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Self-templating method of metal-organic frameworks to construct multi-shelled bimetallic phosphides hollow microsphere as highly efficient electrocatalysts for hydrogen evolution reaction

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Fig. S1 XRD pattern of the NiP microspheres.

Fig. S2 (a, b) SEM images of the NiP microspheres.

Fig. S3 XRD pattern of CoP.

Fig. S4. (a, b) SEM images of CoP.

Fig. S5 EDX image of the as-synthesized CoNiP-0.25 microspheres.

Fig. S6 N_2 adsorption-desorption isotherm (inset: corresponding NLDFT pore diameter distribution) of (a) CoNiP-0.12; (b) CoNiP-0.17; (c) CoNiP-0.25; (d) CoNiP-0.47.

Fig. S7 XPS patterns of CoNiP-0.25 hollow microspheres after HER reaction in alkaline electrolyte solution: (a) Co 2p post-HER; (b) Ni 2p post-HER; (c) P 2p post-HER.

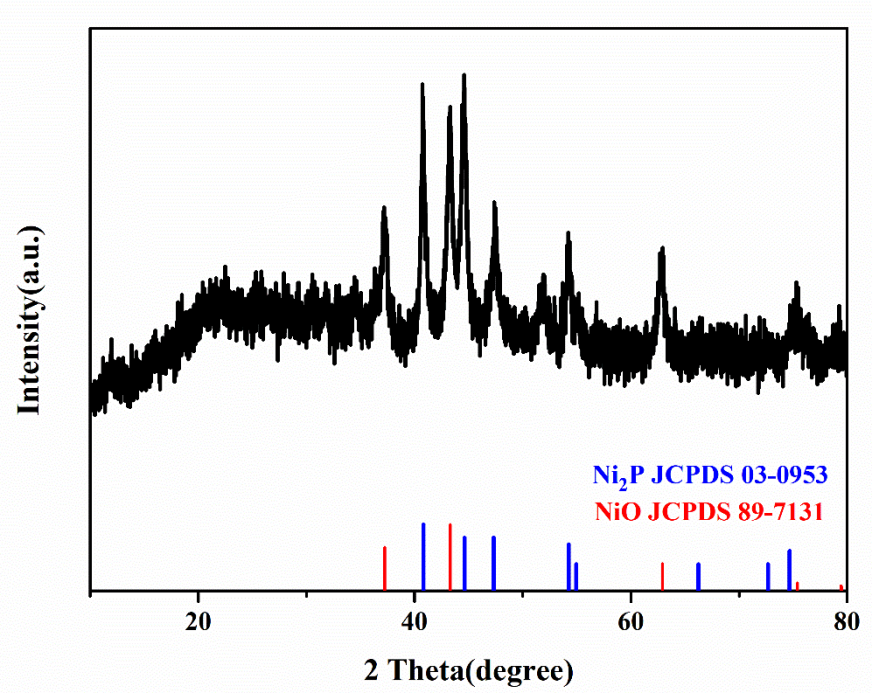
Fig. S8 (a) Nyquist plots of the as-synthesized CoNiP-0.25 microspheres in 1.0 M KOH. (b) Tafel slop of the as-synthesized CoNiP-0.25 microspheres fitted from EIS data.

Fig. S9 (a) HER polarization curves of Pt/C, CoNiP-n (n=0.12, 0.17, 0.25, 0.47) microspheres obtained by two-step phosphatization, (b) Nyquist plots at a potential of -150 mV vs. RHE, (c) HER polarization curves of CoNiP-0.12 microspheres obtained by two-step phosphatization (solid line) and one-step phosphorization (dash dot line), (d) HER polarization curves of CoNiP-0.17 microspheres obtained by two-step phosphatization (solid line) and one-step phosphorization (dash dot line), (e) HER polarization curves of CoNiP-0.25 microspheres obtained by two-step phosphatization (solid line) and one-step phosphorization (dash dot line), (f) HER polarization curves

of CoNiP-0.47 microspheres obtained by two-step phosphatization (solid line) and one-step phosphorization (dash dot line). For all the measurements, iR-compensation-was performed. The scan rate was 5 mV s^{-1} and electrolyte solution was 1.0 M KOH.

Table S1 Summery of ICP results of CoNiP-n

Table S2 Summary of various catalytic electrodes for HER.



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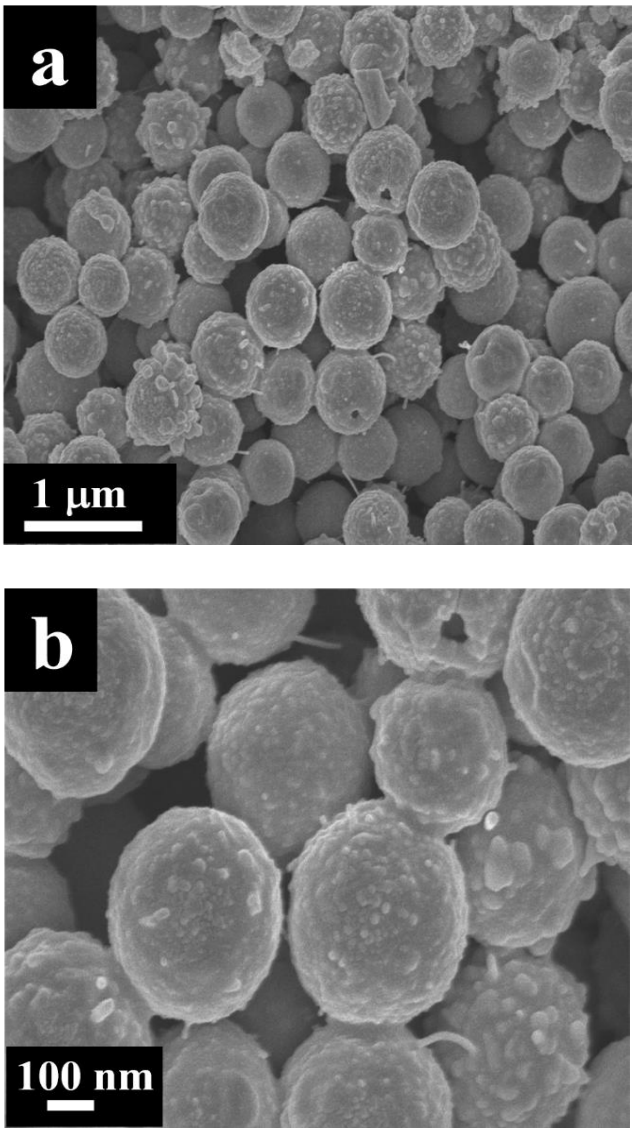


Fig. S2 (a, b) SEM images of the NiP microspheres.

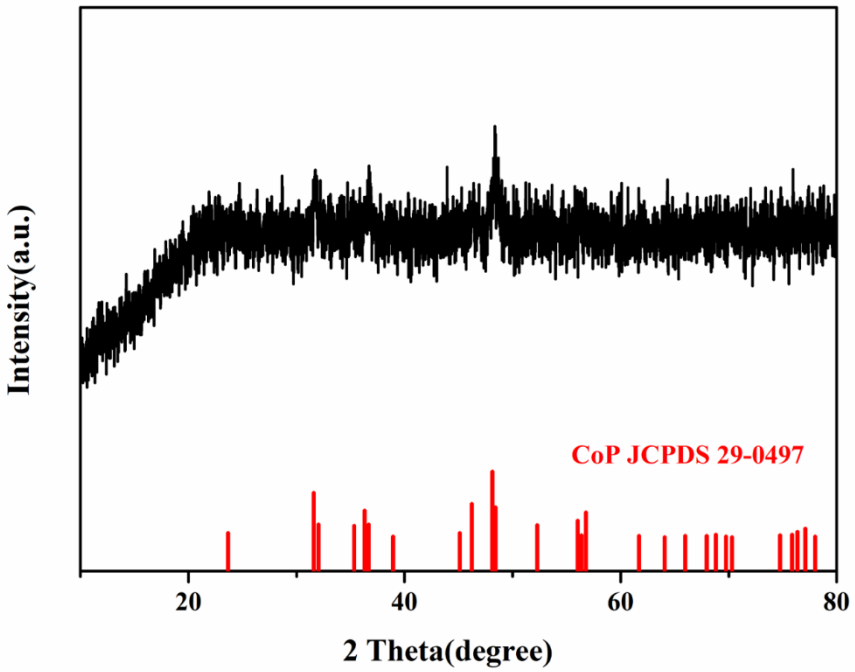


Fig. S3 XRD pattern of CoP.

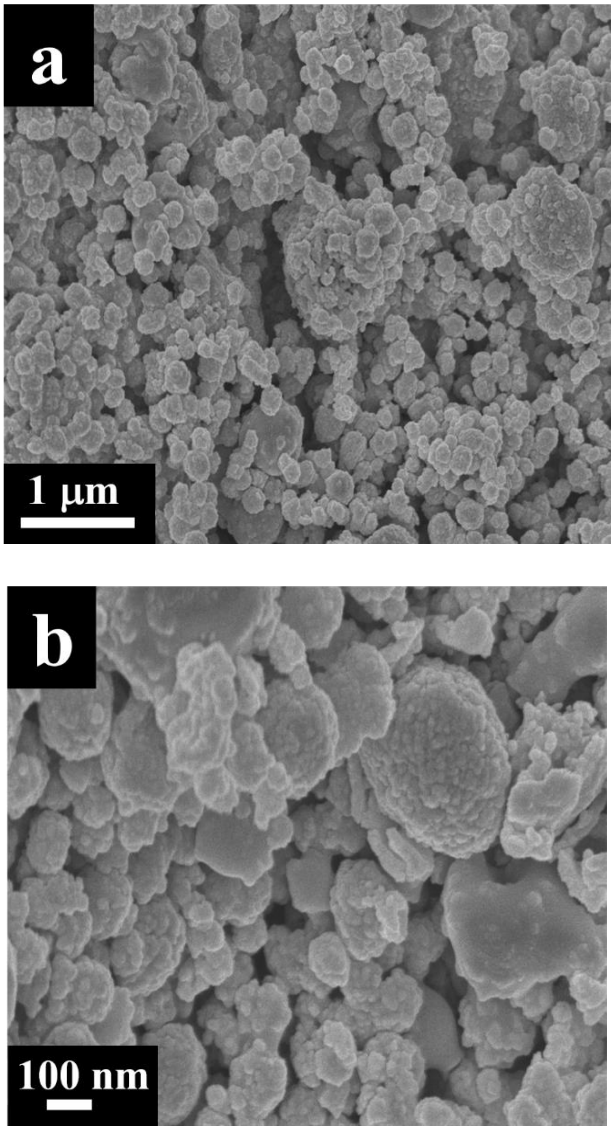


Fig. S4. (a, b) SEM images of CoP.

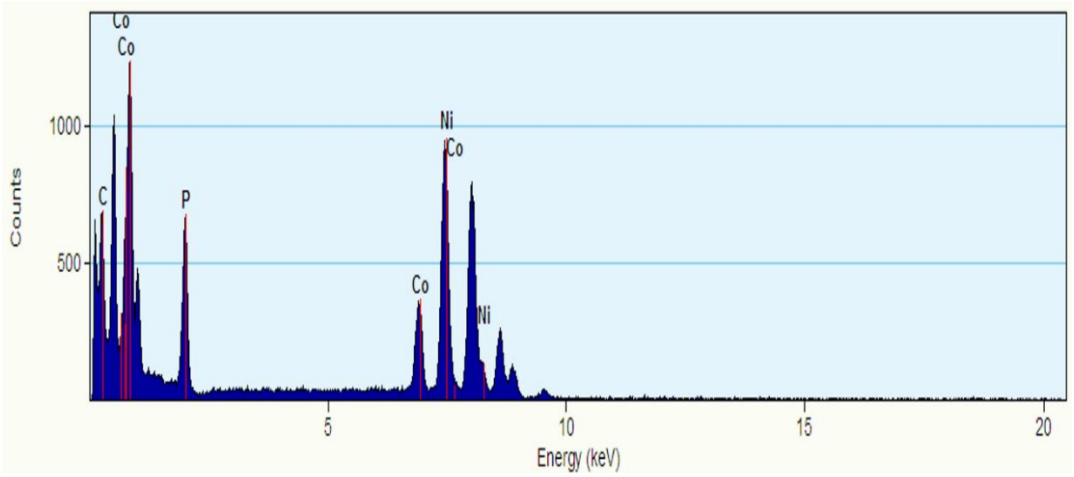
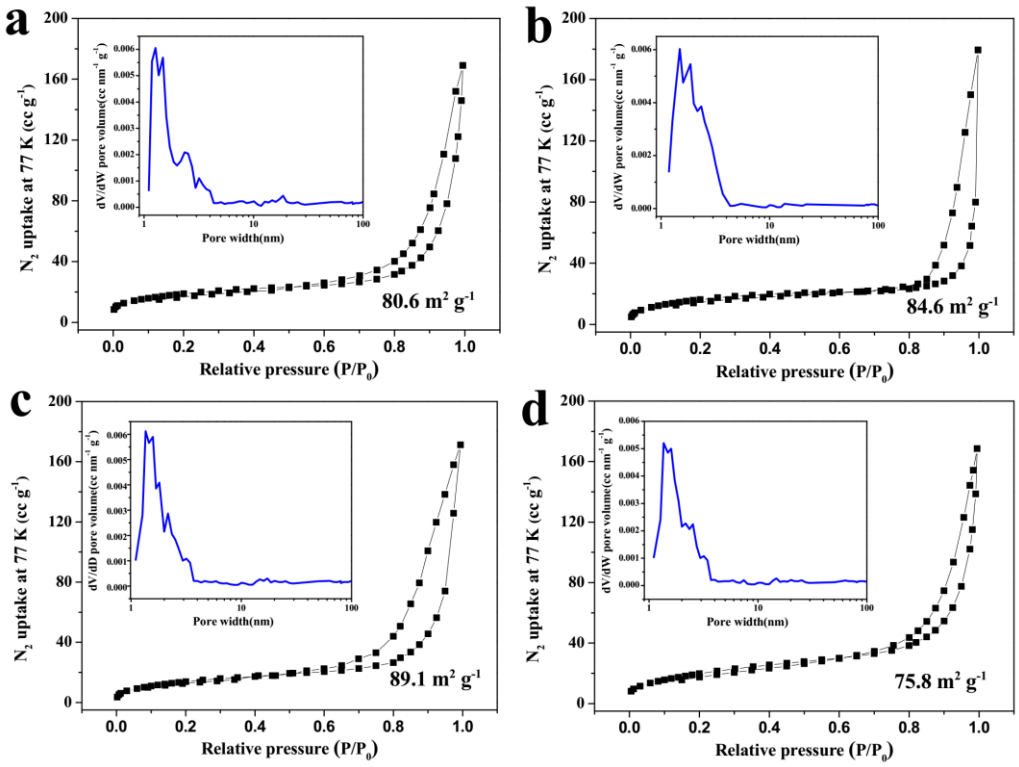


Fig. S5 EDX image of the as-synthesized CoNiP-0.25 microspheres.



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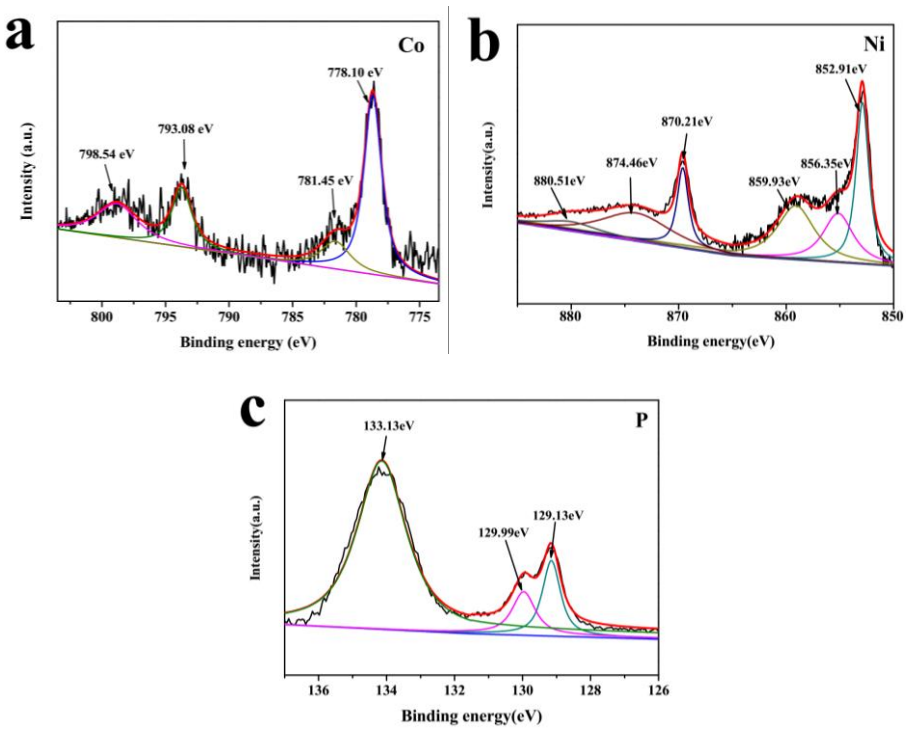

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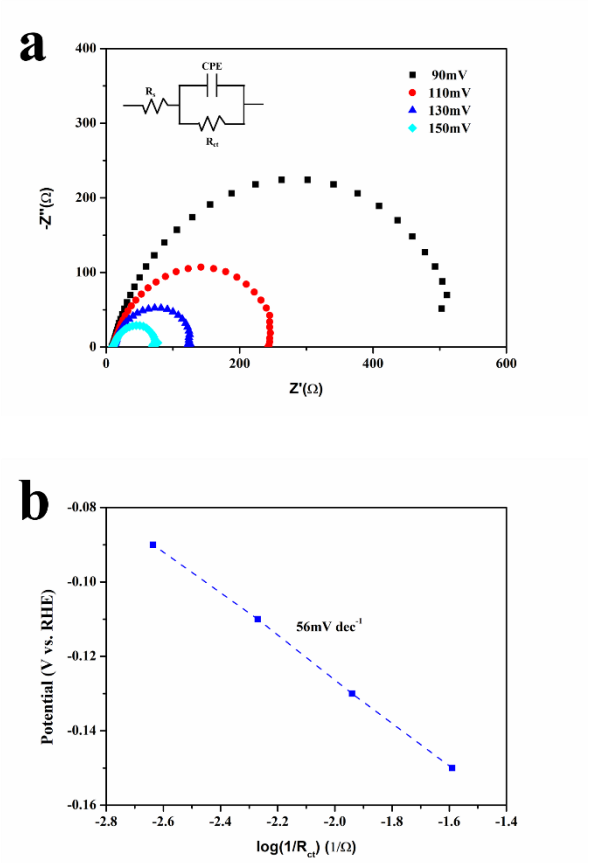

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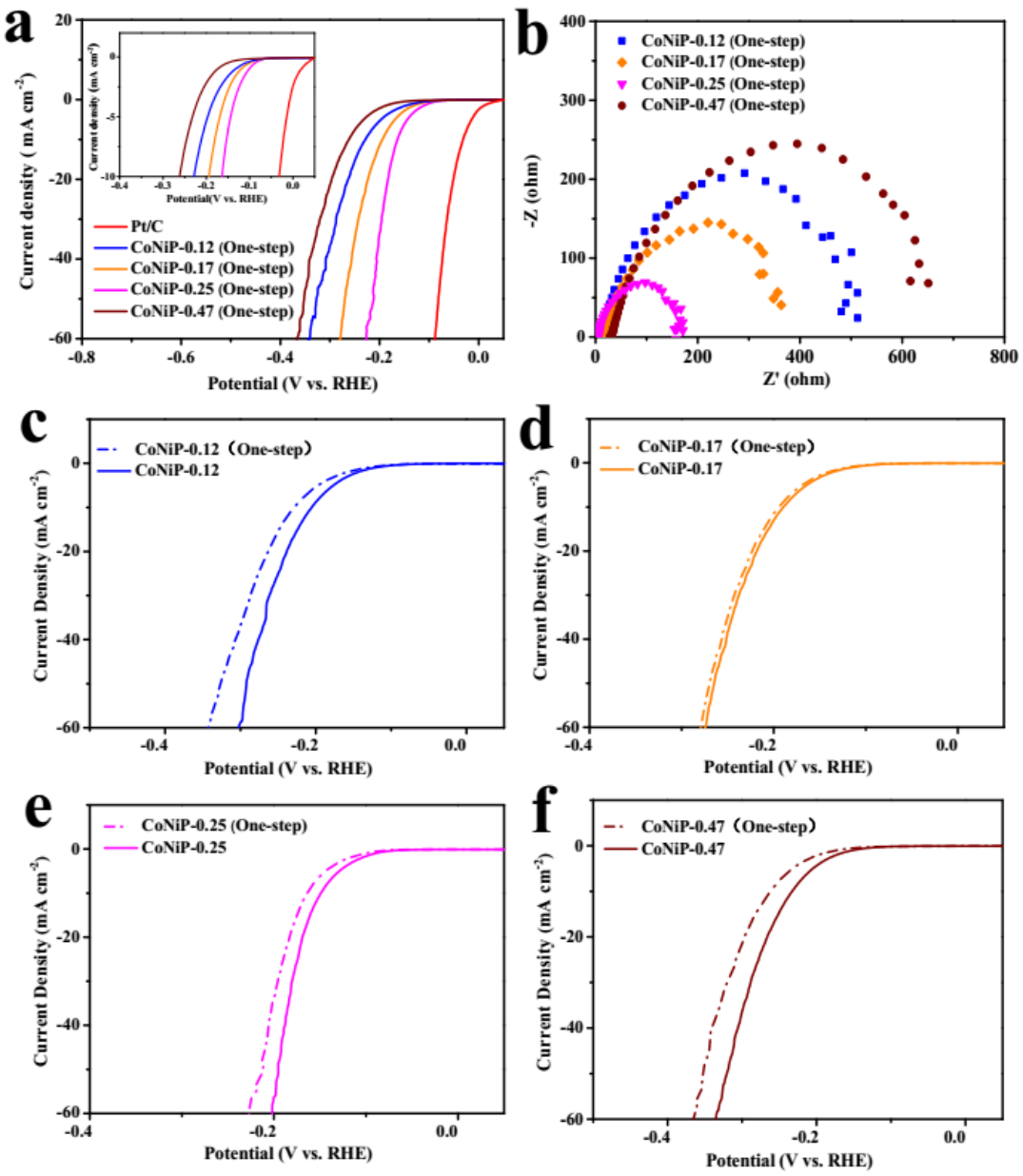

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Table S1 Summery of ICP results of CoNiP-n

Phosphides	CoNiP-0.12	CoNiP-0.17	CoNiP-0.25	CoNiP-0.47
ICP Co/Ni/P ratio in phosphides	1:8.12:3.25	1:5.81:2.41	1:3.98:1.64	1:2.13:0.98
Co/Ni ratio in reactants	1:8	1:6	1:4	1:2

Table S2 Summary of various catalytic electrodes for HER.

Catalysts	**Voltages j_{10}(mV)**	**Tafel slop (mV dec^{-1})**	**Reference**
CoNiP microspheres	145.8	52	This work
CoP@NPMG	151	75	1
$NiCo_2O_4$/NF	164	88	2
Co phosphide /phosphate	380	53	3
Ni_5P_4	150	53	4
Co-P/NC	154	51	5

Supplementary References

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