Electronic Supplementary Material (ESI) for Nanoscale.

Electronic Supplementary Information

Hierarchically scaffolded CoP/CoP_2 nanoparticles: controllable synthesis and their application as a well-matched bi-functional electrocatalyst for overall water splitting

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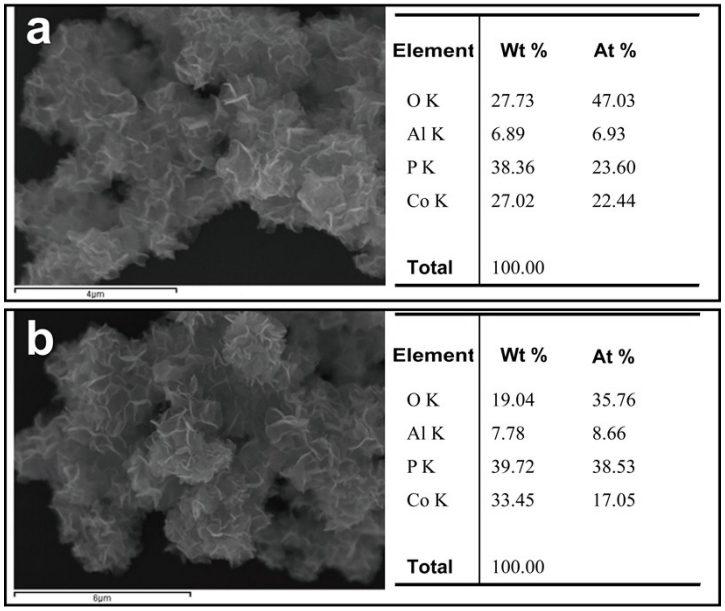
Figure S1



Element	Wt %	At %
O K	27.73	47.03
Al K	6.89	6.93
P K	38.36	23.60
Co K	27.02	22.44
Total	100.00	

Element	Wt %	At %
O K	19.04	35.76
Al K	7.78	8.66
P K	39.72	38.53
Co K	33.45	17.05
Total	100.00	

Fig. S1 SEM/EDX images of (a) f-CoP/Al_2O_3 electrocatalyst and (b) f-CoP/CoP_2/Al_2O_3 electrocatalyst.

Figure S2

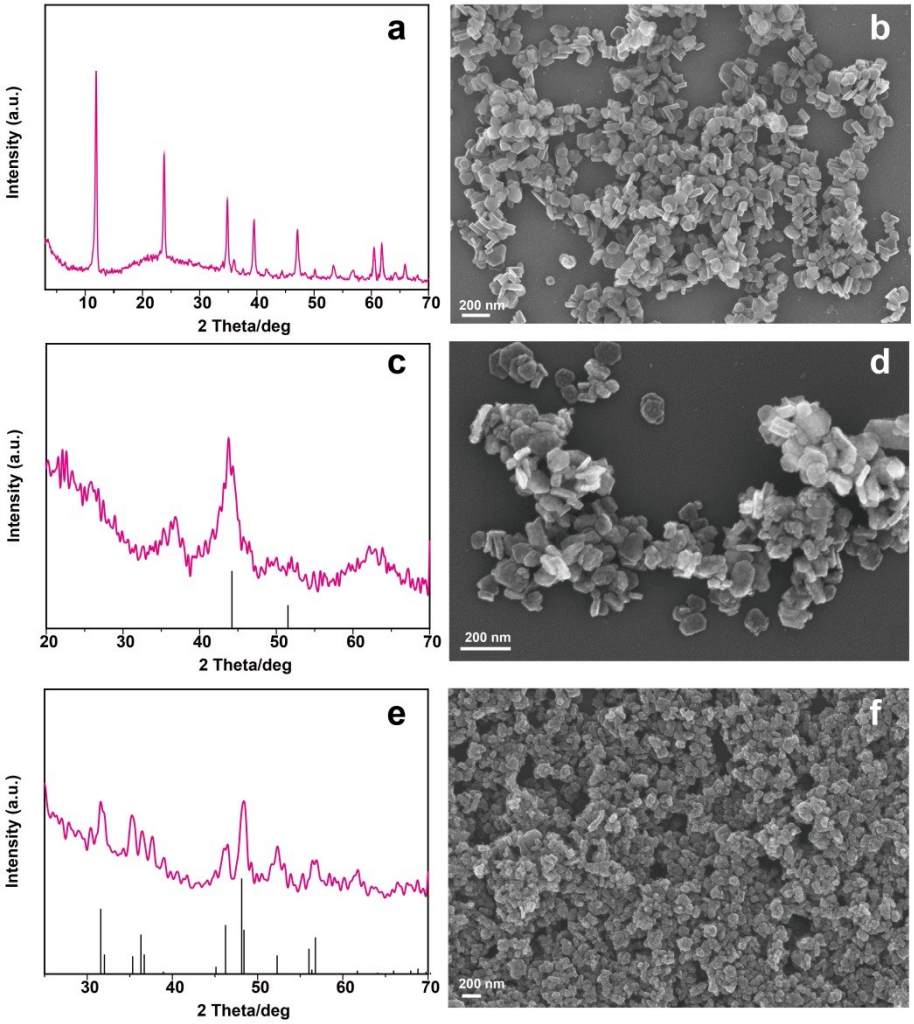


Fig. S2 (a) XRD pattern and (b) SEM images of p-CoAl-LDH precursor, (c) XRD pattern and (d) SEM images of p-Co/Al_2O_3 nanoparticles formed after reduction of p-CoAl-LDH precursor, (e) XRD pattern and (f) SEM images of p-CoP/Al_2O_3 composite formed after short-duration phosphorization of p-Co/Al_2O_3.

Figure S3

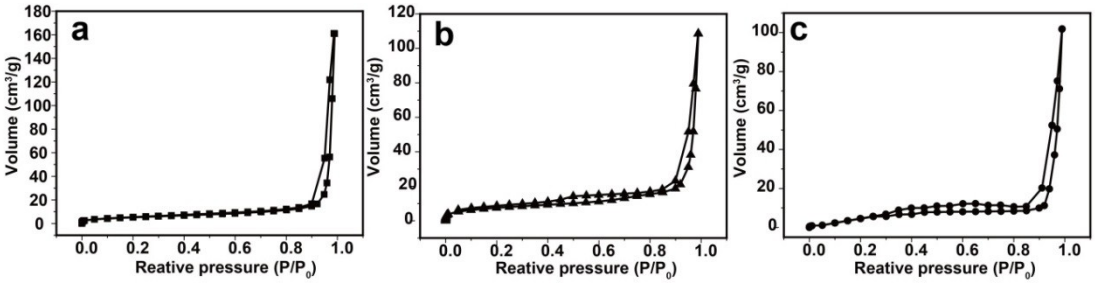


Fig. S3 N_2 adsorption/desorption isotherm of (a) p-CoP/Al_2O_3, (b) f-CoP/Al_2O_3, and (c) f-CoP/CoP_2/Al_2O_3 composites.

Figure S4

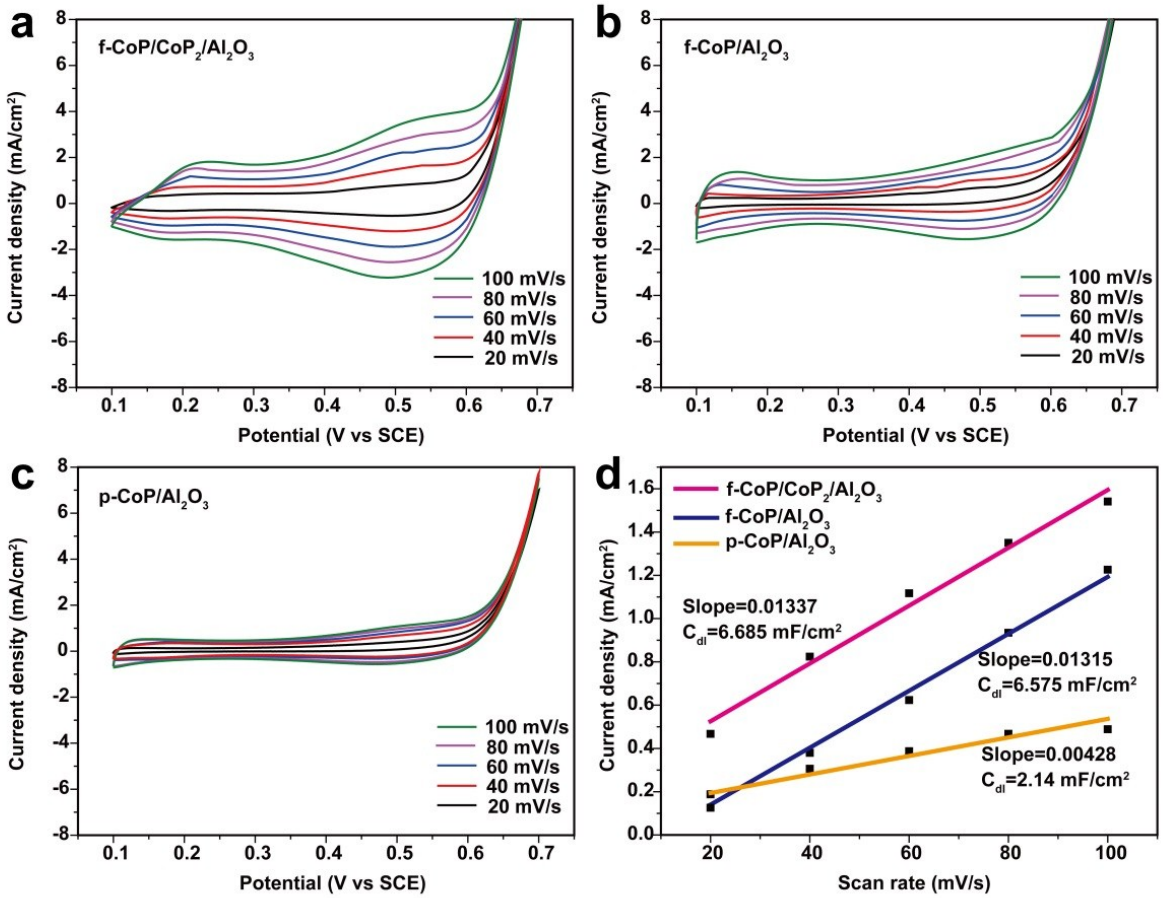


Fig. S4 Cyclic voltammograms (CVs) for (a) f-CoP/CoP_2/Al_2O_3, (b) f-CoP/Al_2O_3, (c) p-CoP/Al_2O_3 measured at different scan rates from 20 to 100 mV/s and (d) corresponding plots of the current density at 0.2 V vs SCE at the scan rate.

Figure S5

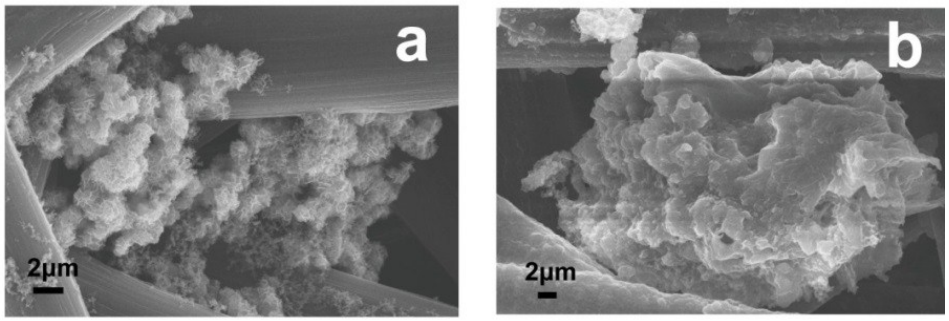


Fig. S5 The SEM images of f-CoP/CoP_2/Al_2O_3 electrode which is adhesion in carbon paper (a) before electrochemical testing, (b) after electrochemical testing for 24h.

Table S1

Comparison of OER performance in alkaline electrolytes for f-CoP/CoP_2/Al_2O_3 composite and some reported high-efficient non-noble metal phosphides based OER electrocatalysts.

Catalyst	Loading mass (mg cm^{-2})	Electrolyte	Over-potential at 10 mA cm^{-2} (mV)	Ref.
NiCoFe-LDHs/CFC	0.4	1.0 M KOH	234	[1]
Co NPs	0.2	1.0 M KOH	390	[2]
$NiCo_2O_4$	0.069	1.0 M KOH	419.3	[3]
Co_3O_4	0.136	1.0 M KOH	410	[4]
NiCo-LDH	0.17	1.0 M KOH	370	[5]
Sandwich-like CoP/C	0.36	1.0 M KOH	330	[6]
CoP film	~	1.0 M KOH	345	[7]
CoP nanorod	0.71	1.0 M KOH	320	[8]
p-CoP/Al_2O_3	0.2	1.0 M KOH	357	This work
f-CoP/Al_2O_3	0.2	1.0 M KOH	320	This work
f-CoP/CoP_2/Al_2O_3	0.2	1.0 M KOH	300	This work

Reference:

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Table S2

Comparison of HER performance in alkaline electrolytes for f-CoP/CoP_2/Al_2O_3 composite and some reported high-efficient non-noble metal phosphides based HER electrocatalysts.

Catalyst	Loading mass (mg cm^{-2})	Electrolyte	Over-potential at 10 mA cm^{-2} (mV)	Ref.
NiCoFe-LDHs/CFC	0.4	1.0 M KOH	200	[1]
CoP/CC	0.92	1.0 M KOH	209	[2]
FeP NAs/CC	1.5	1.0 M KOH	218	[3]
Fe_2P/NGr	1.71	1.0 M KOH	380	[4]
Amorphous MoS_2/FTO	~	1.0 M KOH	540	[5]
Ni wire	0.1	1.0 M NaOH	350	[6]
Ni-Mo alloy/Ti foil	1.0	2.0 M KOH	80	[6]
Co-NRCNTs	0.28	1.0 M KOH	370	[7]
CP@Ni-P		1.0 M KOH	117	[8]
p-CoP/Al_2O_3	0.2	1.0 M KOH	181	This work
f-CoP/Al_2O_3	0.2	1.0 M KOH	170	This work
f-CoP/CoP_2/Al_2O_3	0.2	1.0 M KOH	138	This work

Reference:

[1] A. Wang, H. Xu, G. Li, *ACS Energy Lett.*, 2016, **1**, 445.

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