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Cactus-like NC/Co_xP electrode enables efficient and stable hydrogen evolution for saline water splitting

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Electrochemical Characterization

The corresponding Tafel plots were obtained by fitting the polarization curves between the overpotential and log current densityby the equation:

$$\eta = b\log(j) + a \quad (1)$$

where η is the overpotential, b is the Tafel slope, j is the current density.

Electrochemical active surface area (ECSA) were tested in the non-Faraday region, which could be calculated via the following equation:

$$ECSA = C_{dl}/C_s \quad (2)$$

in which C_s is the specific capacitance for a flat surface and taken as 0.040 mF cm^{-2} in 1 M KOH.

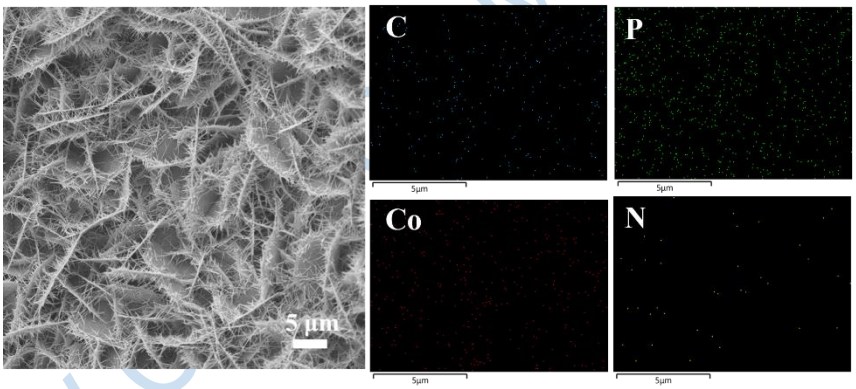

Figure S1. SEM and the corresponding EDS elemental mapping images of the NC@Co_xP@NF-10 catalyst.

Table S1. The element content of the NC@Co_xP@NF-10 sample.

Elements	wt%
C	8.90
N	1.42
P	6.08
Co	83.60

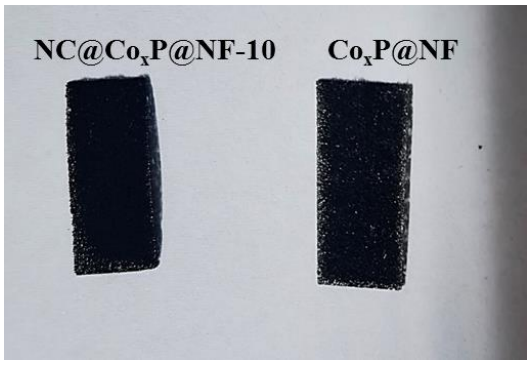

Figure S2. Images of NC@Co_xP@NF-10 and Co_xP@NF after 30 min sonication.

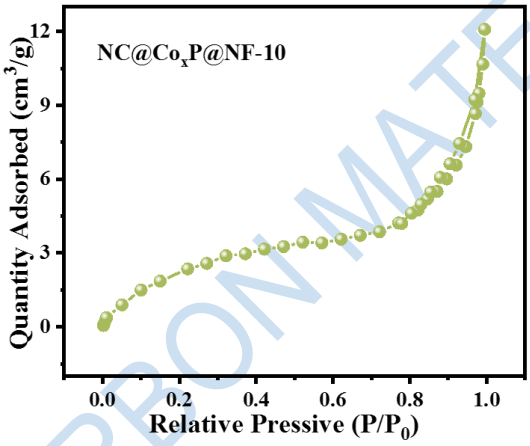

Figure S3. N_2 adsorption/desorption isotherm of NC@Co_xP@NF-10.

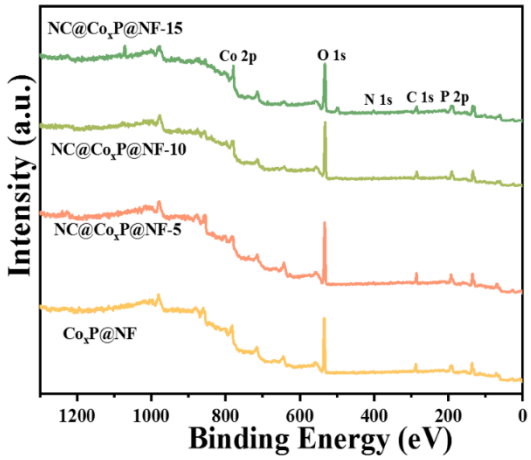

Figure S4. XPS survey spectra of Co_xP@NF, NC@Co_xP@NF-5, NC@Co_xP@NF-10 and NC@Co_xP@NF-15 catalysts.

Table S2. Comparison of HER performance of NC@Co_xP@NF-10 with other reported electrocatalysts at room temperature.

Catalysts	Overpotential@10 mA cm^{-2}	Electrolyte	References
NC@Co_xP@NF-10	107	1 M KOH	This work
	133	1 M KOH +0.5 M NaCl	
0.5CDs-NiCoP/NF	115	1 M KOH	[1]
$IrCo_3O_4$@NC	188	1 M KOH	[2]
$Co(OH)_2/Fe_7Se_8$	183	1 M KOH	[3]
CoNC-SA/N*-C	194	1 M KOH	[4]
V_2CT_x	134	1 M KOH	[5]
SnS_2/SnO_2	108	1 M KOH	[6]
MnFeCrLDH	154	1 M KOH	[7]
Ni_2P-Fe_2P/NF	128	1 M KOH	[8]
	155	1 M KOH +0.5 M NaCl	
CdFe-BDC	148	1 M KOH	[9]
Ni-Co@Fe-Co PBA	183	1.0 M KOH + 0.5 M NaCl	[10]
NiFeP/SG	115	1 M KOH	[11]
NiFe(dobpdc)	113	1 M KOH	[12]
2S-$MnCo_2O_4$/NC	180	1 M KOH	[13]
CoP_x@FeOOH/NF	117	1 M KOH	[14]
CoP/CoS_2/CC	111.2	1 M KOH	[15]
P-Fe_2O_3-CoP	126	1 M KOH	[16]
	152	1 M KOH+0.5 M NaCl	

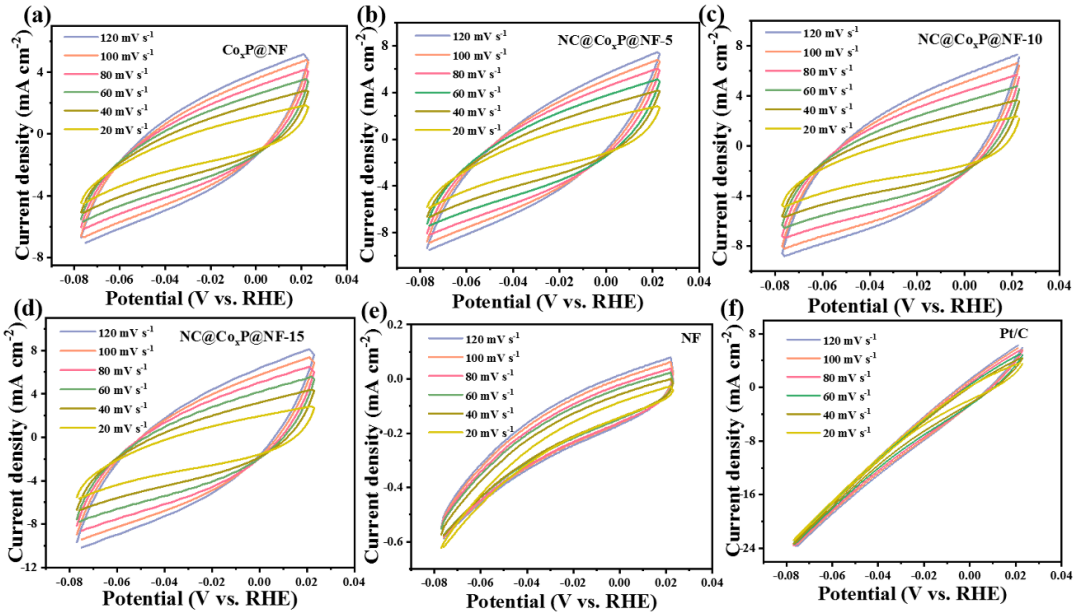

Figure S5. CV curves at different scan rate for (a) Co_xP@NF, (b) NC@Co_xP@NF-5, (c) NC@Co_xP@NF-10, (d) NC@Co_xP@NF-15, (e) NF and (f) Pt/C in 1 M KOH.

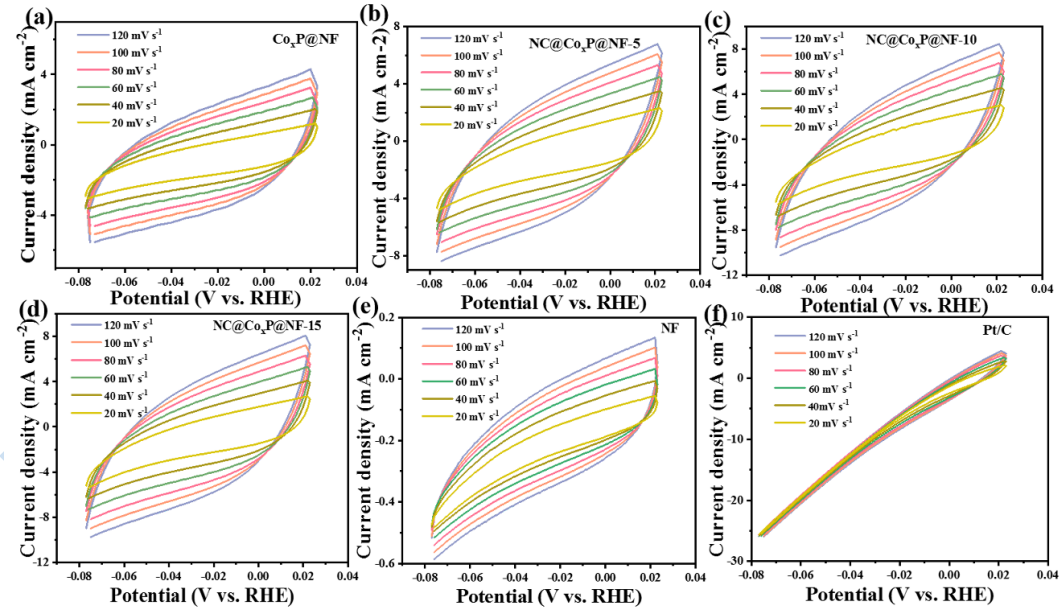

Figure S6. CV curves at different scan rate for (a) Co_xP@NF, (b) NC@Co_xP@NF-5, (c) NC@Co_xP@NF-10, (d) NC@Co_xP@NF-15, (e) NF and (f) Pt/C in 1 M KOH + 0.5 M NaCl.

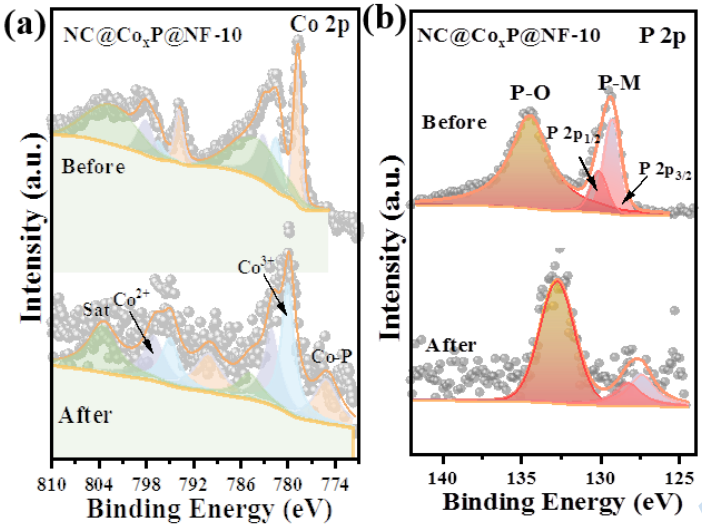

Figure S7. (a) Co 2p and (b) P 2p XPS spectra comparison of NC@Co_xP@NF-10 before and after HER test.

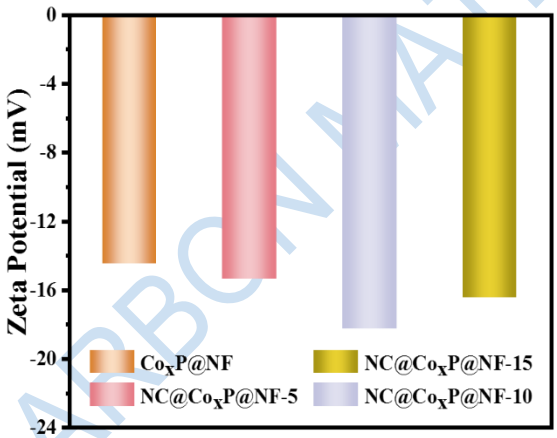

Figure S8. Zeta potential of all catalysts.

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