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Electronic Supplementary Information

Ultrastable nitrogen-doped carbon encapsulating molybdenum phosphide nanoparticles as a highly efficient electrocatalyst for hydrogen generation

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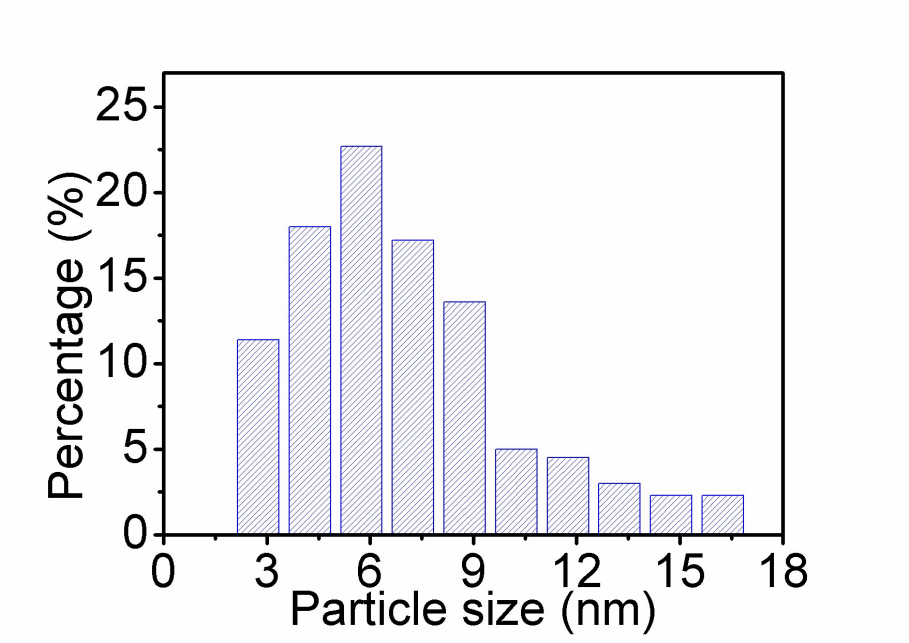

Fig. S1. Particle size distribution histograms of MoP NPs@NC.

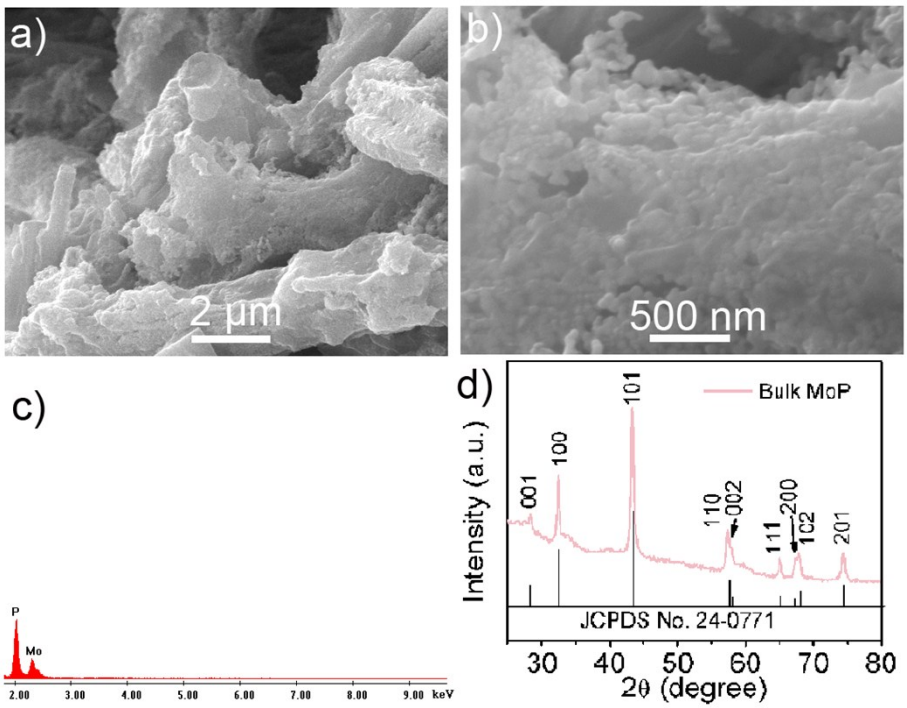

Fig. S2. (a) Low- and (b) high-magnification SEM images of bulk MoP. (c) EDX spectrum and (d) XRD pattern for bulk MoP.

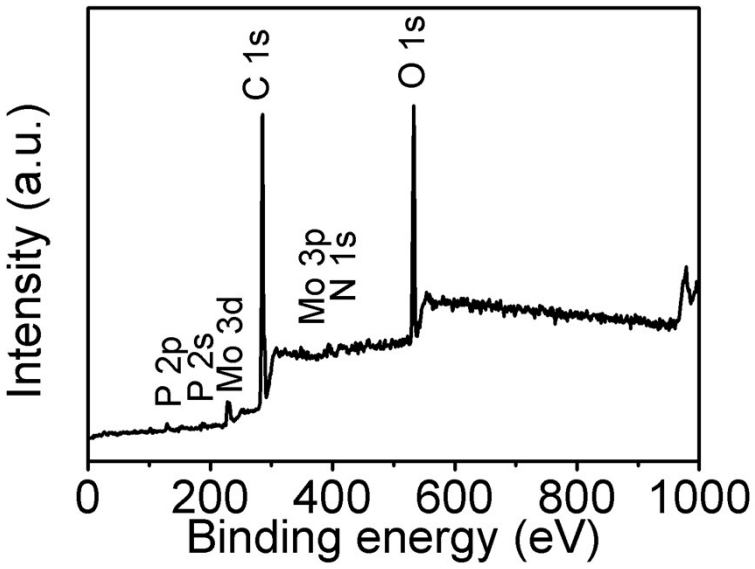

Fig. S3. The survey spectrum of the MoP NPs@NC.

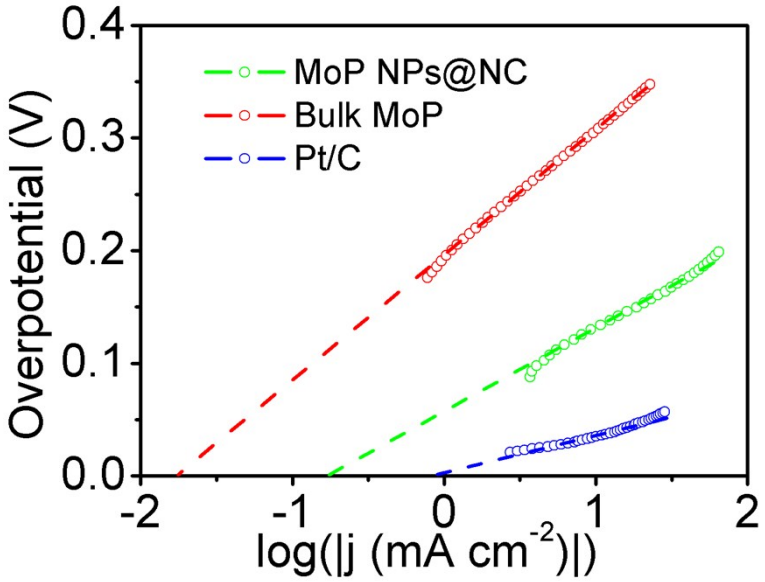

Fig. S4. Calculation of exchange current density of MoP NPs@NC, bulk MoP and Pt/C by applying extrapolation method to the Tafel plot.

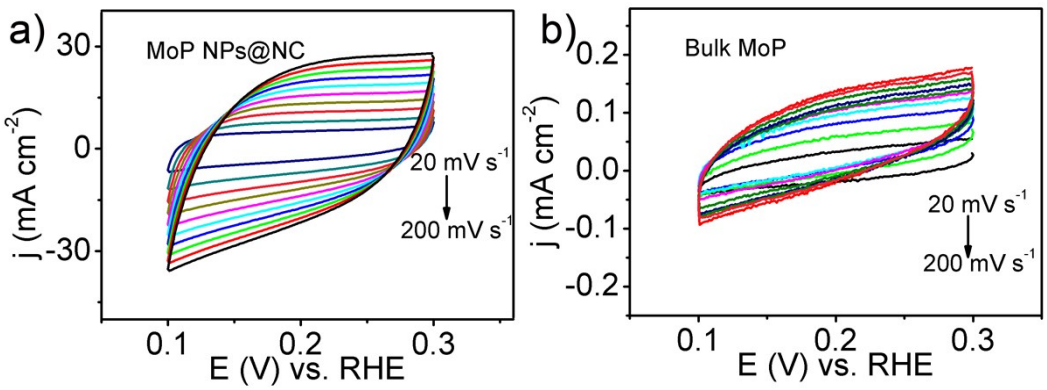

Fig. S5. CVs for (a) MoP NPs@NC and (b) bulk MoP.

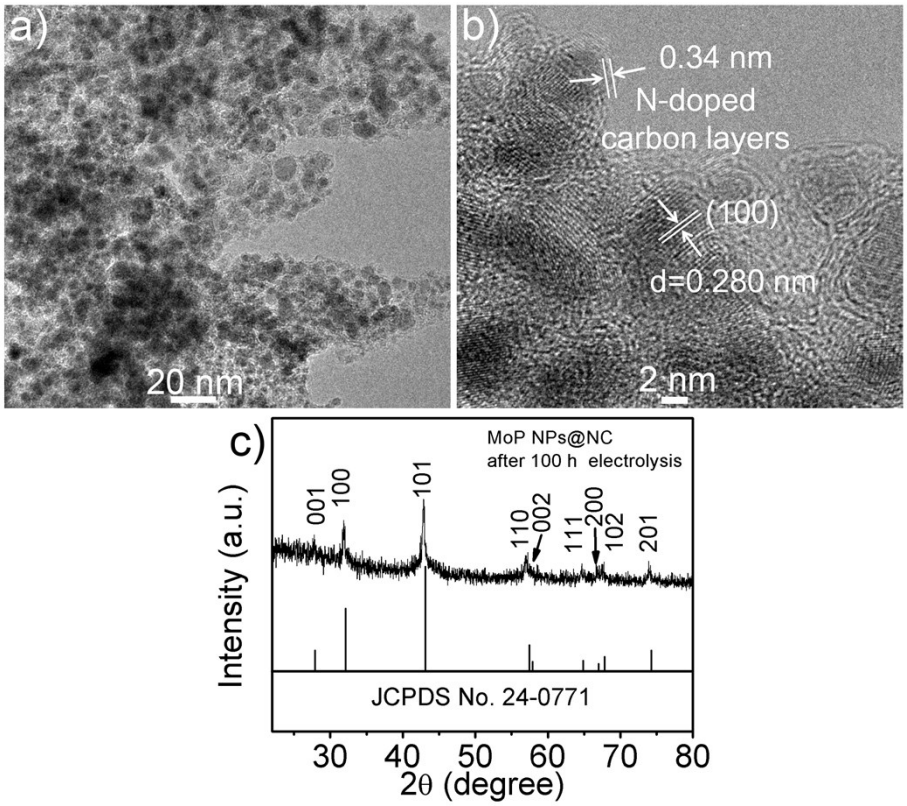

Fig. S6. (a and b) TEM images and (c) XRD pattern of MoP NPs@NC after long-term stability test.

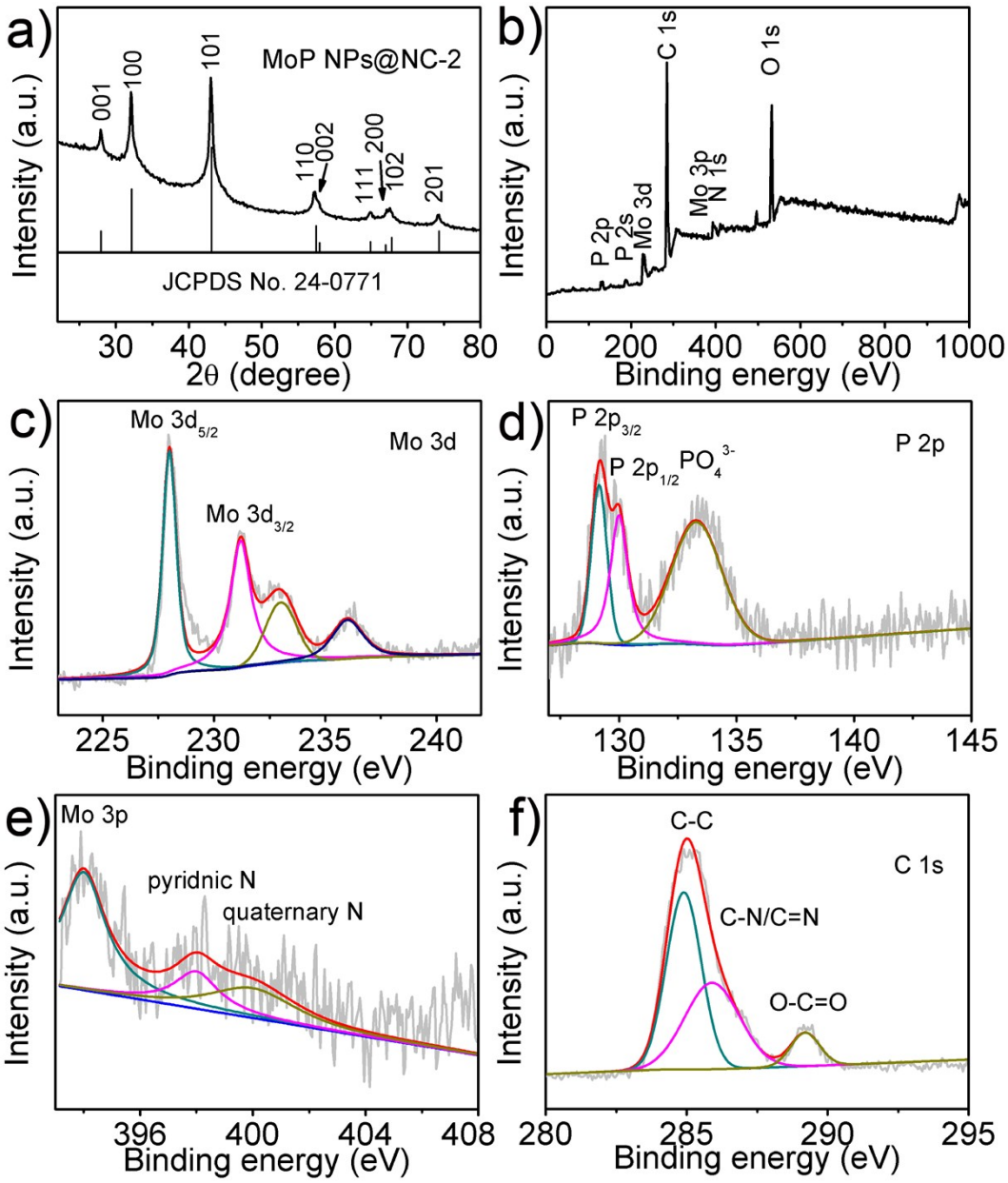

Fig. S7. (a) XRD pattern of MoP NPs@NC-2. (b) The survey XPS spectra of the MoP NPs@NC-2. (c-f) The high-resolution XPS spectra of the MoP NPs@NC-2.

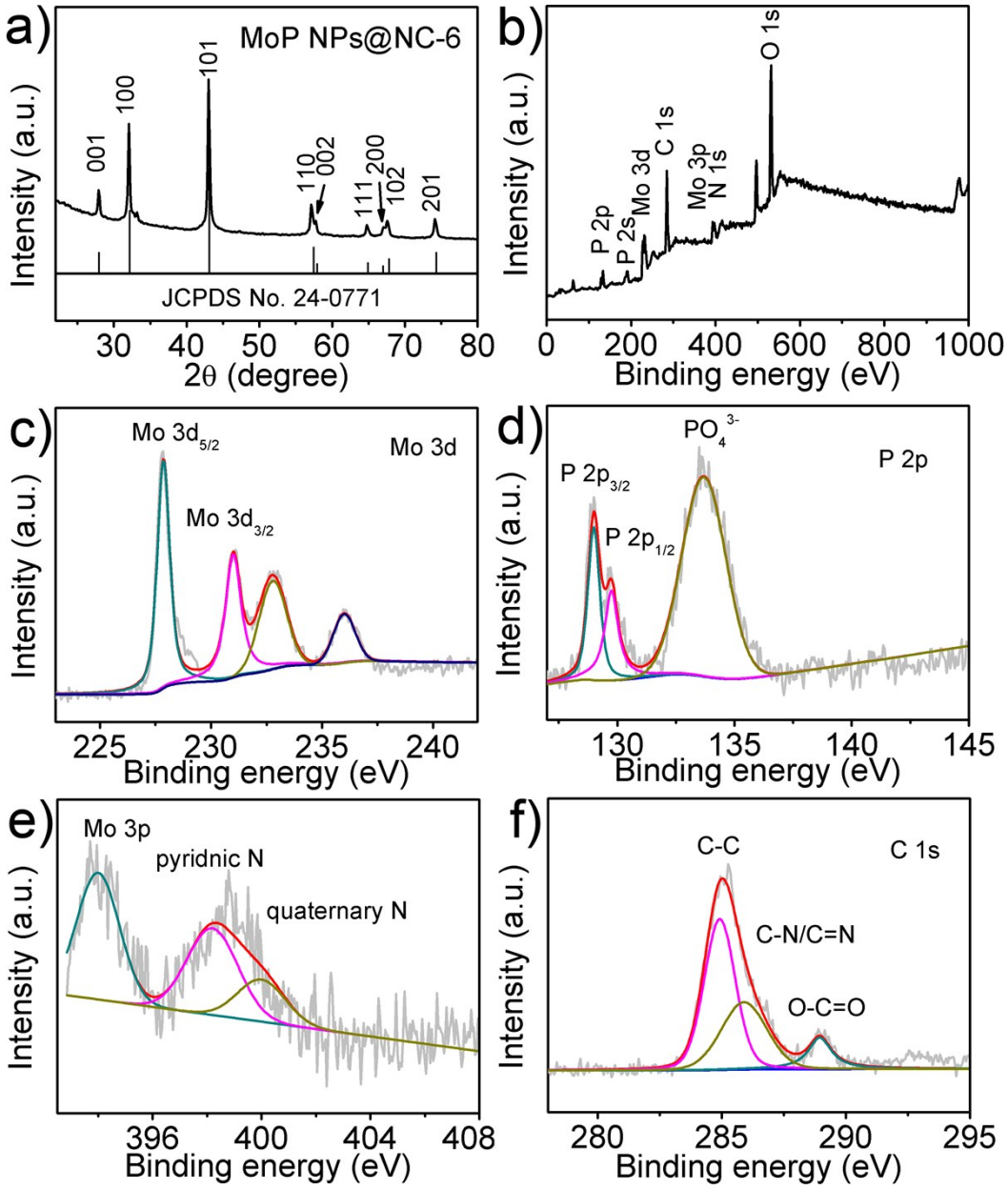

Fig. S8. (a) XRD pattern of MoP NPs@NC-6. (b) The survey XPS spectra of the MoP NPs@NC-6. (c-f) The high-resolution XPS spectra of the MoP NPs@NC-6.

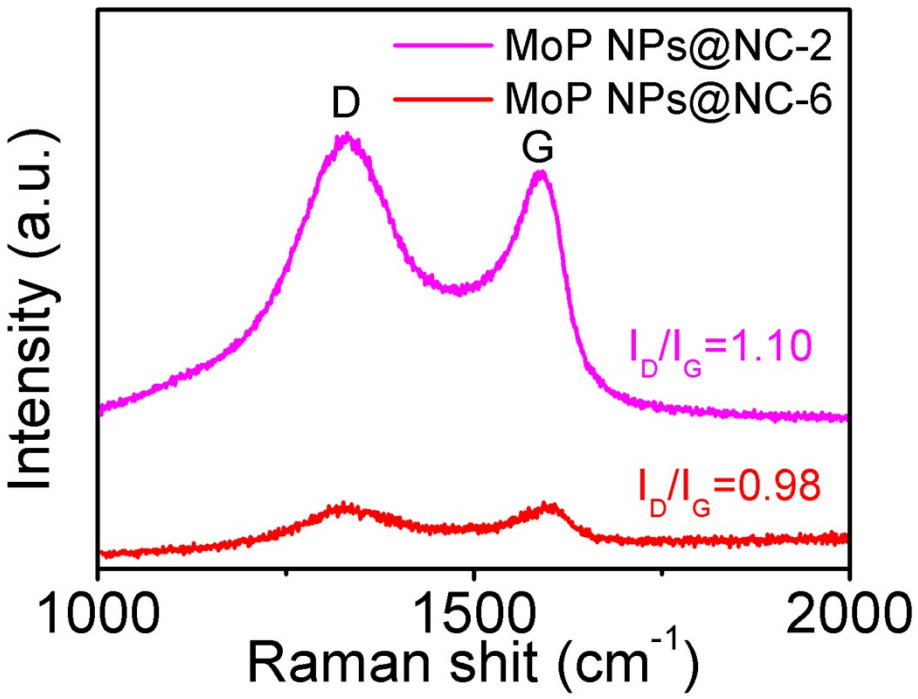

Fig. S9. Raman spectrum for MoP NPs@NC-2 and MoP NPs@NC-6.

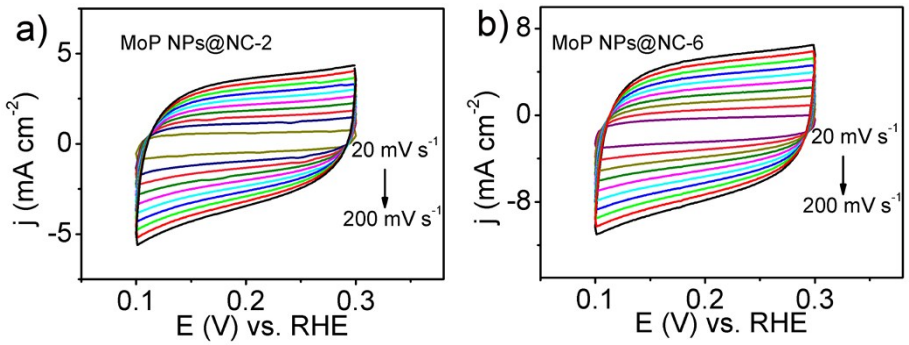

Fig. S10. CVs for (a) MoP NPs@NC-2 and (b) MoP NPs@NC-6.

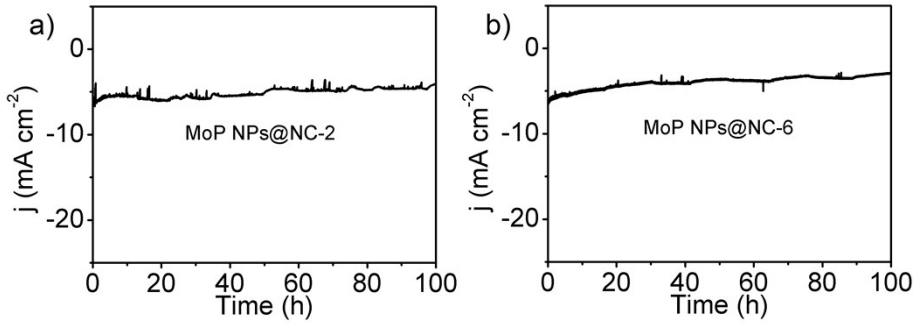

Fig. S11. Time-dependent current density curves for (a) MoP NPs@NC-2 and (b) MoP NPs@NC-6.

Table S1. Comparison of the electrocatalytic activity of MoP NPs@NC with other Mo-based HER catalysts recently reported for acidic solutions.

Catalyst	Current density (j, mA cm^{-2})	η at the corresponding j (mV)	Ref.
MoP NPs@NC	10	115	This work
	30	147	
	100	193	
MoP	10	246	2
MoP/CF	10	200	3
MoP nanoparticle	30	180	4
MoP interconnected network nanoparticles	10	125	5
amorphous MoP	10	90	6
3D MoP	10	105	7
$MoS_{2(1-x)}P_x$	10	150	8
MoP/CC	10	124	9
MoP_2/Mo	10	143	10
MoS_2/Mo foil	18.6	300	11
MoS_2/Mo	10	168	12
amorphous MoS_x	10	200	13
MoS_x/graphene/CC	100	~225	14
PPy/MoS_x/GCE	50	60	15
MoN	70	300	16
Mo_2C@NC	10	124	17
β-Mo_2C	10	172	18

Table S2. Comparison of the electrocatalytic activity of MoP NPs@NC with other non-noble metal HER catalysts recently reported for neutral solutions.

Catalyst	**Current density (j, mA cm^{-2})**	**Overpotential at the corresponding j (mV)**	**Ref.**
MoP NPs@NC	2	80	This work
	10	136	
MoP/CF	1	~300	3
MoP/CC	10	187	9
MoP_2 NPs/Mo	10	211	10
MoS_2/Mo	2	172	12
Mo_2C@NC	10	156	17
WP NAs/CC	2	95	19
CoP/CC	2	65	20
Co-NRCNTs	2	380	21
FeP/Ti	10	102	22
bulk Mo_2C	1	200	23
bulk Mo_2B	1	250	23
H_2-CoCat/FTO	2	385	24
Co-S/FTO	2	83	25
$CuMoS_4$ crystals	2	210	26

Table S3. Comparison of the electrocatalytic activity of MoP NPs@NC with other non-noble metal HER catalysts recently reported for alkaline solutions.

Catalyst	**Current density (j, mA cm^{-2})**	**Overpotential at the corresponding j (mV)**	**Ref.**
MoP NPs@NC	10	80	This work
MoP/CC	10	80	9
MoP_2 NPs/Mo	10	194	10
MoS_2/Mo	2	172	12
Mo_2C@NC	10	60	17
β-Mo_2C	10	112	18
WP NAs/CC	10	150	19
CoP/CC	10	209	20
Co-NRCNTs	10	370	21
bulk Mo_2B	1	250	23
Ni	10	400	23
Co-S/FTO	1	480	25
Ni_2P nanoparticles	20	250	27
Ni wire	10	350	28
Ni-Mo alloy/Ti foil	10	80	28

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