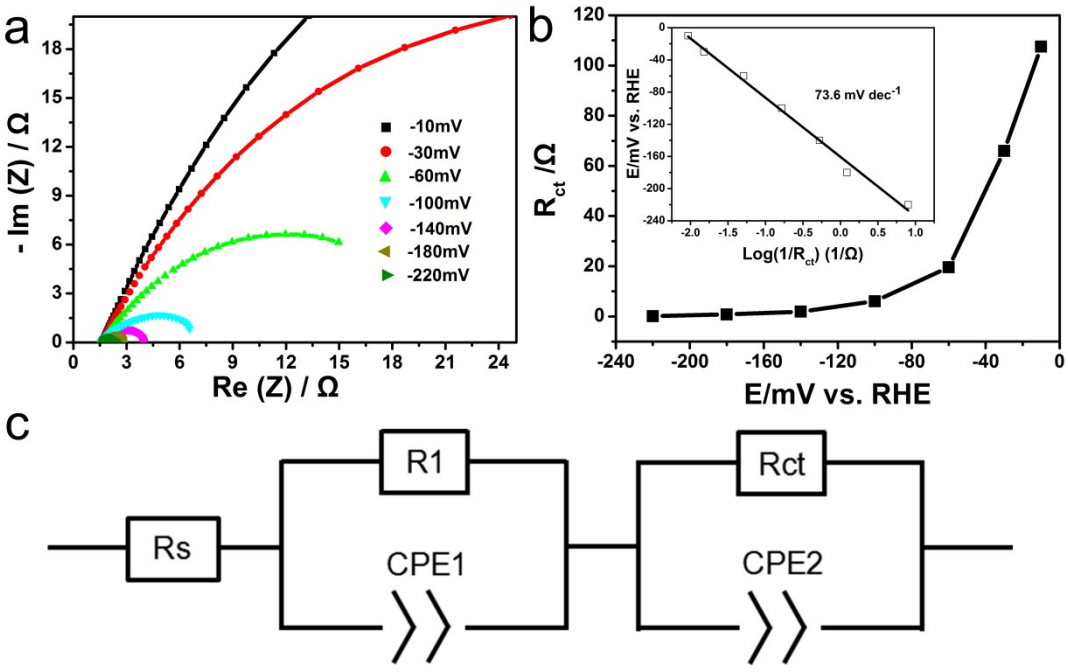


Figure S8. (a) Nyquist plots of electrochemical impedance spectroscopy (EIS) for Ni-P NA/NF electrode obtained at different overpotentials. (b) Dependence of the charge-transfer resistance

(R_{ct}) on the overpotential. Inset: overpotential versus log($1/R_{ct}$). (c) Equivalent circuit (2CPE model) used for fitting the Nyquist plots.

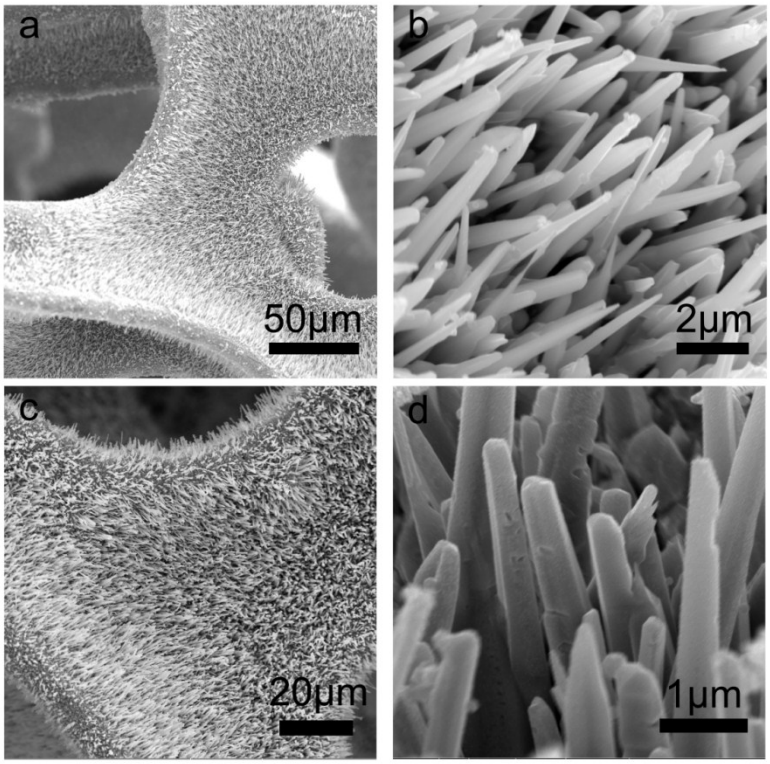


Figure S9. SEM images of the Ni-P NA/NF electrode after the long-term stability tests for (a, b) HER and (c, d) OER

Table S2. Comparison of electrocatalytic activity of some non-noble metal OER catalysts reported in the literature. (test in KOH)

Catalyst	η_{20} (mV vs. RHE)	Tafel slope (mV dec^{-1})	Ref.
Ni-P NA/NF	357	76.0	**This work**
Co_2B	410	45	13
Ni_2P nanowires	346	47	23
Ni-P/CF	362	120	24
Co-P film	375	46	42
N-CG–CoO	373	71	43
N-doped graphene	526	156	44
$NiCo_2O_4$			
PCN-CFP	430	61.6	45
$Co@Co_3O_4/NC$	420		46
CP/CTs/Co-S	326	72	48