

Supporting Information (SI) *for*:

Metallic Co₉S₈ nanosheets grown on carbon cloth as efficient binder-free electrocatalysts for hydrogen evolution reaction under neutral media

Liang-Liang Feng,^{‡a} Meihong Fan,^{‡a} Yuanyuan Wu,^a Yipu Liu,^a Guo-Dong Li,^a Hui Chen,^{a,c} Wei Chen,^b Dejun Wang^d and Xiaoxin Zou^{*a}

^aState Key Laboratory of Inorganic Synthesis and Preparative Chemistry, International Joint Research Laboratory of Nano-Micro Architecture Chemistry, College of Chemistry, Jilin University, Changchun 130012, P. R. China

^bInstitute of Theoretical Chemistry, International Joint Research Laboratory of Nano-Micro Architecture Chemistry, Jilin University Changchun 130023, P. R. China

^cDepartment of Materials Science and Engineering, Jilin University, Changchun 130022, P. R. China

^dDepartment of Chemistry, Tsinghua University, Beijing 100084, P. R. China

[‡] These authors contributed equally to this work.

E-mail: xxzou@jlu.edu.cn

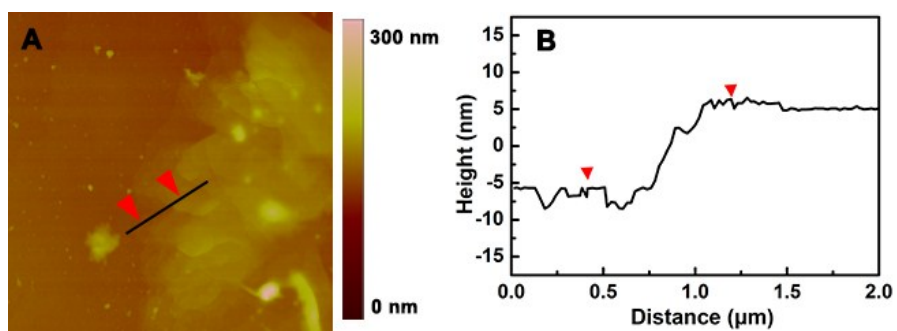


Figure S1 (A) AFM image of Co₉S₈/CC-1 and (B) the height along the corresponding line in the AFM image.

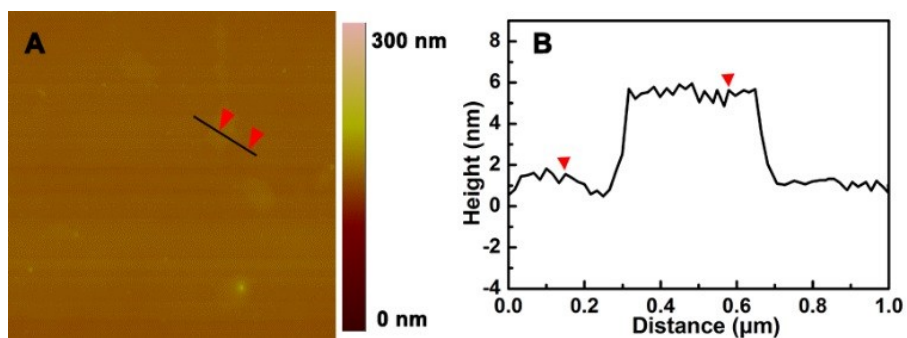


Figure S2 (A) AFM image of Co₉S₈/CC-2 and (B) the height along the corresponding line in the AFM image.

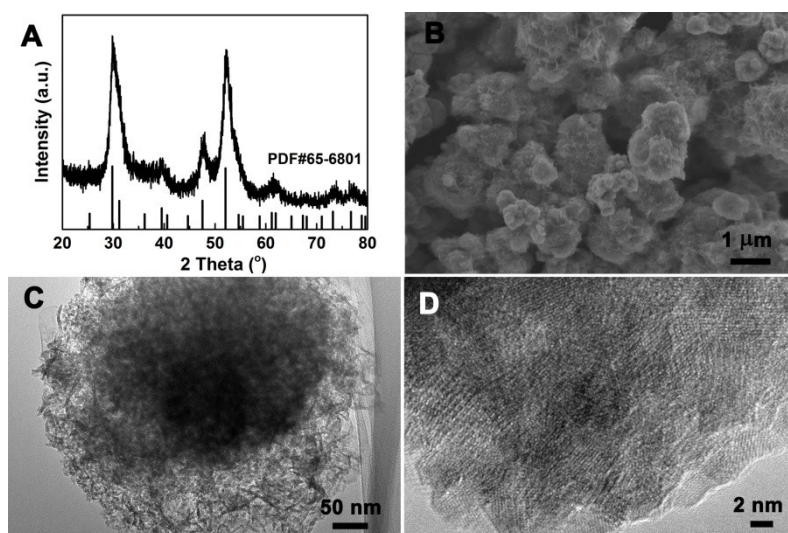


Figure S3 (A) XRD pattern, (B) SEM image, (C) TEM image and (D) HRTEM image of $\text{Co}_9\text{S}_8\text{-P}$.

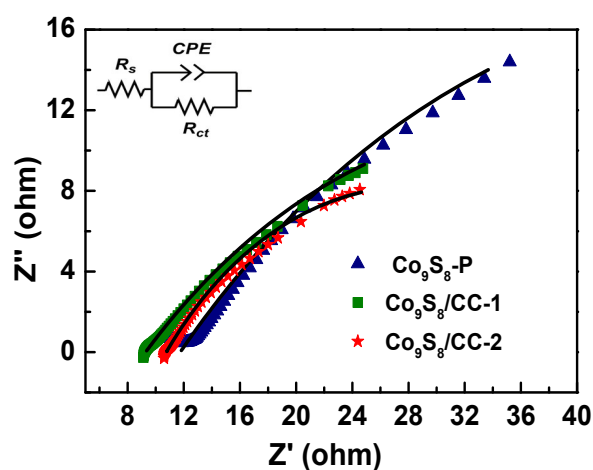


Figure S4 Electrochemical impedance spectroscopy (EIS) Nyquist plots of $\text{Co}_9\text{S}_8\text{-P}$, $\text{Co}_9\text{S}_8/\text{CC-1}$ and $\text{Co}_9\text{S}_8/\text{CC-2}$ in neutral solution. The applied potential for the EIS measurement is -0.226 V vs. RHE . The equivalent circuit used to fit the ESI response is shown in the inset.

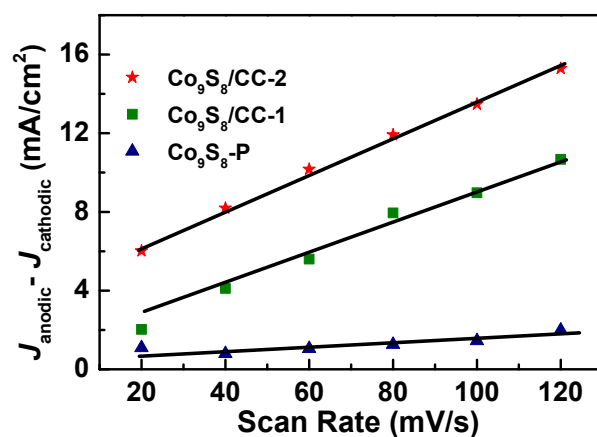


Figure S5 Scan rate dependence of the current density at $E = 0.259\text{ V vs. RHE}$ for the $\text{Co}_9\text{S}_8\text{-P}$, $\text{Co}_9\text{S}_8/\text{CC-1}$ and $\text{Co}_9\text{S}_8/\text{CC-2}$ electrodes.

Table S1 Comparison of the electrocatalytic activity of Co₉S₈/CC with some representative solid-state HER catalysts recently reported for neutral solutions.

Catalyst	Loading density (mg/cm ²)	Current density (<i>j</i>)	Overpotential at the corresponding <i>j</i>	Onset potential	Reference
Co₉S₈/CC-2	0.33	10 mA/cm²	175 mV	25 mV	This work
FeP nanoparticles film grown on Carbon cloth	4.1	10 mA/cm ²	120 mV	19 mV	<i>ACS Appl. Mater. Interfaces</i> , 2014 , 6, 20579
CoP/Ti	2	10 mA/cm ²	149 mV	40 mV	<i>Chem. Mater.</i> 2014 , 26, 4326
Electrodeposited cobalt-sulfide	----	10 mA/cm ²	160 mV	43 mV	<i>J. Am. Chem. Soc.</i> 2013 , 135, 17699.
FeP nanorod array	1.5	10 mA/cm ²	202 mV	20 mV	<i>ACS Catal.</i> 2014 , 4, 4065.
Tungsten Phosphide Submicroparticles	0.5	10 mA/cm ²	244 mV	54 mV	<i>ACS Catal.</i> , 2015 , 5 (1), 145.
CuMoS ₄	0.0416	2 mA/cm ²	210 mV	135 mV	<i>Energy Environ. Sci.</i> 2012 , 5, 8912
MoS ₂ /N-doped graphene nanosheet aerogel	0.704	10 mA/cm ²	261 mV	236 mV	<i>J. Mater. Chem. A</i> , 2014 , 2, 13795
Carbon-armored Co ₉ S ₈ nanoparticle	~0.28	10 mA/cm ²	280 mV	150 mV	<i>ACS Appl. Mater. Interfaces</i> 2015 , 7, 980–988
MoP nanosheets supported on carbon flake	~0.36	1 mA/cm ²	300 mV	~300 mV	<i>Applied Catalysis B: Environmental</i> 2015 , 164, 144
Co-NRCNTs	~0.28	1 mA/cm ² 10 mA/cm ²	330 mV 540 mV	~140 mV	<i>Angew. Chem. Int. Ed.</i> 2014 , 53, 4372.
Metallic cobalt@cobalt-oxo/hydroxo phosphate	-----	2 mA/cm ²	385 mV	~320 mV	<i>Nature Mater.</i> 2012 , 11, 802
MoB	-----	1 mA/cm ²	250 mV	100 mV	<i>Angew. Chem. Int. Ed.</i> 2012 , 51, 12703.
CoB	----	10 mA/cm ²	250 mV	70 mV	<i>J. Power.Sources</i> 2015 , 279, 620.
WN nanorods array grown on carbon cloth	2.5	2 mA/cm ² 10 mA/cm ²	186 mV 302 mV	~100 mV	<i>Electrochim. Acta</i> , 2015 , 154, 345.