Supporting Information

Toward High-performance and Low-cost Hydrogen Evolution Reaction Electrocatalysts: Nanostructuring Cobalt Phosphide (CoP) Particles on Carbon Fiber Paper

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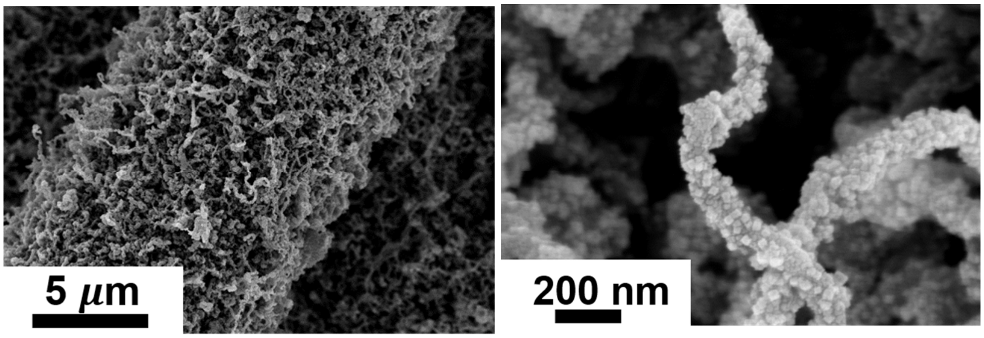

Figure S1. The conditions of growing crystalline Co_3O_4 nanocubes with size 30-60 nm are the same as growing Co_3O_4/CFP (150-200 nm) except with a shorter hydrothermal time (4 hrs).

Figure S2: The photo shows a HER electrode (1.5 cm x 6 cm) with CoP loaded on carbon fiber paper, suggesting large-scale fabrication is possible.

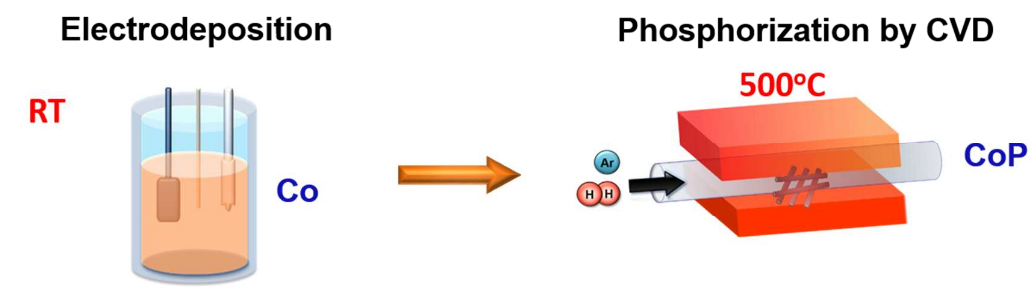

Figure S3. The schematic diagram of fabricating CoP by using electrodeposition followed by CVD phosphorization.

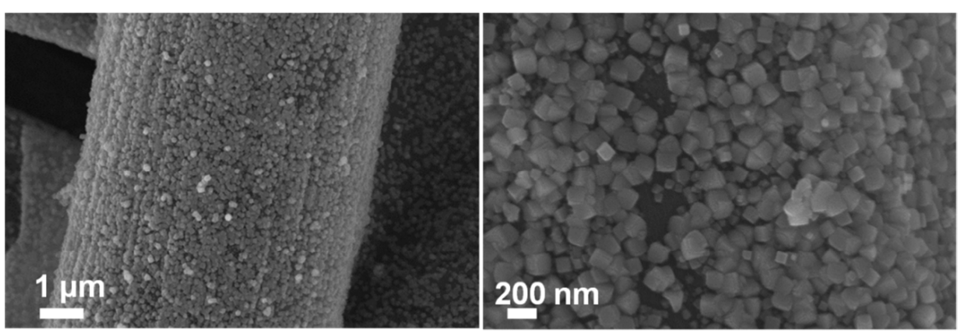

Figure S4: As-synthesized cobalt oxide (Co_3O_4) by a hydrothermal method. The size of cubic Co_3O_4 particles is between 150 nm to 200 nm.

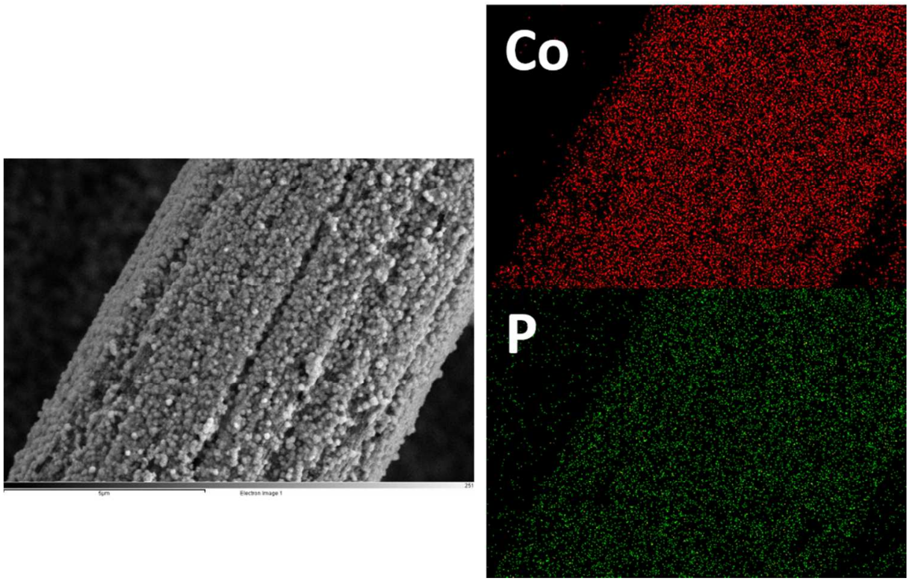

Figure S5: EDX element mapping of CoP/CFP-H. It was found that cobalt and phosphorus are evenly distributed.

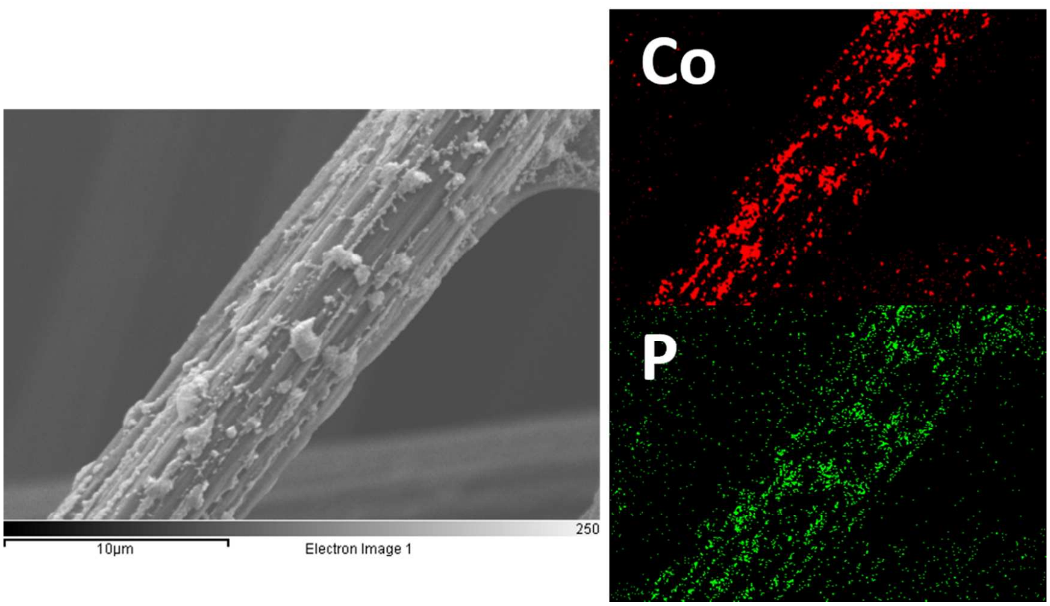

Figure S6: EDX element mapping of CoP/CFP-E. It was found that cobalt and phosphorus elements are evenly distributed.

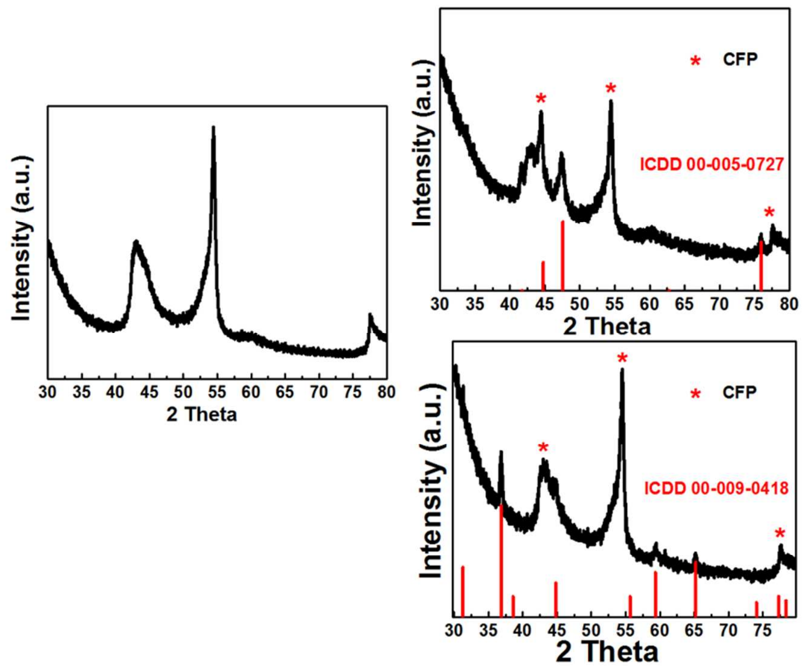

Figure S7: XRD of carbon fiber paper, Co_3O_4/CFP prepared through hydrothermal, and Co/CFP prepared through electrodeposition.

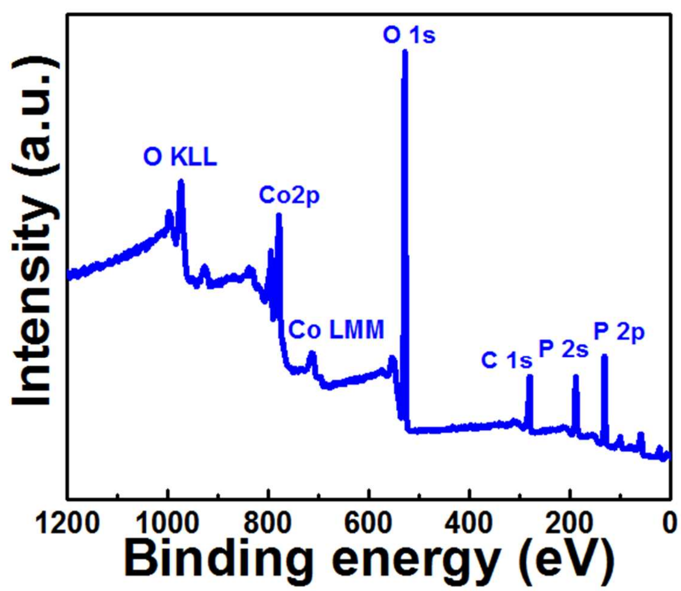

Figure S8: Survey scan of CoP/CFP-H shows the presence of Co, P, C and O elements.

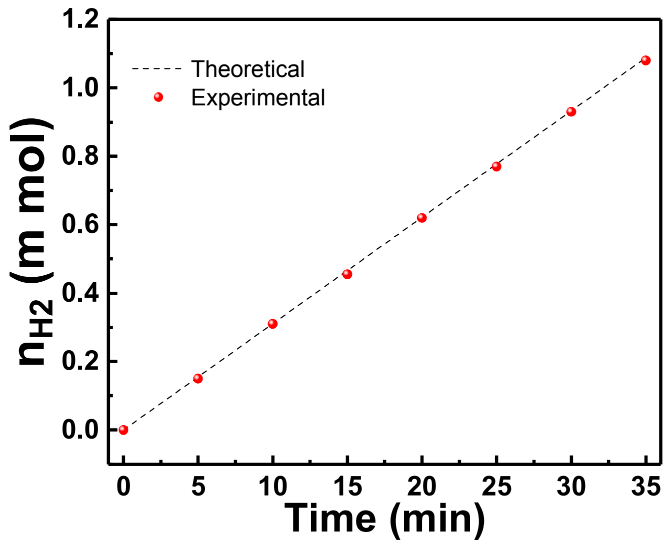

Figure S9: The Faradaic efficiency of CoP/CFP-H at cathode current density of – 100 mA cm^{-2}.

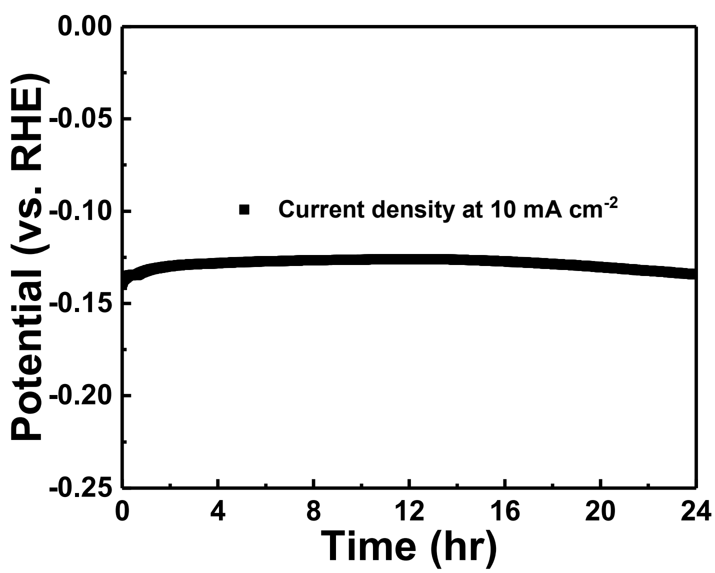

Figure S10: The durability test of CoP/CFP-H in chronopotentiometry mode for 24 hours.

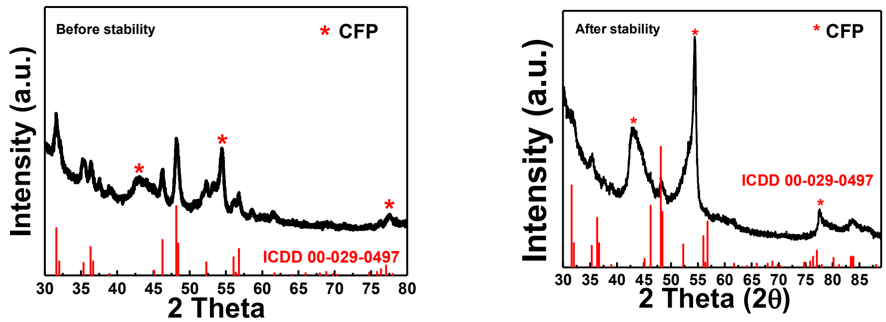

Figure S11. The typical XRD of CoP/CFP-H after and stability test for 24 hrs.

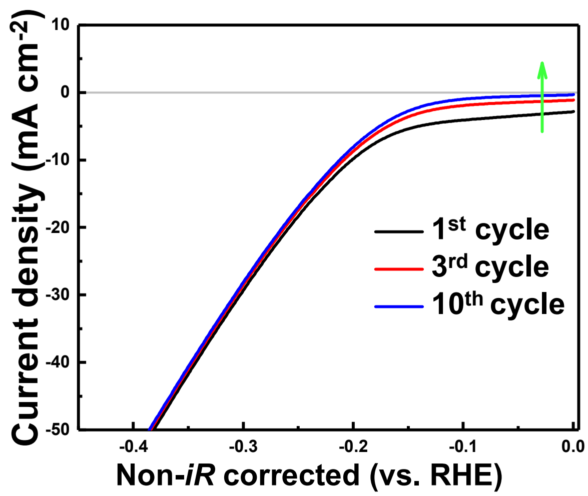

Figure S12: LSV of CoP/CFP-H after adding 10 mM NaSCN.

Electrocatalysts	Overpotential (mV)			Tafel slope (mV dec^{-1})	Synthesis method	Ref.
	η_{10}	η_{20}	η_{100}	*b*		
CoP/CFP-H (0.3 mg cm^{-2})	128	144	191	49.7	Hydrothermal (IPA) followed by CVD phosphorization	This work
Metallic MoS2 nanosheets (Loading is not given)	187	-	-	43	Chemically exfoliation via lithium intercalation	(1)
MoO_3-MoS_2/FTO (Loading is not given)	310	-	-	50-60	Hot-wire CVD	(2)
$CoSe_2$/CFP (Loading is not given)	131	150	181	40	Drop casting (DMF) followed by CVD selenization	(3)
FeP/Graphene (0.28 mg cm^{-2})	123	-	-	50	Solvothermal (DMF) followed by CVD phosphorization	(4)
CoP on RGO (0.29 mg cm^{-2})	> 200	-	-	104 ~ 149 (5 samples)	Hydrothermal (NH3) followed by CVD phosphorization	(5)
In situ CoP-CNTs coupling (Not given)	139	-	-	52	Self-assembly of Co_3O_4 assisted by MIN solvent & ZIF 67 followed by CVD phosphorization	(6)
CoP nanocrystal on CNT (0.285 mg cm^{-2})	122	-	-	54	Hydrothermal (NH4OH) followed by CVD phosphorization	(7)
Co_2P/Ti (1.0 mg cm^{-2})	95	109	-	45	Reflux condenser (1-octadecene, oleylamine, and nonanoic acid)	(8)
Self-supported CoP nanowire (0.92 mg cm^{-2})	67	100	204	51	Hydrothermal (NH4F, urea) followed by CVD phosphorization	(9)

Table S1: This table lists out the performances of some non-noble catalysts and their synthesis methods.

References

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