

Electronic Supplementary Information

Electrodeposited Amorphous Co-P-B Ternary Catalyst for Hydrogen Evolution

Reaction

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Table S1. The concentration of the electrolyte for the Co-P-B catalysts electrodeposition in this experiment and its corresponding atomic ratio

Catalyst	Electrolyte concentration (mM)				Atomic ratio ^a (%)		
	CoCl ₂ ·6H ₂ O	NaH ₂ PO ₂ ·H ₂ O	H ₃ BO ₃	NaCl	Co	P	B
Co ₇₇ P ₂₃ /CP		500	0		77.08	22.92	0.00
Co ₅₇ P ₂₇ B ₁₆ /CP		400	100		56.85	26.93	16.22
Co ₅₃ P ₂₇ B ₂₀ /CP		300	200		53.41	27.15	19.44
Co ₅₉ P ₂₀ B ₂₁ /CP	1	250	250	100	59.35	19.68	20.97
Co ₄₁ P ₂₁ B ₃₈ /CP		200	300		40.56	21.25	38.19
Co ₃₄ P ₂₀ B ₄₆ /CP		100	400		33.65	19.60	46.75
Co ₈₉ B ₁₁ /CP		0	500		88.62	0.00	11.38

a: Atomic ratio of each Co-P-B catalyst was measured using XPS analysis.

Table S2. Electrochemical properties of Co-P-B catalyst with different atomic composition

Catalyst	Overpotential at -10 mA cm^{-2} (mV)	Tafel slope (mV dec^{-1})	Exchange current density (mA cm^{-2})	Double layer capacitance ($\mu\text{F cm}^{-2}$)
$\text{Co}_{77}\text{P}_{23}/\text{CP}$	381	140	0.017	54.77
$\text{Co}_{57}\text{P}_{27}\text{B}_{16}/\text{CP}$	201	67	0.006	156.48
$\text{Co}_{53}\text{P}_{27}\text{B}_{20}/\text{CP}$	184	62	0.015	230.69
$\text{Co}_{59}\text{P}_{20}\text{B}_{21}/\text{CP}$	172	68	0.031	210.67
$\text{Co}_{41}\text{P}_{21}\text{B}_{38}/\text{CP}$	177	66	0.022	250.72
$\text{Co}_{34}\text{P}_{20}\text{B}_{46}/\text{CP}$	183	65	0.016	271.33
$\text{Co}_{89}\text{B}_{11}/\text{CP}$	438	157	0.016	30.27

Table S3. Comparison of electrochemical properties of $\text{CoP}_{0.33}\text{B}_{0.35}/\text{CP}$ in 0.5 M H_2SO_4 with other HER electrocatalysts

	Catalyst	Co-P Ratio	Overpotential @ -10 mA cm^{-2} (mV)	Double layer capacitance ($\mu\text{F cm}^{-2}$)	Current density @ -0.15 V_{RHE} (mA cm^{-2})	Scaled current @ -0.15 V_{RHE} (mA mF^{-1})
1	$\text{Co}_2\text{P@NPG}^{[64]}$	$\text{Co}_{66.6}\text{P}_{33.3}$	103	66,800	27.3	0.408
2	$\text{Co}_2\text{P/NCNTs}^{[47]}$	$\text{Co}_{66.6}\text{P}_{33.3}$	150	5,700	10.1	1.771
3	$\text{CoP-OMC}^{[32]}$	$\text{Co}_{50}\text{P}_{50}$	112	22,720	29.8	1.311
4	$\text{CoP/CC}^{[41]}$	$\text{Co}_{50}\text{P}_{50}$	49	172,500	346	2.006
5	$\text{H-CoP/C}^{[65]}$	$\text{Co}_{50}\text{P}_{50}$	111	26500	95	3.584
6	$\text{u-CoP/Ti}^{[66]}$	$\text{Co}_{50}\text{P}_{50}$	45	86,000	341	3.965
7	$\text{CoP/NCNTs}^{[47]}$	$\text{Co}_{50}\text{P}_{50}$	79	16700	79	4.730
8	$\text{CoP UPNSs}^{[67]}$	$\text{Co}_{50}\text{P}_{50}$	56	7,870	157	19.949
9	$\text{CoP}_3\text{ NWs/CFP}^{[66]}$	$\text{Co}_{25}\text{P}_{75}$	65	93,400	131	1.402
10	$\text{PCPTF}^{[68]}$	Co_xP_y	153	3,800	9.8	2.579
This work	$\text{Co}_{59}\text{P}_{20}\text{B}_{21}/\text{CP}$	$\text{Co}_{59}\text{P}_{20}\text{B}_{21}$	172	210.67	4.849	23.017

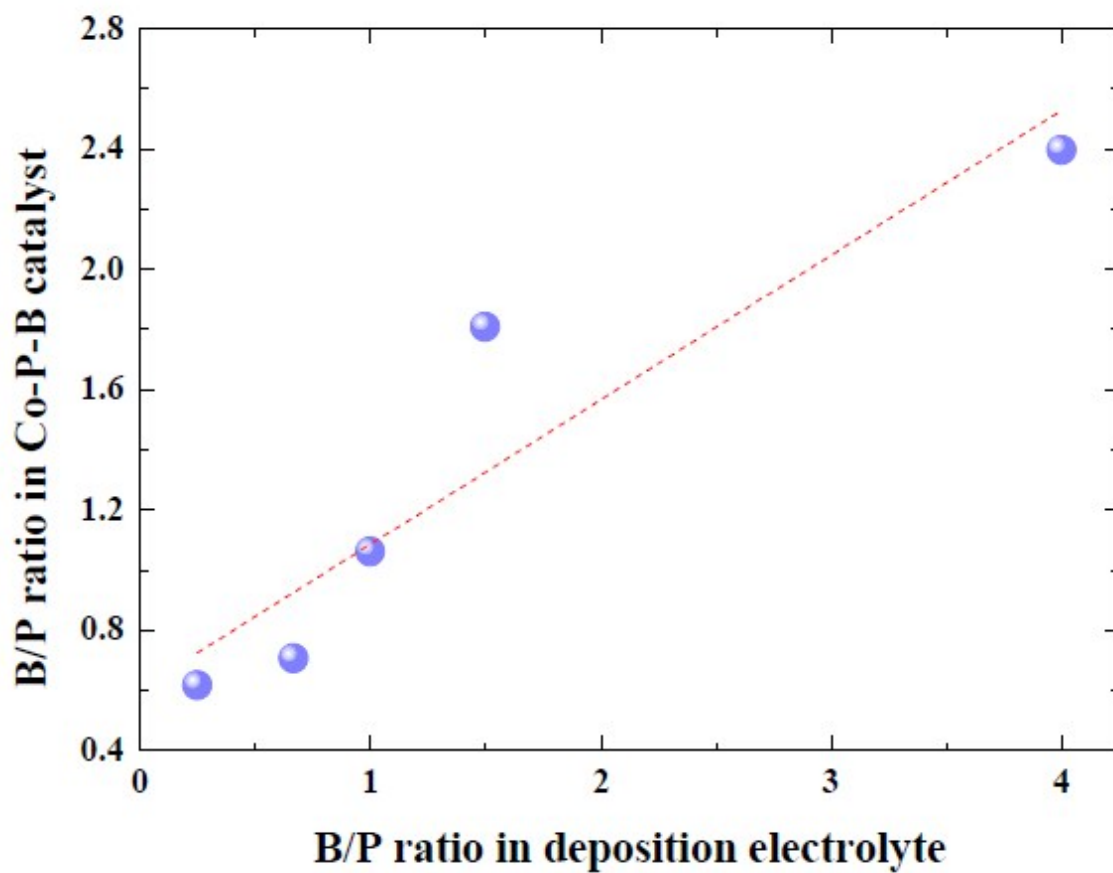


Fig. S1. Linear relationship between B/P ratio in electrolyte and B/P ratio in Co-P-B catalyst.

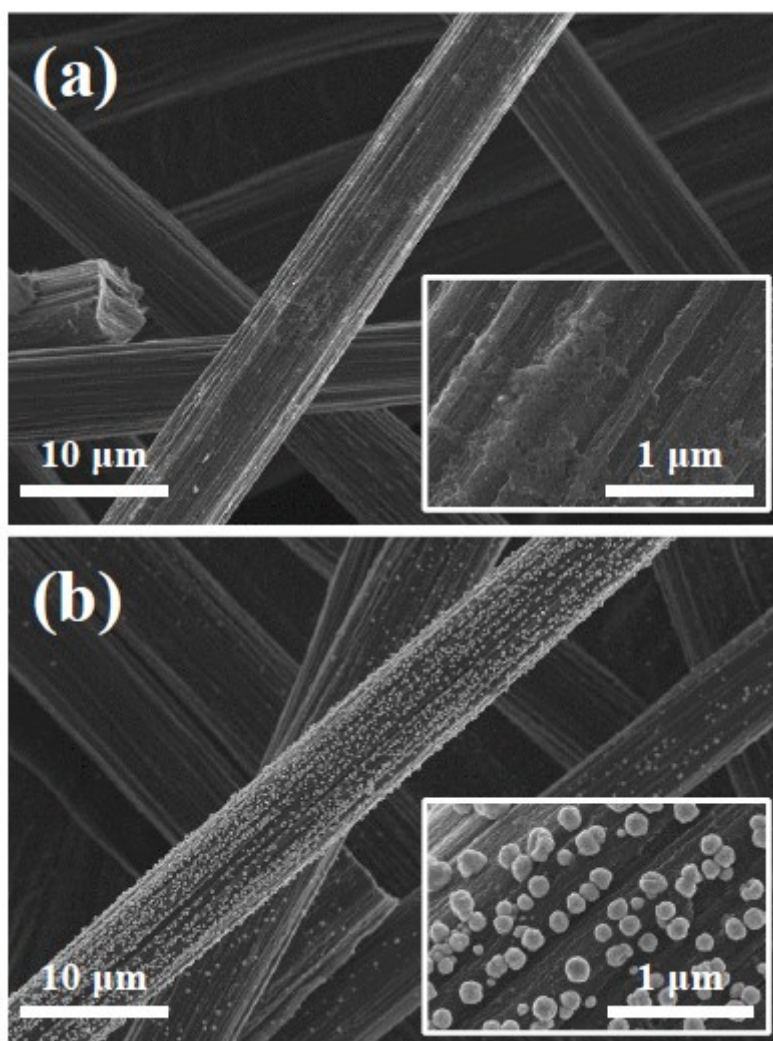


Fig. S2. Low- and (inset) high-magnification FESEM images of (a) Co₇₇P₂₃/CP and (b) Co₈₉B₁₁/CP.

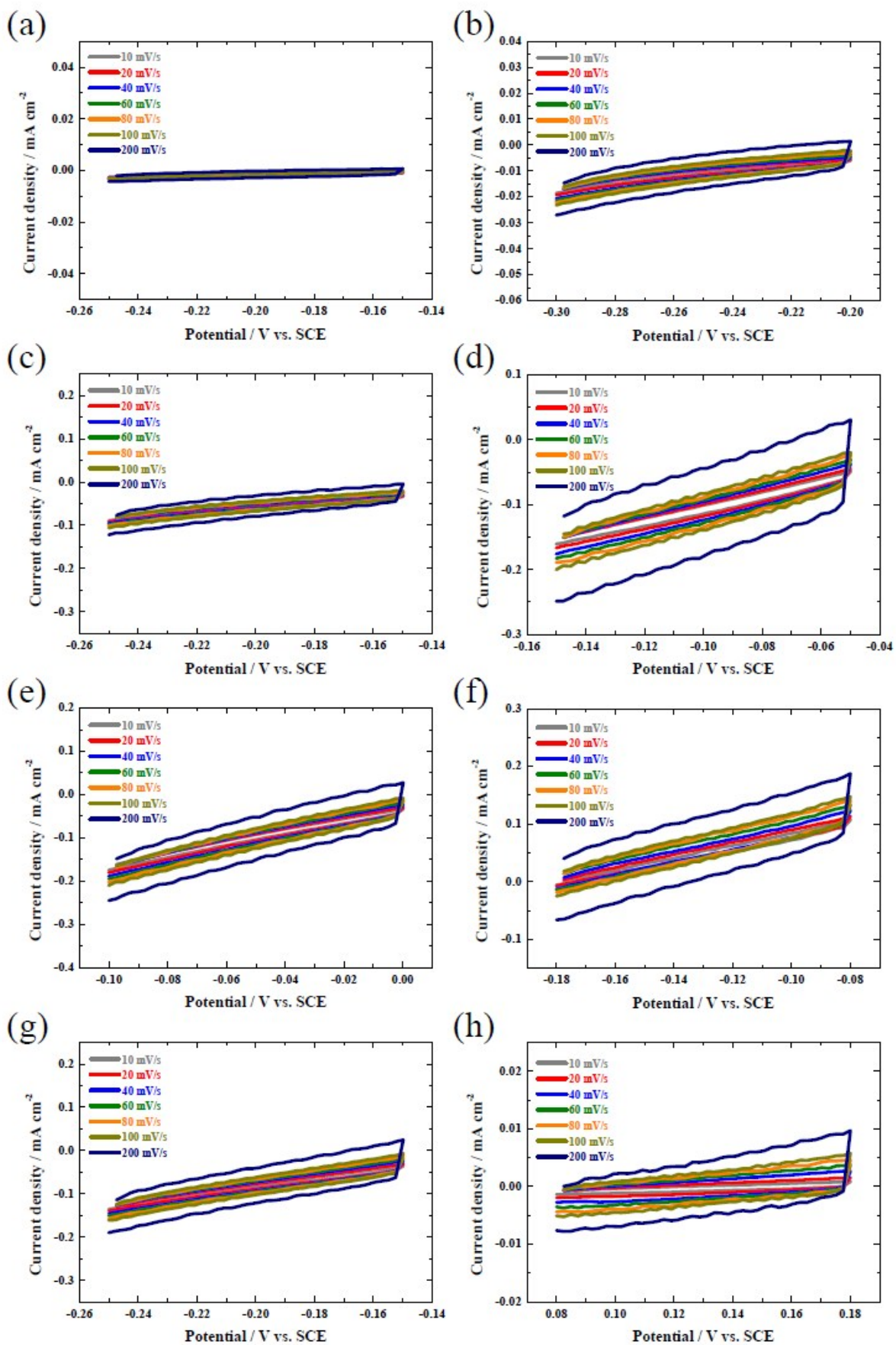


Figure S3. Double layer capacitance using cyclic voltammetry curves of (a) CP and Co-P-B catalysts in 0.5 M H₂SO₄ solution with different scan rates from 10 mV s⁻¹ to 200 mV s⁻¹: (b) Co₇₇P₂₃/CP, (c) Co₅₇P₂₇B₁₆/CP, (d) Co₅₃P₂₇B₂₀/CP, (e) Co₅₉P₂₀B₂₁/CP, (f) Co₄₁P₂₁B₃₈/CP, (g) Co₃₄P₂₀B₄₆/CP, (h) Co₈₉B₁₁/CP.