Supplementary Information

Co_2P nanowire arrays anchored on 3D porous reduced graphene oxide matrix embedded in nickel foam for high-efficiency hydrogen evolution reaction

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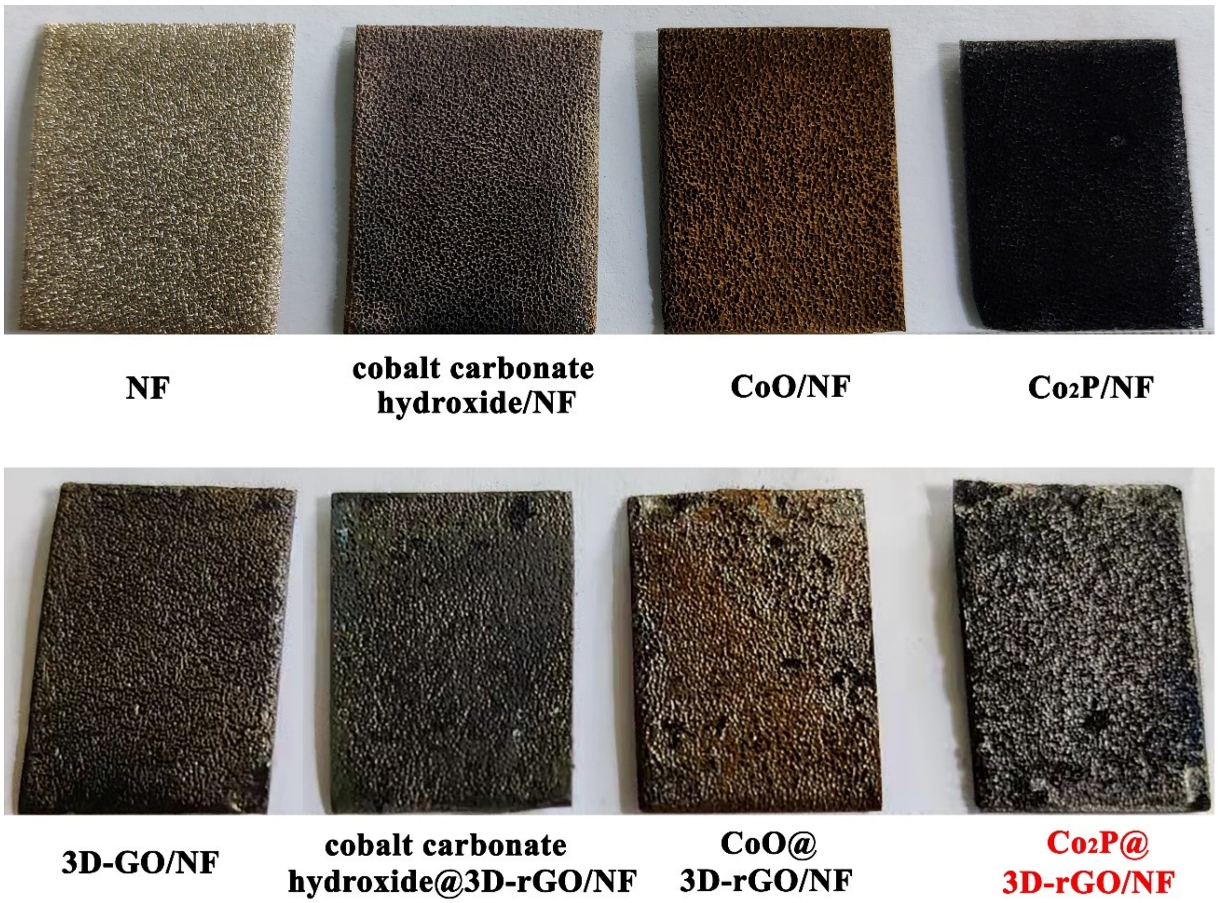

Fig. S1. Digital photographs of the samples during the preparation of Co_2P/NF and Co_2P@3D-rGO/NF.

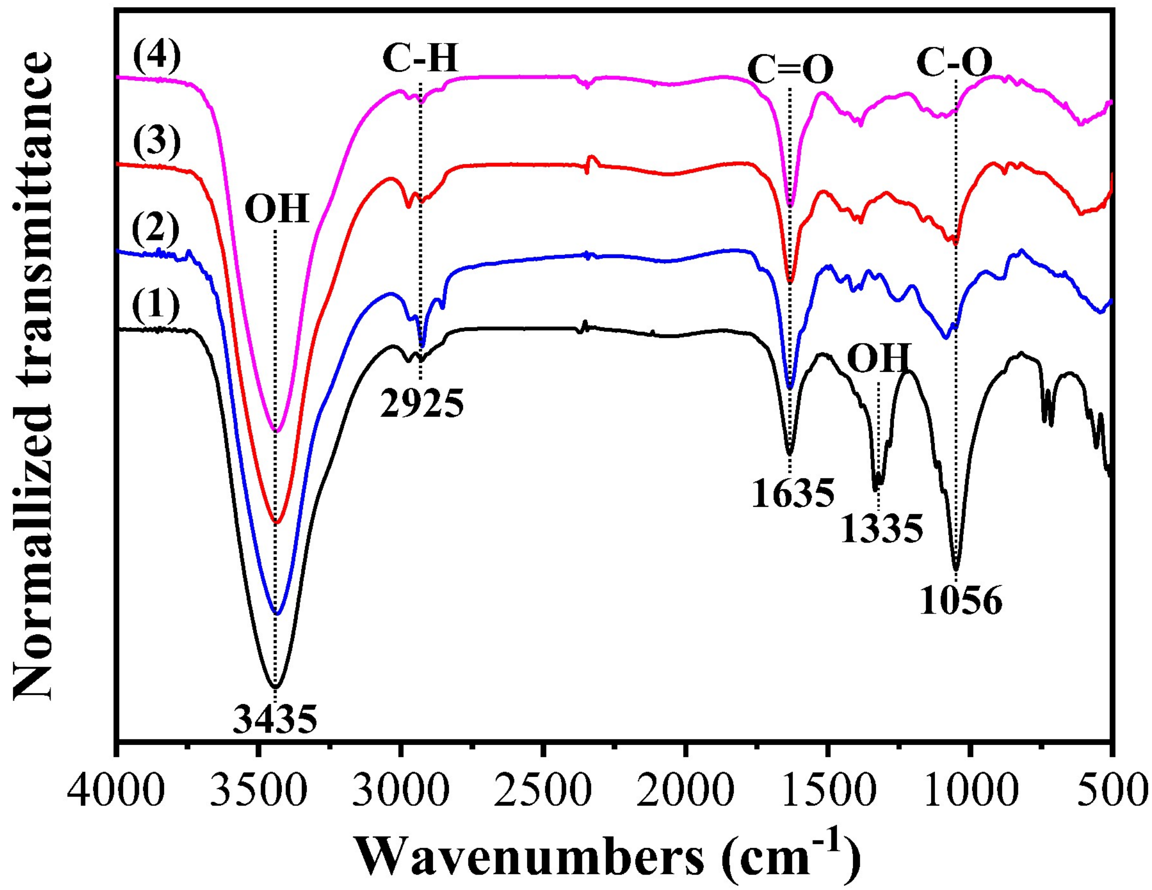

Fig. S2. FT-IR spectra of the samples: (1) 3D-GO obtained from 3D-GO/NF, (2) rGO powder prepared by the reduction of GO in HI acid, (3) Co_2P powder obtained from Co_2P/NF, and (4) Co_2P@3D-rGO powder obtained from Co_2P@3D-rGO/NF.

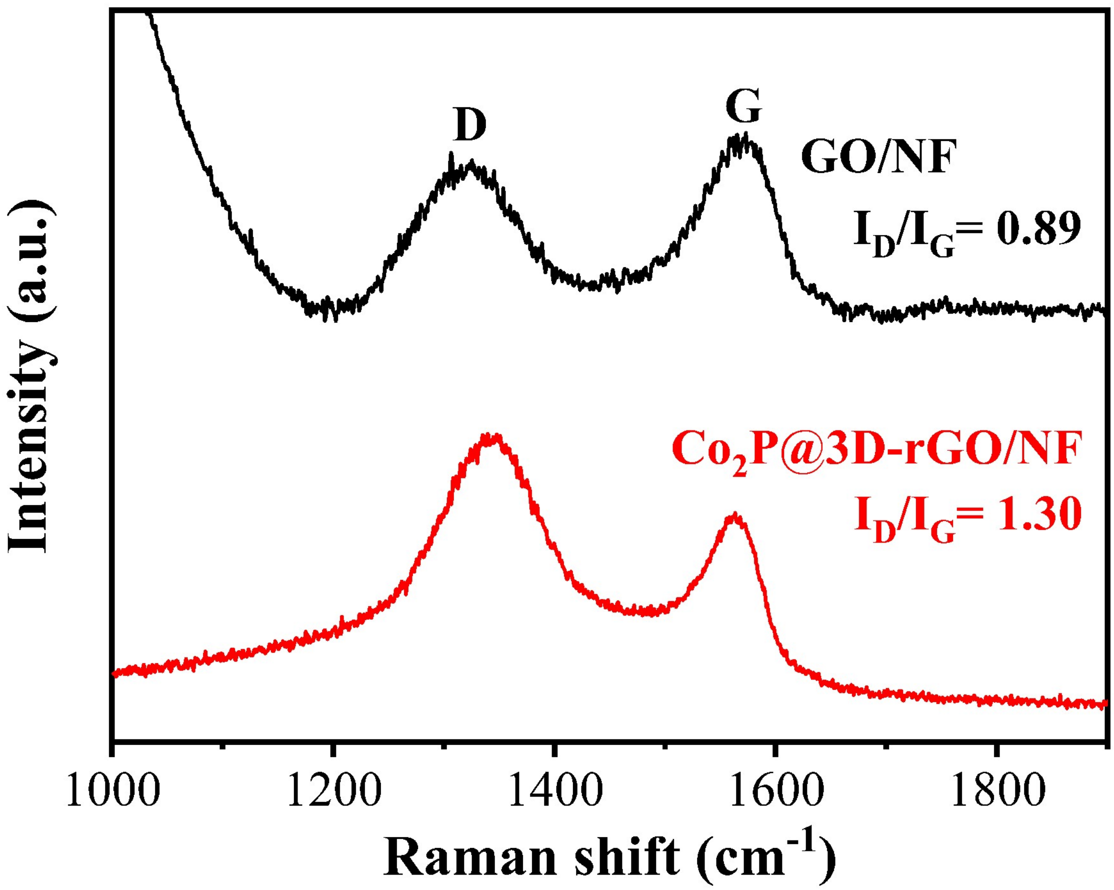

Fig. S3. Raman spectra of GO/NF and Co_2P@3D-rGO/NF.

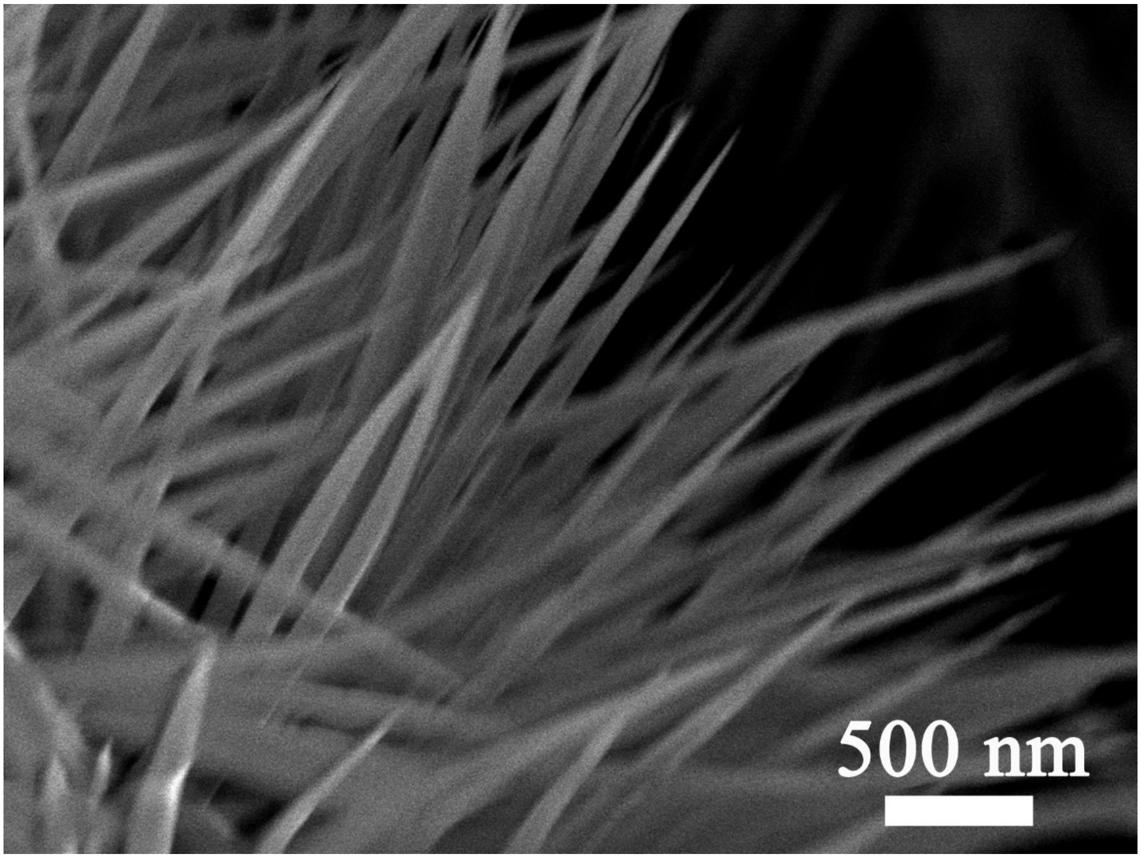

Fig. S4. FESEM image of $Co(CO_3)_{0.5}(OH)_{0.11}\cdot H_2O$@3D-GO/NF.

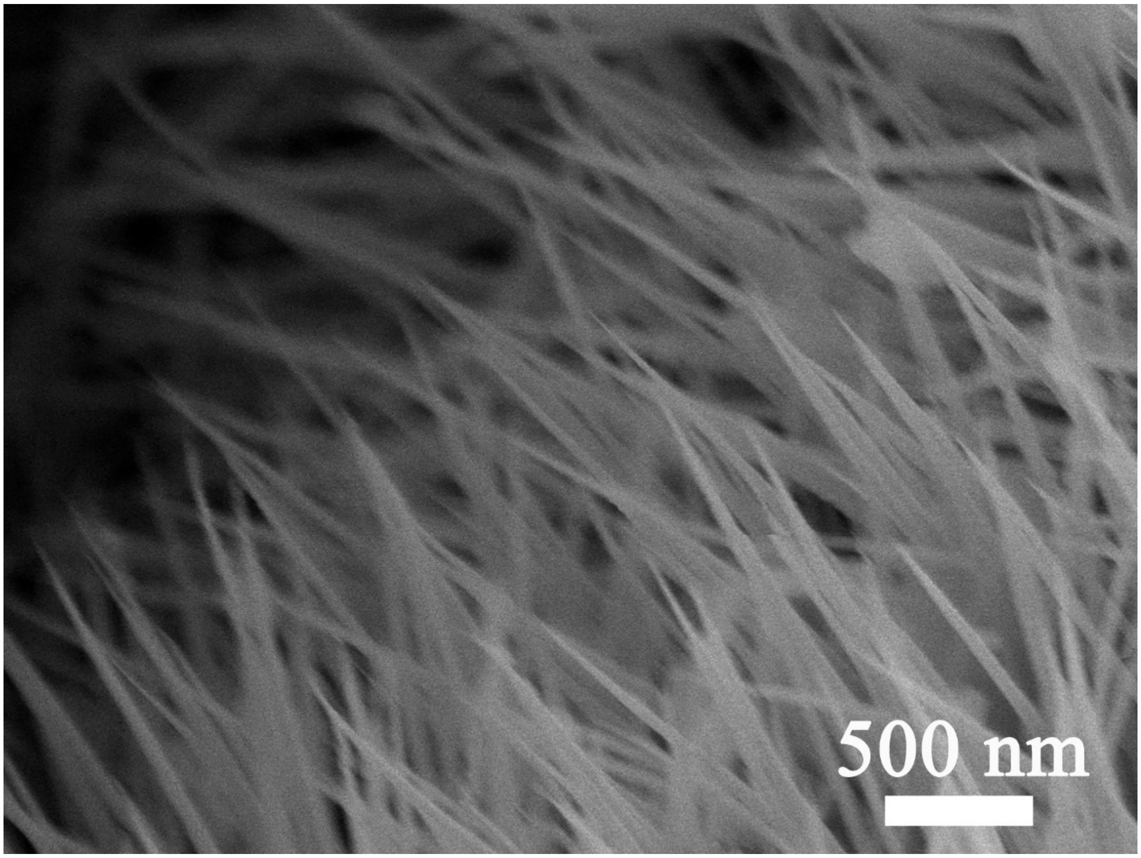

Fig. S5. FESEM image of CoO@3D-GO/NF.

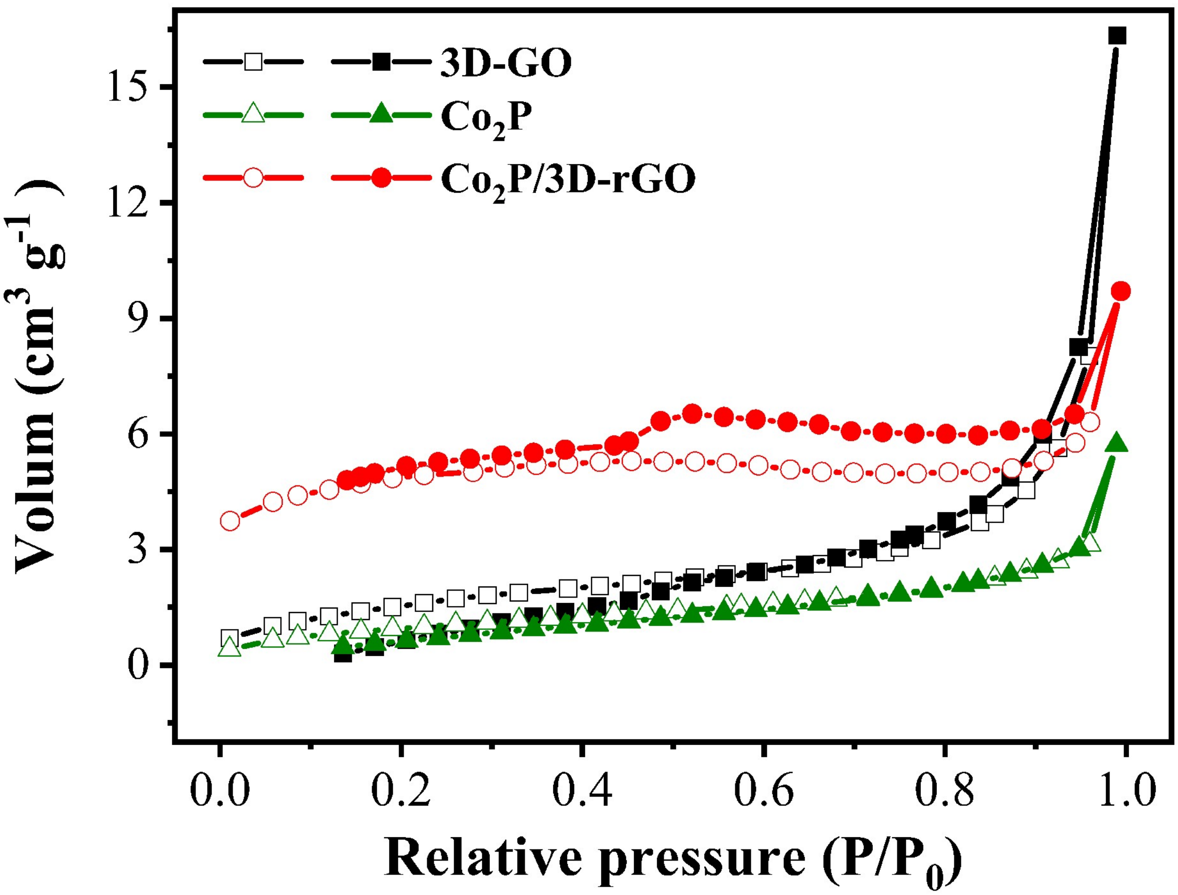

Fig. S6. N_2 adsorption-desorption isotherms of 3D-GO, Co_2P, and Co_2P@3D-rGO powders scraped from 3D-GO/NF, Co_2P/NF and Co_2P@3D-rGO/NF, respectively.

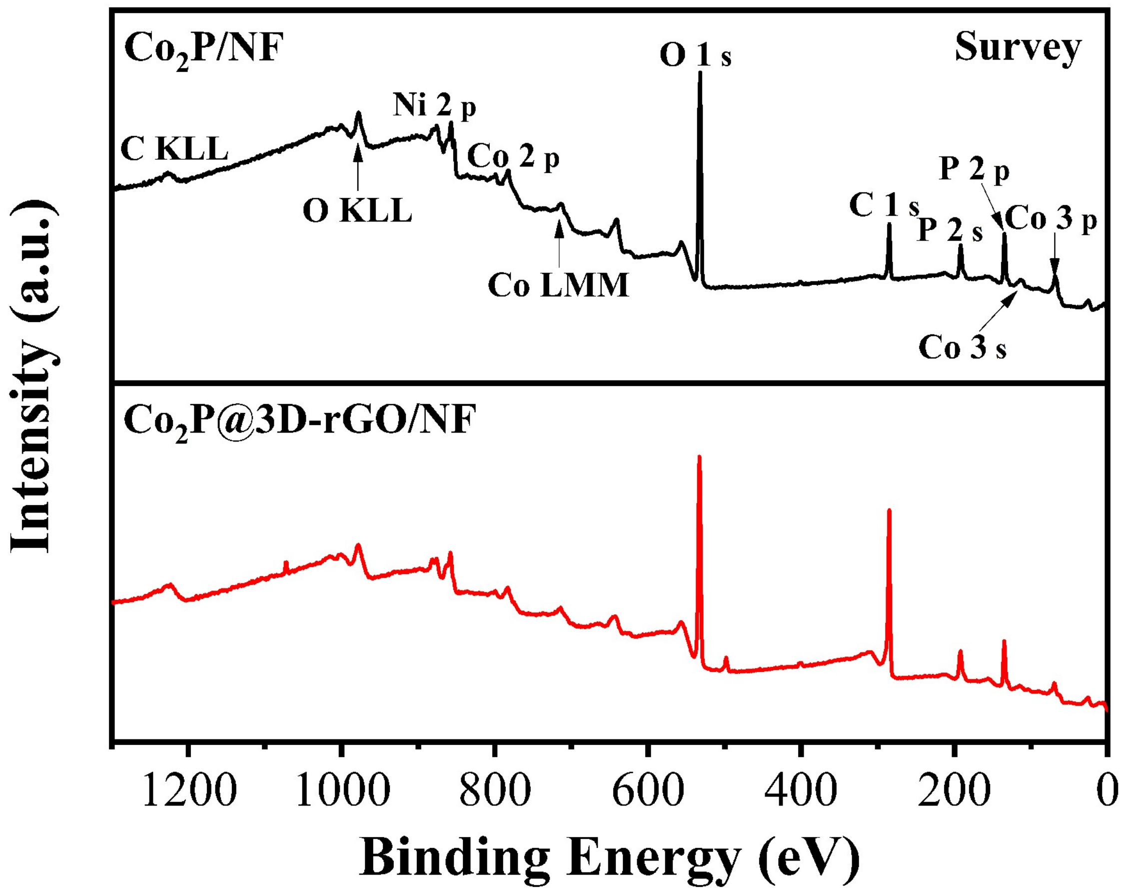

Fig. S7. XPS full survey spectra of Co_2P/NF and Co_2P@3D-rGO/NF.

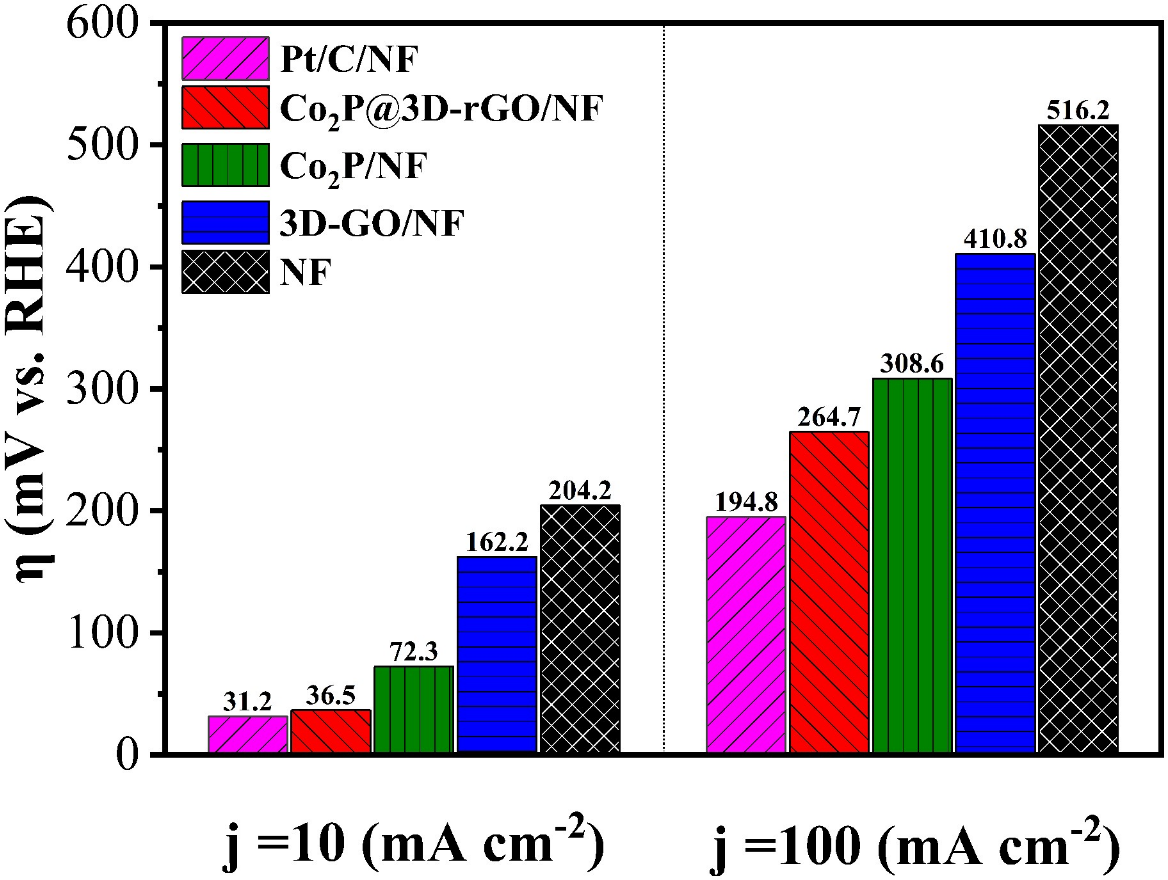

Fig. S8. HER overpotentials of the electrodes.

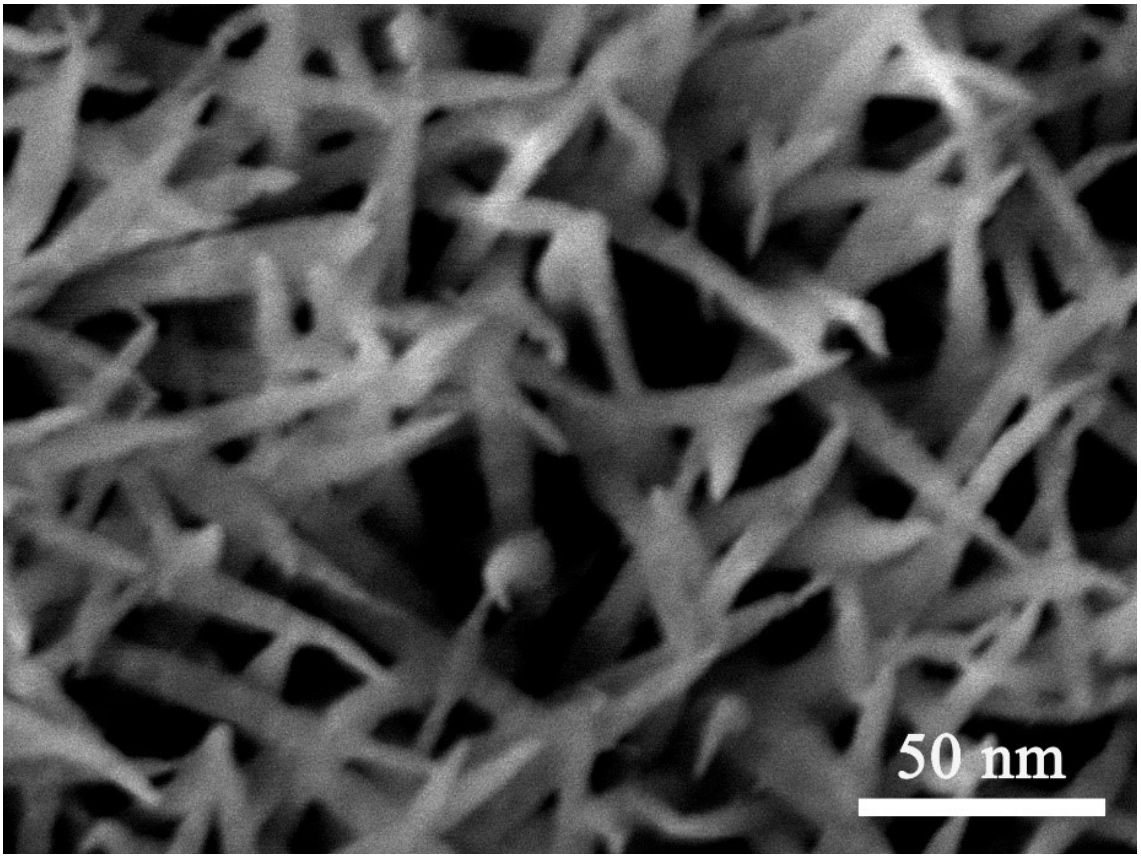

Fig. S9. FESEM image of Co_2P@3D-rGO/NF after the LSV test.

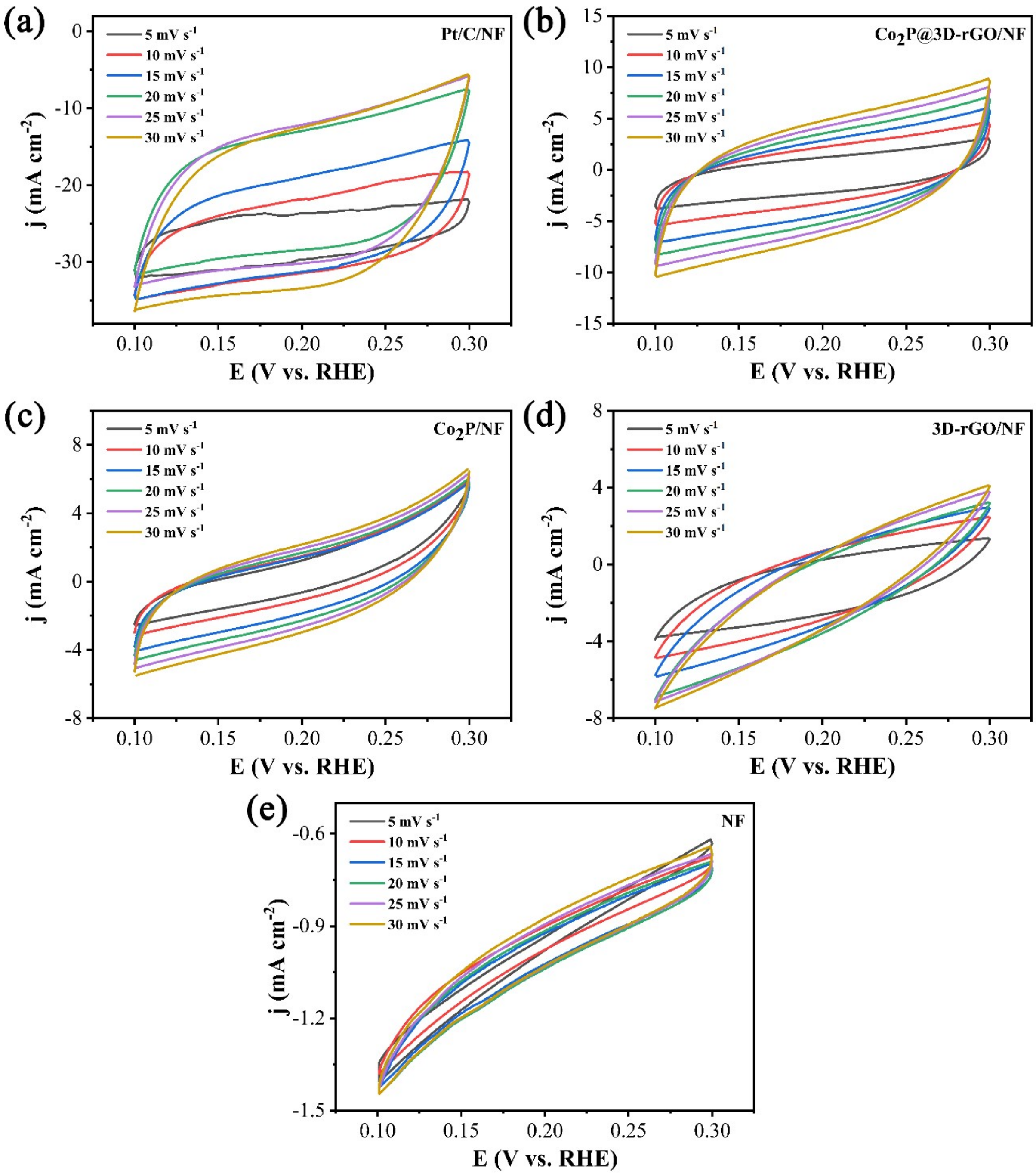

Fig. S10. Cyclic voltammetry curves of the electrodes: (a) Pt/C/NF, (b) Co_2P@3D-rGO/NF, (c) Co_2P/NF, (d) 3D-GO/NF, and (e) NF in a potential window (0.10 - 0.30 V vs. RHE) at various scan rates in 1.0 M KOH solution.

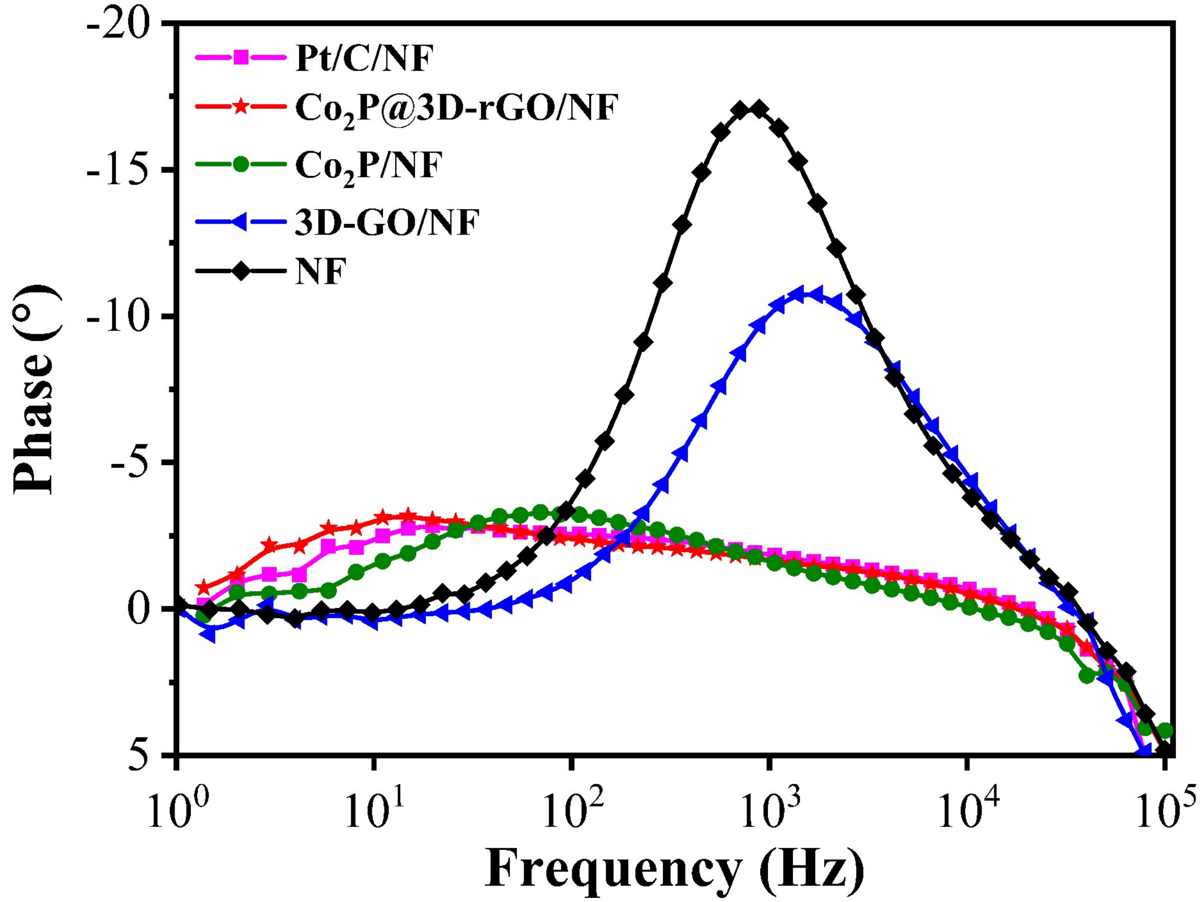

Fig. S11. Bode-phase plots of the electrodes.

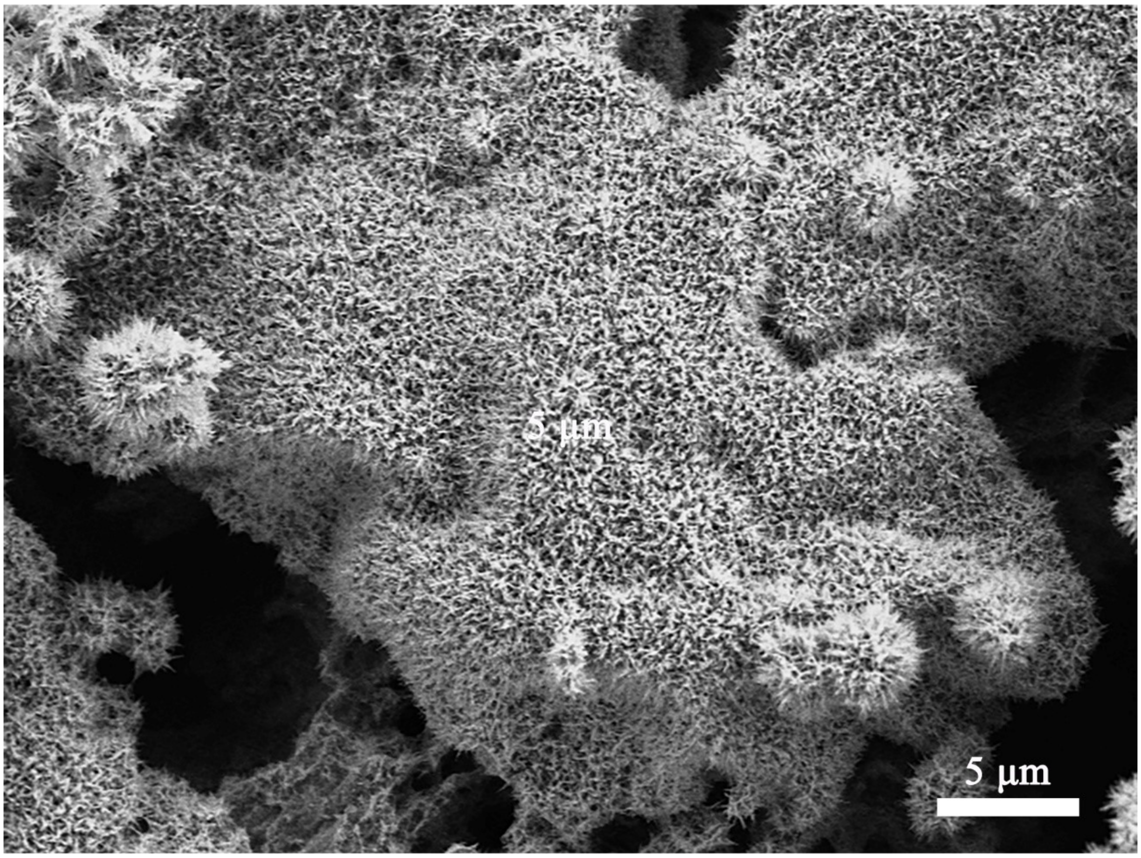

Fig. S12. FESEM image of Co_2P@3D-rGO/NF after 2000 CV sweeps.

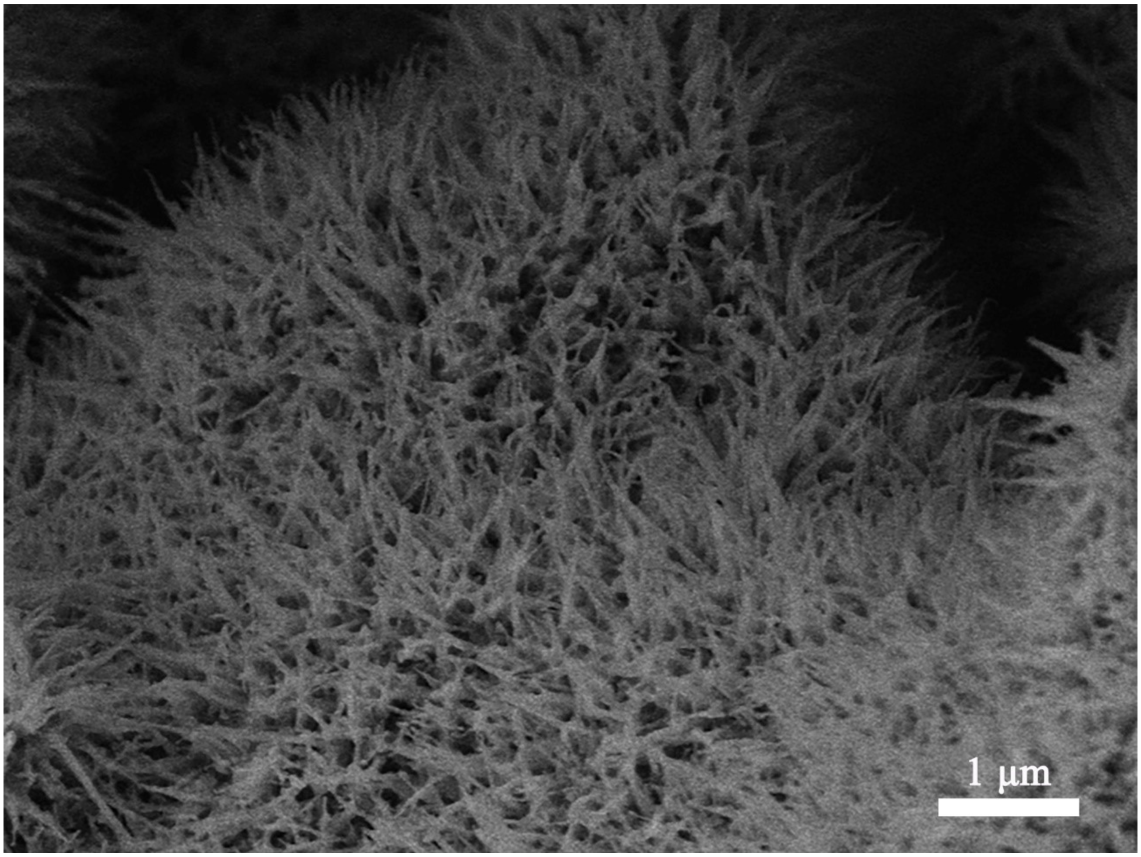

Fig. S13. FESEM image of Co_2P@3D-rGO/NF after 20 h of chronoamperometry test.

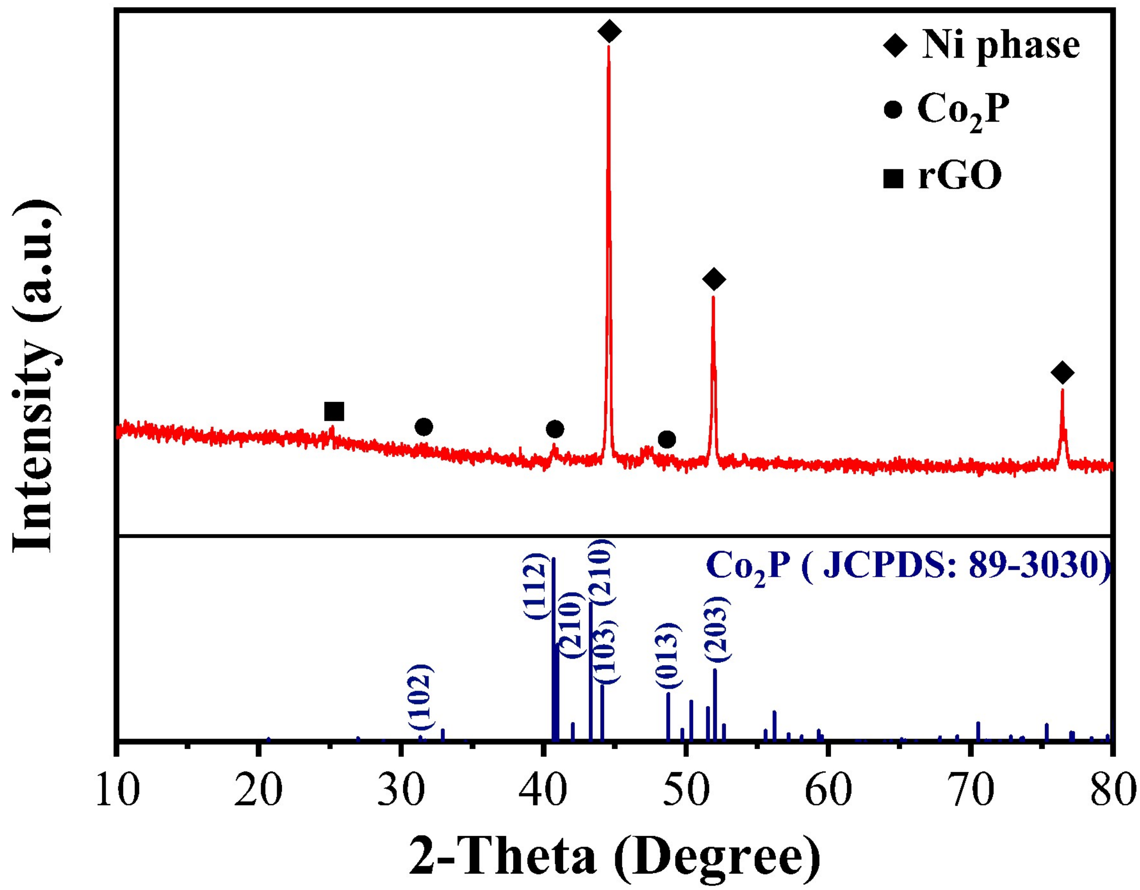

Fig. S14. XRD pattern of Co_2P@3D-rGO/NF after 20 h of chronoamperometry test.

Table S1 The pore properties of 3D-GO, Co_2P, and Co_2P@3D-rGO powders scraped from 3D-GO/NF, Co_2P/NF, and Co_2P@3D-rGO/NF, respectively.

Pore properties	3D-GO	Co_2P	Co_2P@3D-rGO
BET surface area (m^2 g^{-1})	15.7	3.6	6.0
BJH Adsorption Pore volume (cm^3 g^{-1})	0.0096	0.0088	0.0255
BJH Desorption Pore volume (cm^3 g^{-1})	0.0097	0.0087	0.0247
BJH Adsorption pore size (nm)	7.5	10.2	16.8
BJH Desorption pore size (nm)	6.2	10.6	15.9

Table S2 HER activities of nanocomposite electrocatalysts associated with Co_2P.

Electrocatalysts	Electrolyte	η(mV)@j ($mA \cdot cm^{-2}$)	Tafel Slope ($mV \cdot dec^{-1}$)	Reference
CoP/Co_9S_8-Cu	1 M KOH	118@10	66.75	Ref [1]
CoP@FeCoP/NC YSMPs	1 M KOH	141@10	56.34	Ref [2]
Co_2P/$CoWO_4$/NF	1 M KOH	81@10	79	Ref [3]
Co_2P/NPSC-800	1 M KOH	173@10	106.52	Ref [4]
Co_2P NRs	1 M KOH	151@10	--	Ref [5]
Co_2P/NPSC-800	1 M KOH	173@20	106.52	Ref [6]
Co/CoN/Co_2P-NPC	1 M KOH	99@10	51	Ref [7]
CoP/Co_2P hybrids	1 M KOH	103@10	61.2	Ref [8]
Co_2P NPs	1 M KOH	131@10	36	Ref [9]
Co_2P/CoP branched	1 M KOH	87@10	76.8	Ref [10]
Co_2P/CNTs	1 M KOH	132@10	103	Ref [11]
Fe-Co_2P BNRs	1 M KOH	156@10	90	Ref [12]
Co_2P@3D-rGO/NF	**1 M KOH**	**36.5@10**	**55.5**	**This work**

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