

Supplementary Materials

Electronic Structure Modulation of Fe-Ni₂P@CoP Heterojunction for Efficient Industrial Water Electrolysis toward Hydrogen Production

Xin Li, Jia Shi, Yang Li, Zhixin Dai, Ning Li, Yangqin Gao, Lei Ge*

State Key Laboratory of Heavy Oil Processing, College of Materials Science and Engineering, China University of Petroleum Beijing, No. 18 Fuxue Rd., Beijing 102249, People's Republic of China.

*Corresponding Author, E-mail: gelei@cup.edu.cn (Lei Ge)

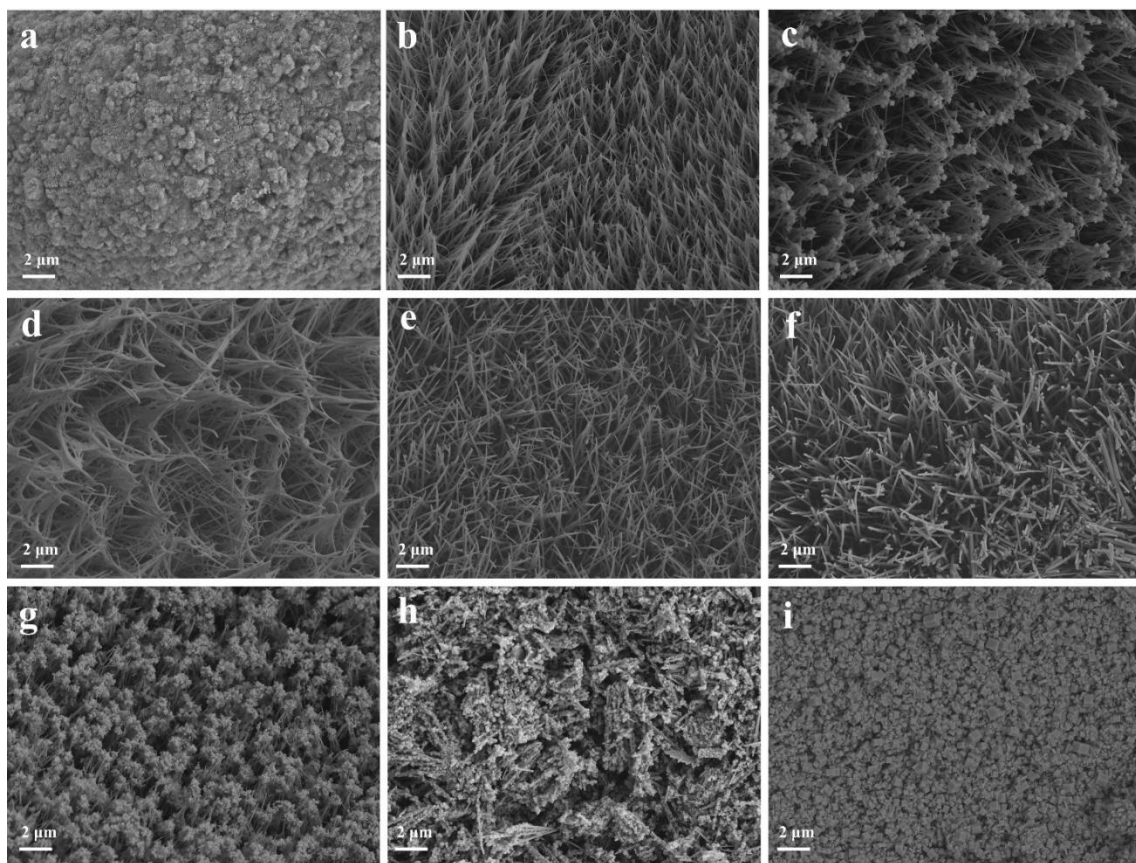


Figure S1. SEM images of a) Fe-Ni₂P, b) Co pre (before phosphorization), c) PBA@Co pre, d) CoP, e) Fe-Ni₂P@CoP 4 h, f) Fe-Ni₂P@CoP 8 h, g) Fe-Ni₂P@CoP 16 h, h) Fe-Ni₂P@CoP 20 h, and i) Fe-Ni₂P@CoP 24 h.

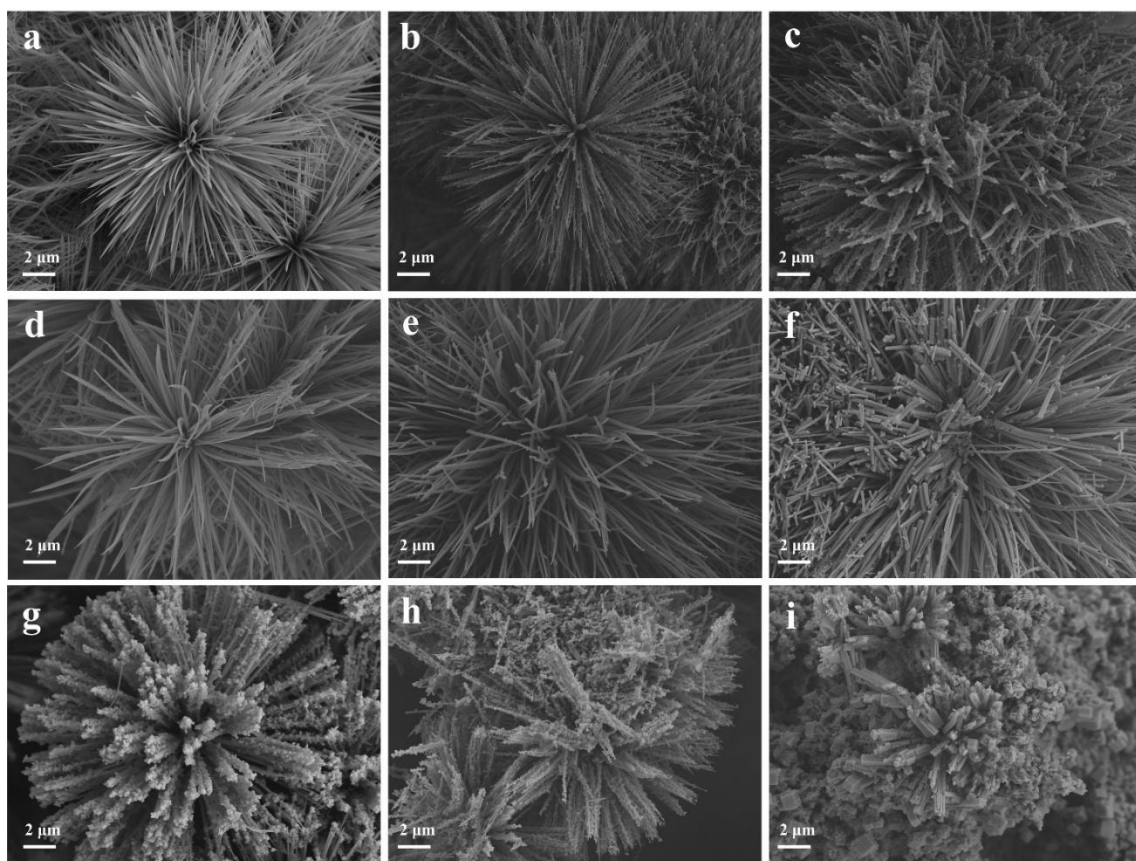


Figure S2. Edge of the nickel foam (NF) SEM images of a) Fe-Ni₂P, b) Co pre, c) PBA@Co pre, d) CoP, e) Fe-Ni₂P@CoP 4 h, f) Fe-Ni₂P@CoP 8 h, g) Fe-Ni₂P@CoP 16 h, h) Fe-Ni₂P@CoP 20 h, and i) Fe-Ni₂P@CoP 24 h.

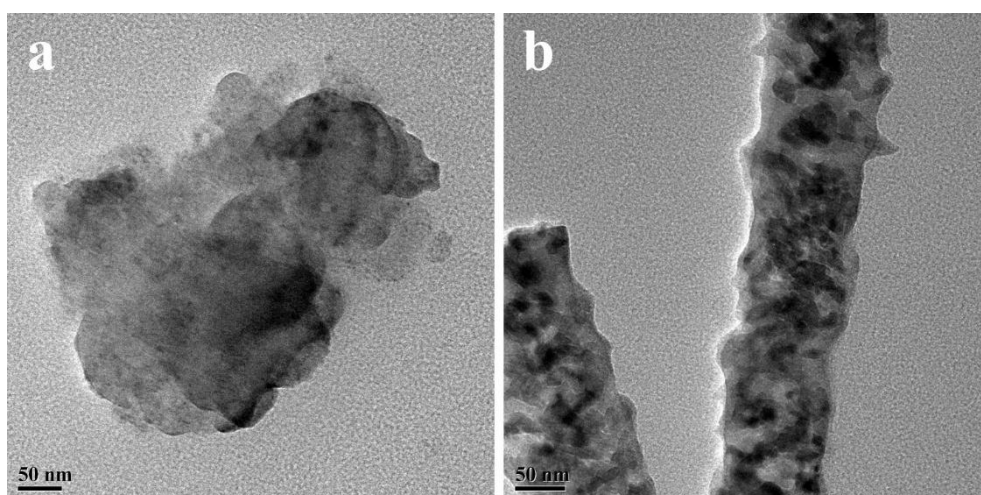


Figure S3. TEM image of a) Fe-Ni₂P and b) CoP.

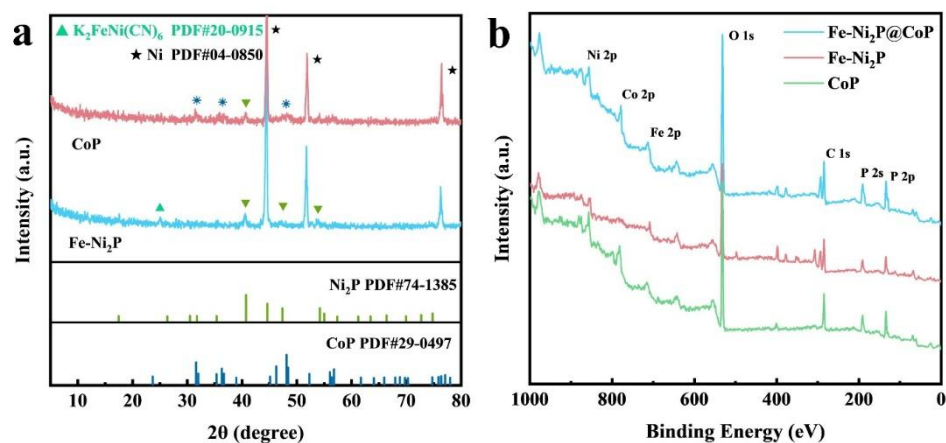


Figure S4. a) XRD patterns of Fe-Ni₂P and CoP, b) XPS survey spectra of Fe-Ni₂P@CoP, Fe-Ni₂P and CoP.

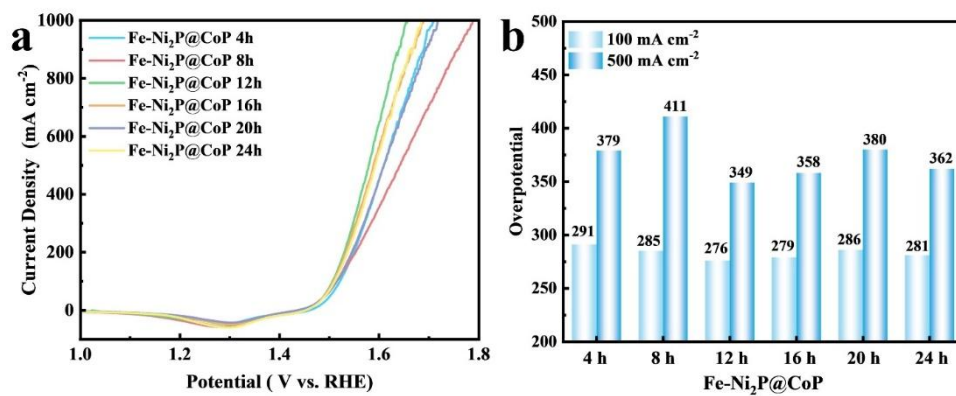


Figure S5. a) LSV curves and b) overpotential plots of different samples.

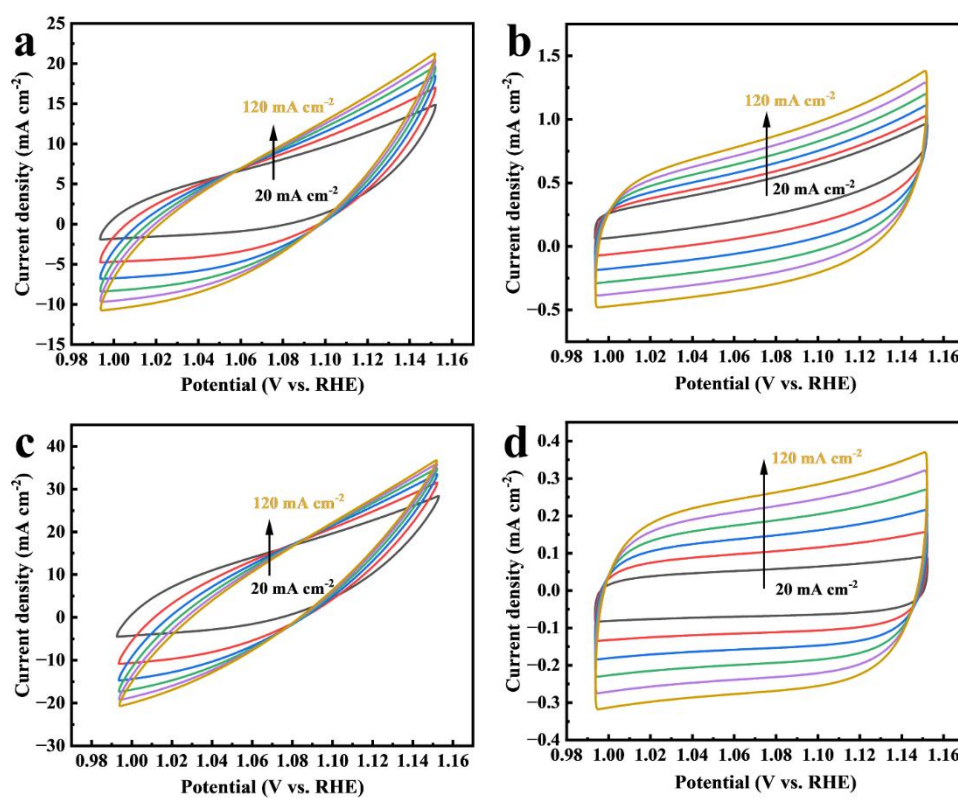


Figure S6. CV curves of a) Fe-Ni₂P@CoP, b) Fe-Ni₂P, c) CoP, and d) NF.

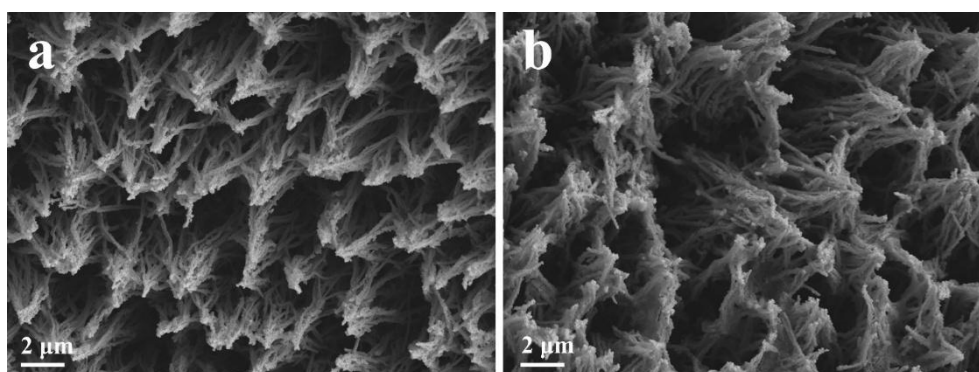


Figure S7. SEM images of Fe-Ni₂P@CoP after a) OER stability test and b) AEMWE stability test.

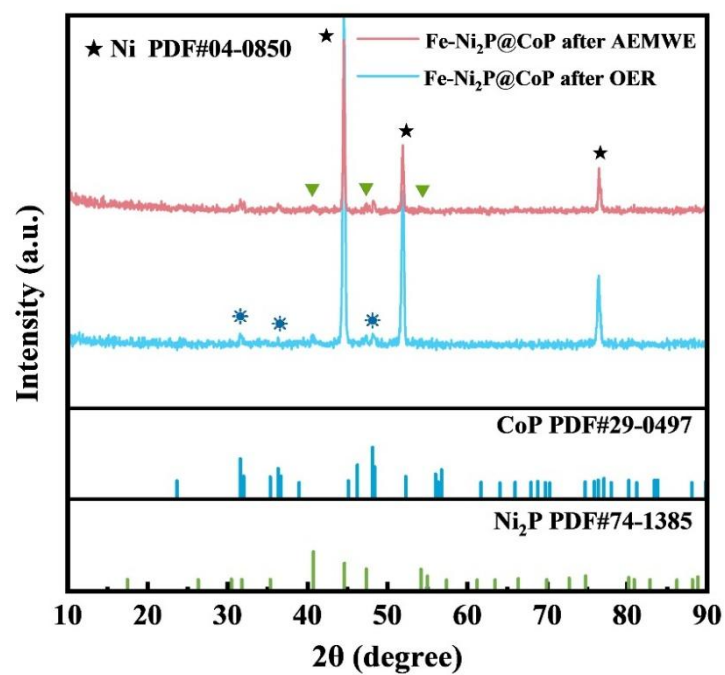


Figure S8. XRD patterns of Fe-Ni₂P@CoP after OER (or AEMWE) stability test.

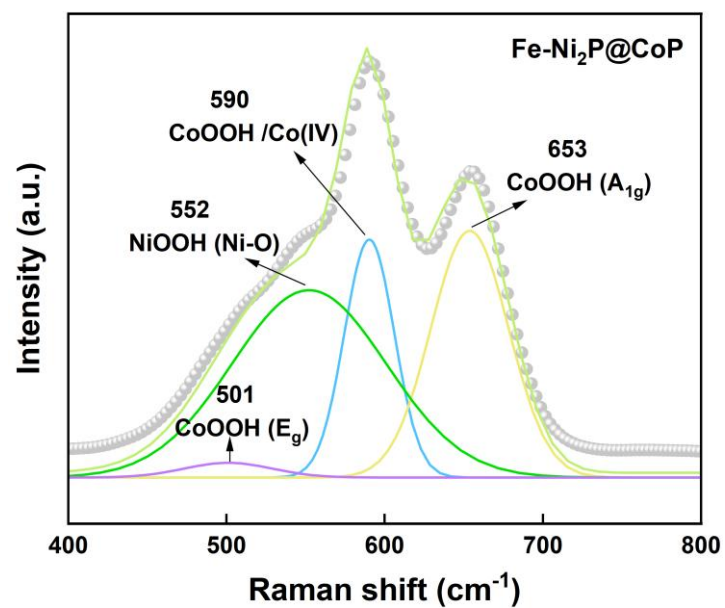


Figure S9. Raman spectrum of the post-OER Fe-Ni₂P@CoP electrode.

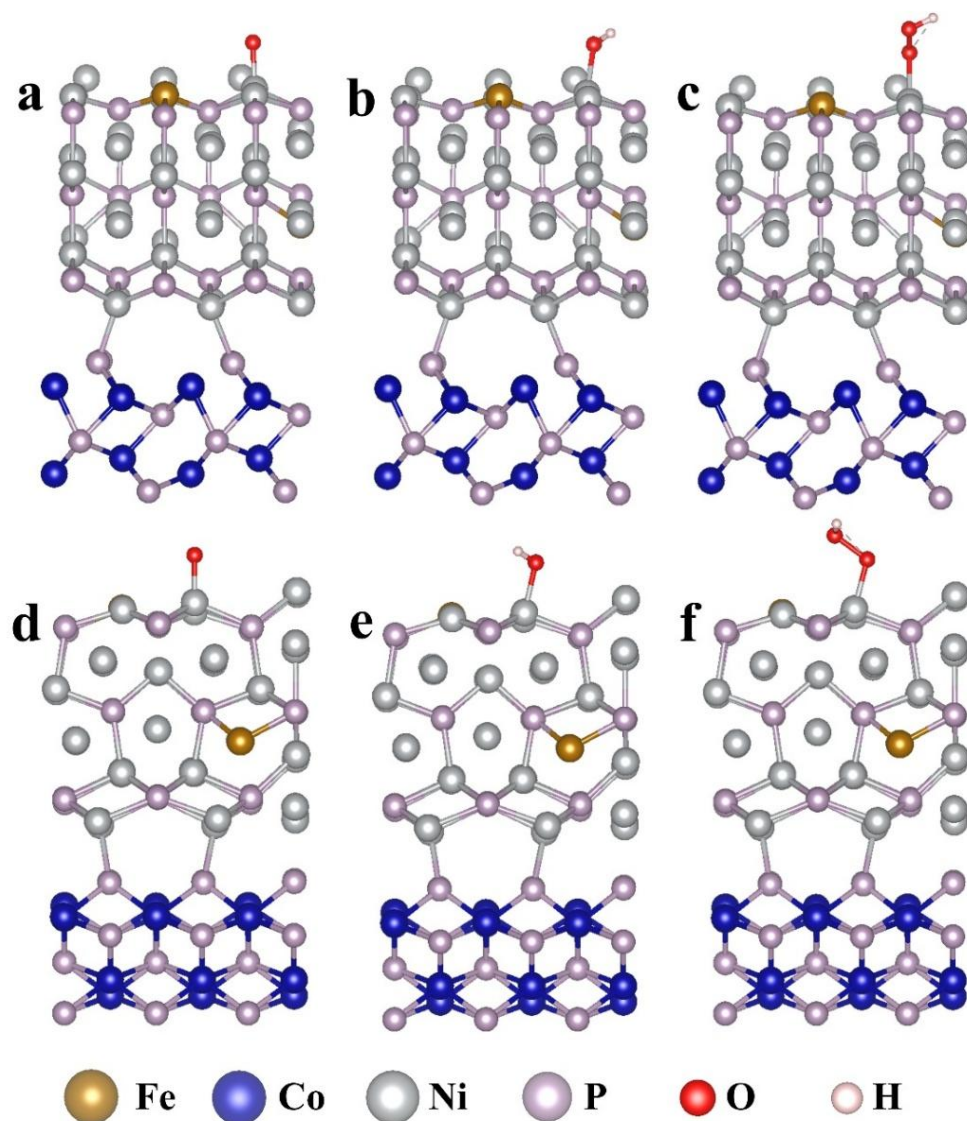


Figure S10. a) $\ast\text{O}$, b) $\ast\text{OH}$, and c) $\ast\text{OOH}$ adsorption structure models of Fe-Ni₂P@CoP (front view); d) $\ast\text{O}$, e) $\ast\text{OH}$, and f) $\ast\text{OOH}$ adsorption structure models of Fe-Ni₂P@CoP (side view).

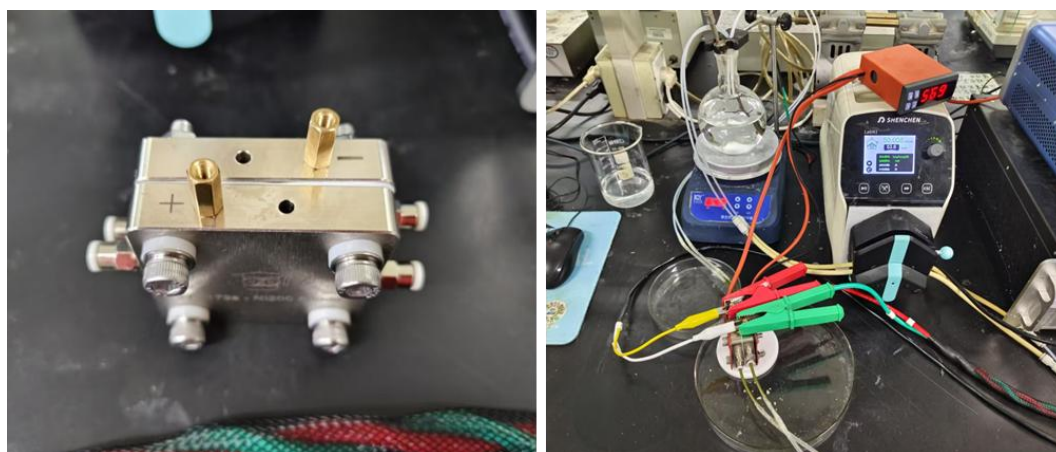


Figure S11. Photograph of AEMWE electrolyzer and platform.

Table S1. Comparison of OER overpotentials at 100 mA cm⁻² for different catalysts

Catalyst	Electrolyte	η 100 (mV)	Ref.
Br _{0.036} -Co _{1.085} P@NF	1 M KOH	220	[1]
Fe-NiP _x /NF	1 M KOH	256	[2]
FeP-CoP ₃	1 M KOH	263	[3]
Fe-Ni ₂ P@CoP	1 M KOH	276	This work
FeOx-ACs/CoxP	1 M KOH	278	[4]
Mo _(M) -Ni ₅ P ₂	1 M KOH	~280	[5]
np-CoNiFeAgP	1 M KOH	283	[6]
NiFeP	1 M KOH	284	[7]
CFP	1 M KOH	296	[8]
CoP/CoFeP	1 M KOH	~300	[9]
NiCoP@Ti ₃ C ₂ T _x	1 M KOH	326	[10]
CoPS/NFL	1 M KOH	331	[11]
P-ZnCo ₂ O ₄	1 M KOH	332	[12]

Table S2. Electrodes materials and AEMWE performance of previous studies.

Anode material	Cathode material	AEM	Temp. (°C)	Cell voltage (V) at 1 A cm ⁻²	Ref.
NiFeP	Pt/C	KMem AM01-50	60	1.68	[13]
NiP-FN/NF	Pt/C	PiperION	60	1.71	[14]
Ni ₂ P-Fe/NF	Pt/C	PE (VBTAC)	80	1.73	[15]
Fe-Ni ₂ P@CoP	Pt/C	PiperION-A40	60	1.76	This work
FeP/SSF-700-5	Pt/C	-	60	1.77	[16]
Ni ₂ P @ FePO _x H _y	MoNi ₄ /MoO ₂	Sustainion X37-50	60	1.84	[17]
Ni ₂ P/FeP ₂ /MN	Pt/C	FAA-3-50	25	1.88	[18]
Ir@Zr-CoP	Ir@Zr-CoP	-	60	1.88	[19]
Fe ₂ P-Ni ₁₂ P ₅ /NF	Co ₂ P-Ni ₁₂ P ₅ /NF	FAA-3-50	60	1.95	[20]
FeO _x -ACs/Co _x P	Pt/C	-	60	~2.15	[4]

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