Supporting information

Electrodeposited Superaerophobic Nickel Catalyst on Pencil-Drawn Paper: A Novel Approach for Highly Efficient and Stable Hydrogen Evolution

Qian Sun[1], Xiaoyu Hao[1], Tianyi Zhang[1], Zelin Ma[1], Kui Hu[6], Ming Yang[4,5], Xiaolei Huang[3*], Xuqin Liu[1,2*]*

[1] State Key Laboratory of Solidification Processing, Center of Advanced Lubrication and Seal Materials, Northwestern Polytechnical University, Xi'an, Shaanxi 710072, P. R. China.

[2] Shandong Laboratory of Yantai Advanced Materials and Green Manufacture, Yantai, 264006, China

[3] Institute of Material and Chemistry, Ganjiang Innovation Academy, Chinese Academy of Sciences, Ganzhou, 341000, China.

[4] Department of Applied Physics, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China.

[5] Research Centre on Data Sciences & Artificial Intelligence, The Hong Kong Polytechnic University, Hung Hom, Kowloon, Hong Kong SAR, China.

[6] Department of Chemistry, University of Manchester, Manchester, M13 9PL, UK.

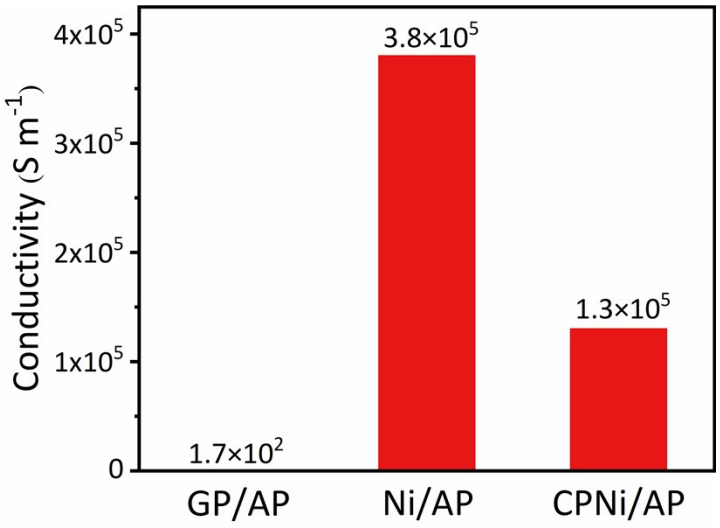

Figure S1. GP/AP, Ni/AP and CPNi/AP's conductivity chart.

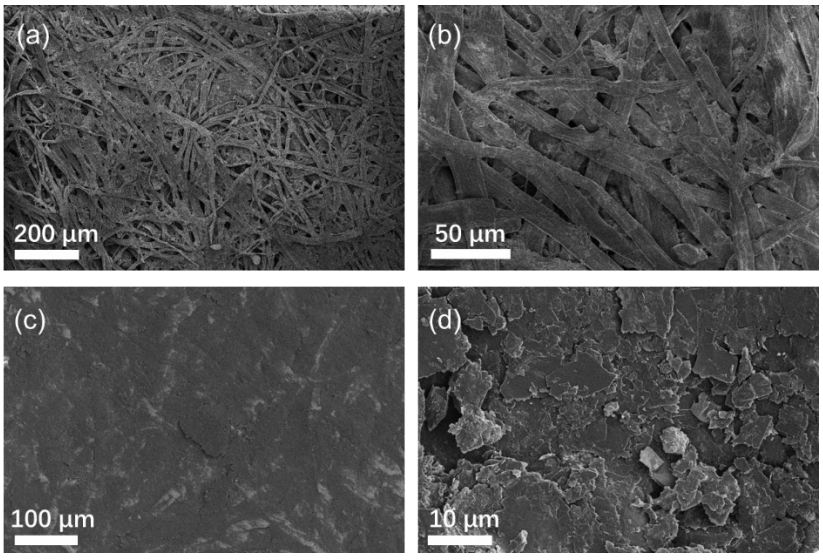

Figure S2. (a)-(b) SEM images of A4 paper and (c)-(d) GC/AP at different magnifications.

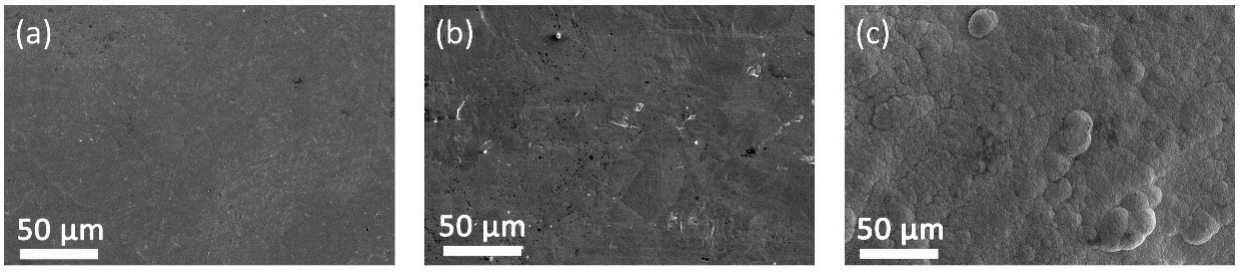

Figure S3. SEM images of (a) Pt Plate, (b) Ni Plate, and (c) Ni/AP.

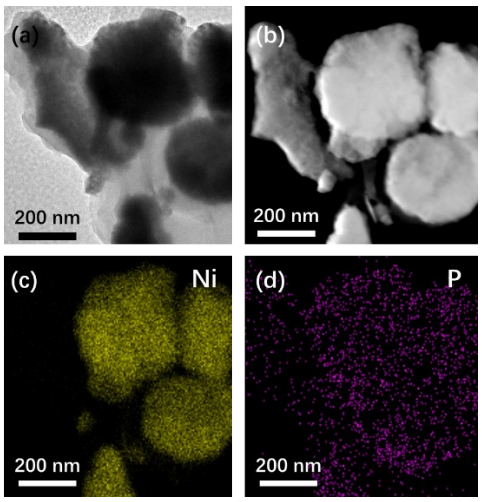

Figure S4. (a) TEM images, (b) HAADF-TEM images of CPNi/AP, and (c)-(d) corresponding Ni and P EDS images.

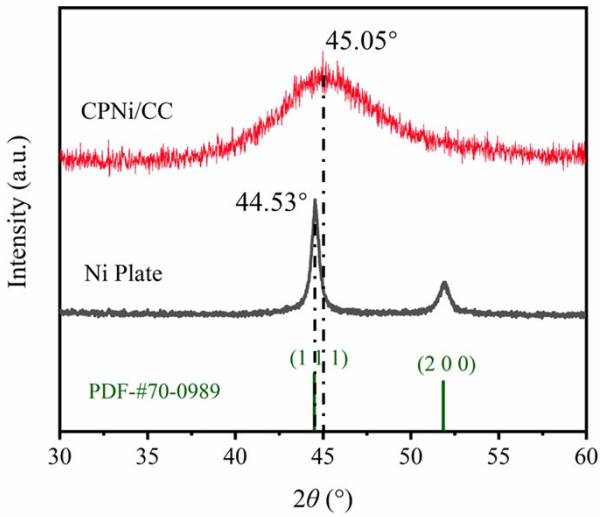

Figure S5. XRD patterns of Ni Plate, cracked phosphorus doped nickel plating on carbon cloth (CPNi/CC) at 30° to 60° magnification intervals.

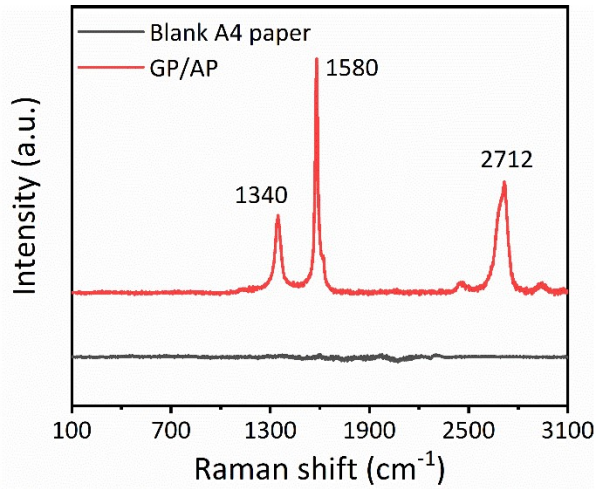

Figure S6. Raman spectra of the blank A4 paper and GP/AP.

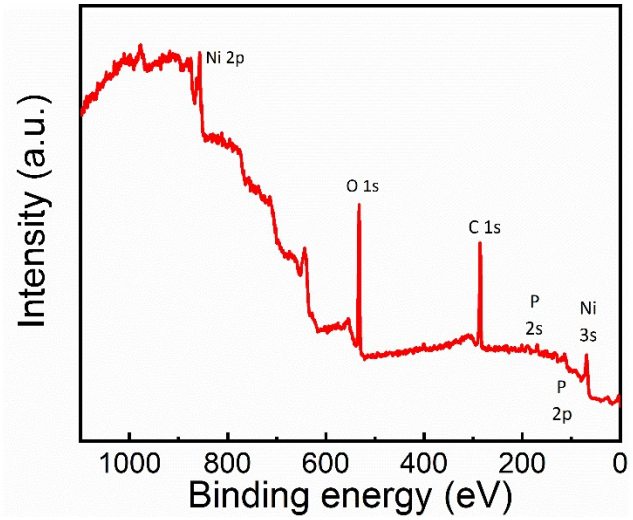

Figure S7. XPS survey spectrum of CPNi/AP.

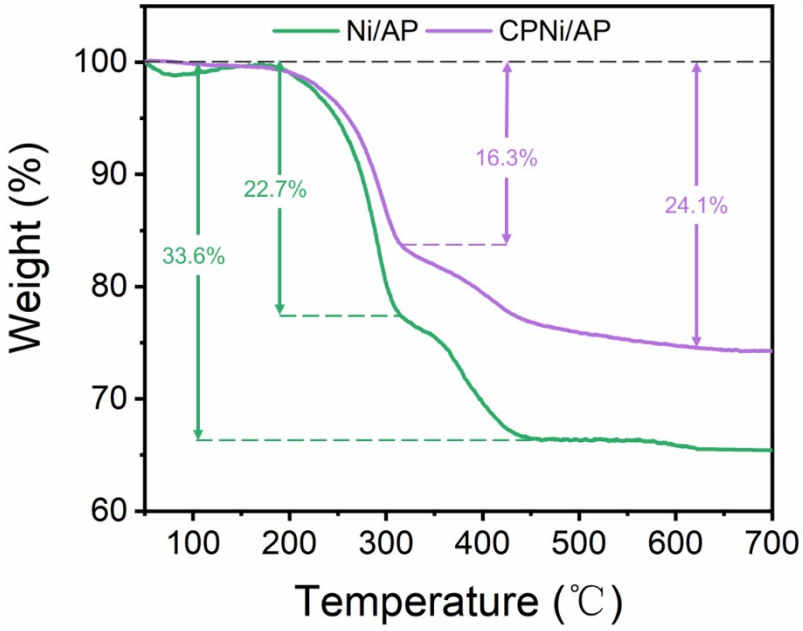

Figure S8. TG curves of CPNi/AP and Ni/AP.

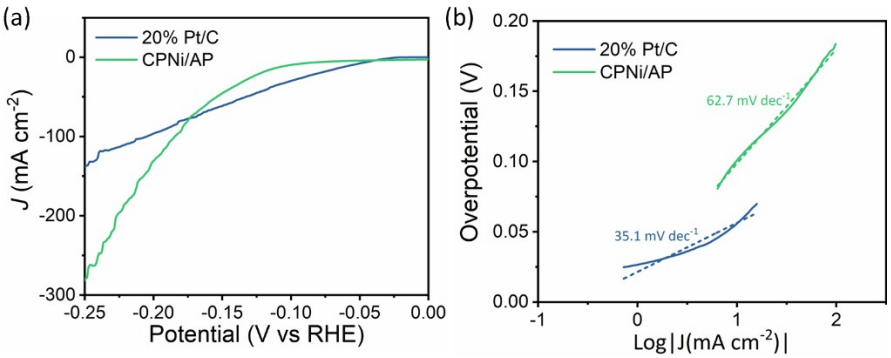

Figure S9. (a) HER polarization curves and (b) Tafel plots of 20% Pt/C and CPNi/AP in 1.0M KOH solution at a scan rate of 1 mV s^{-1}.

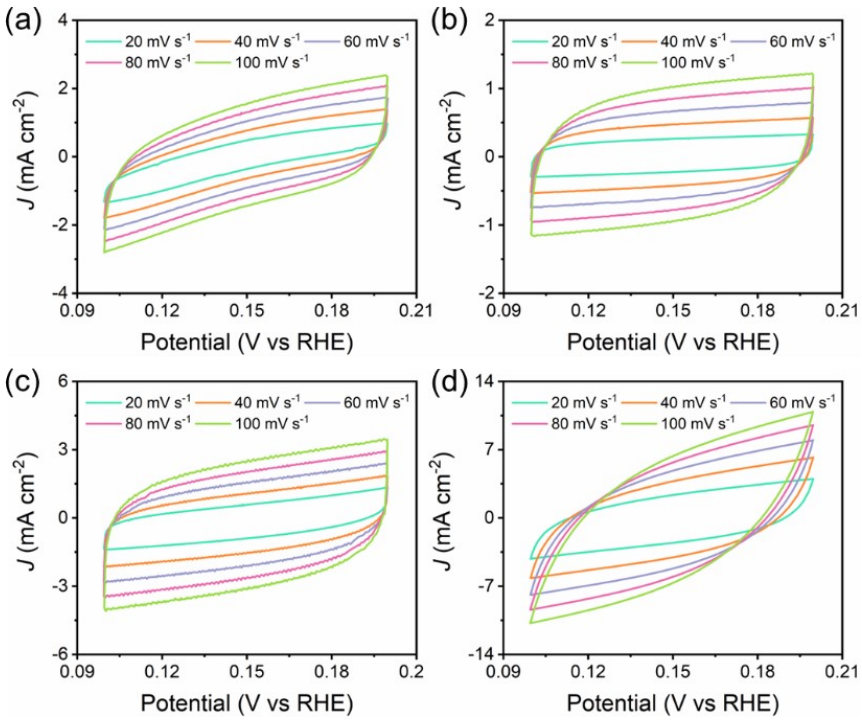

Figure S10. CV curves of (a) Pt plate, (b) Ni plate, (c) Ni/AP and (d) CPNi/AP with different current density.

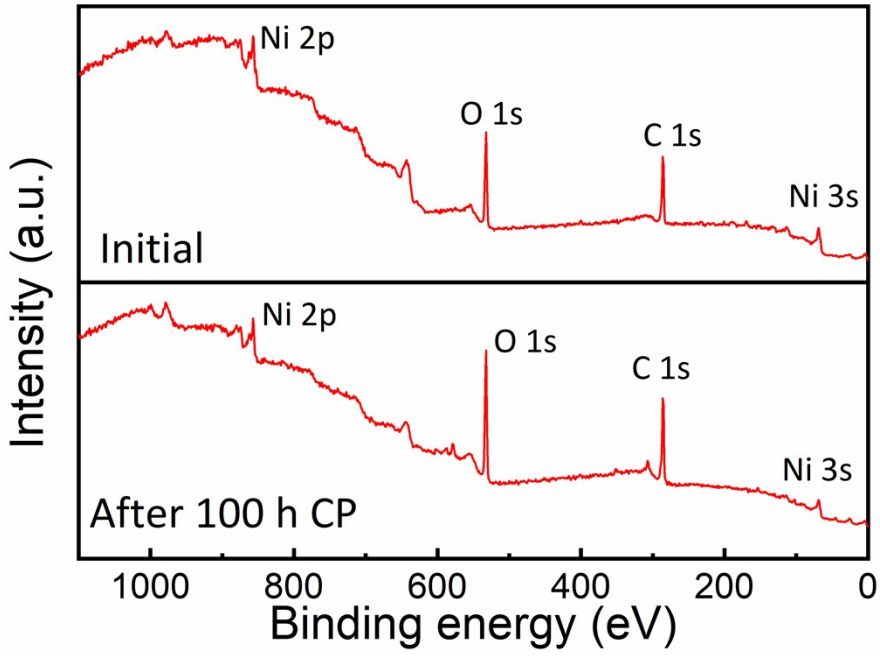

Figure S11. XPS survey spectra of CPNi/AP before and after the chronopotentiometry tests with a constant current density of 10 mA cm^{-2} for 100 h.

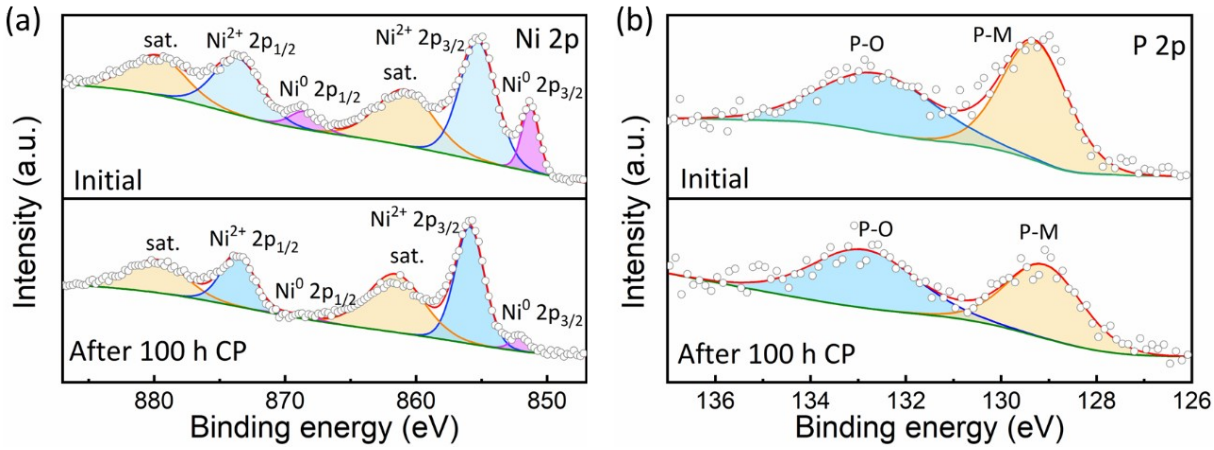

Figure S12. High-resolution XPS spectra of (a) Ni 2p and (b) P 2p in CPNi/AP before and after the chronopotentiometry tests with a constant current density of 10 mA cm^{-2} for 100 h.

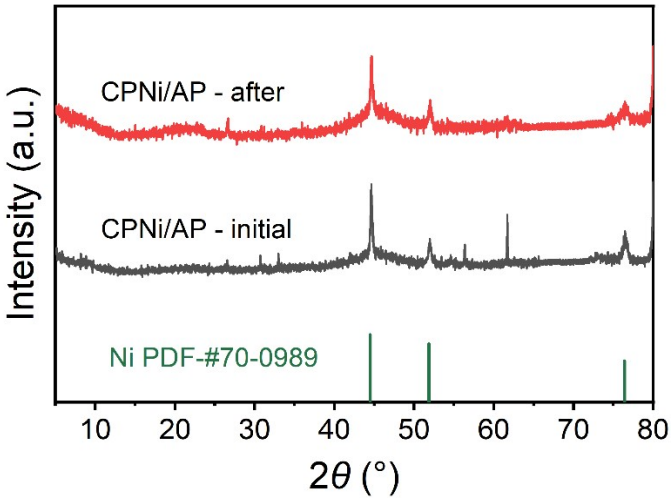

Figure S13. XRD patterns of CPNi/AP before and after reaction.

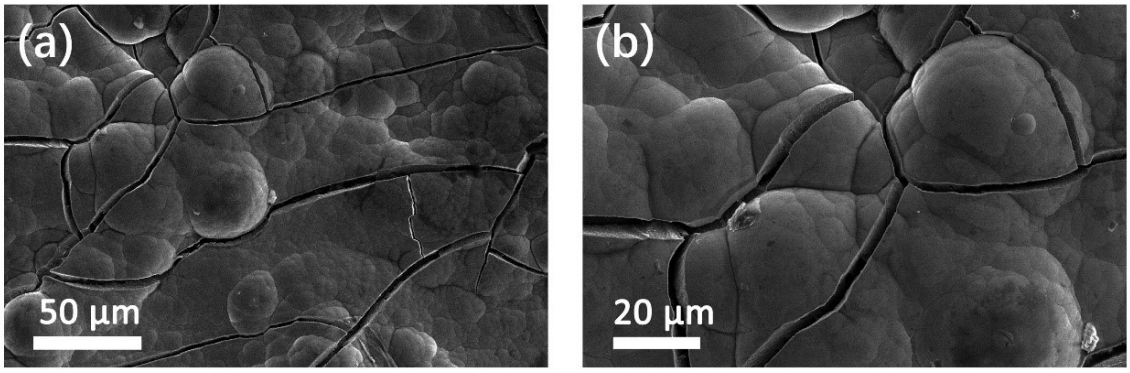

Figure S14. SEM images of CPNi/AP at different magnifications after 100 h CP test.

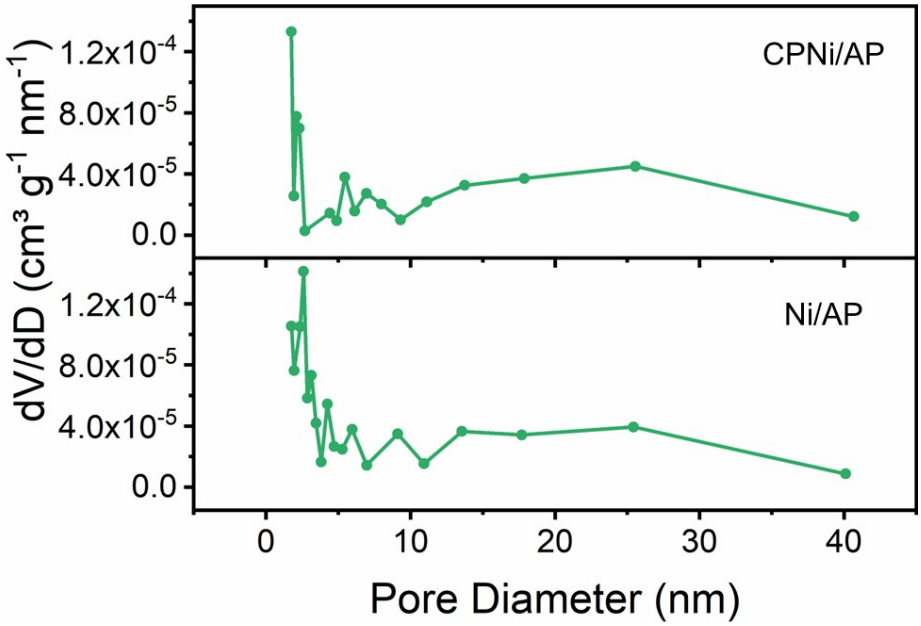

Figure S15. Pore size distribution of CPNi/AP and Ni/AP.

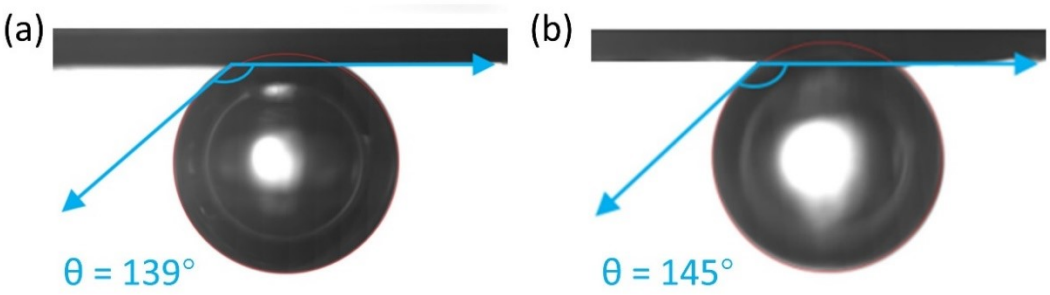

Figure S16. The gas bubble contact angles of (a) Ni plate and (b) Ni/AP.

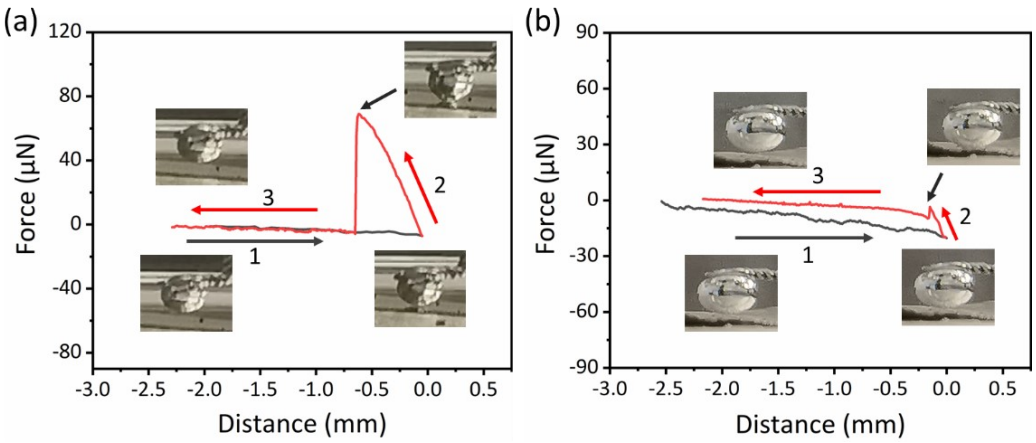

Figure S17. Adhesive forces measurements of the gas bubbles on (a) Ni plate and (b) Ni/AP.

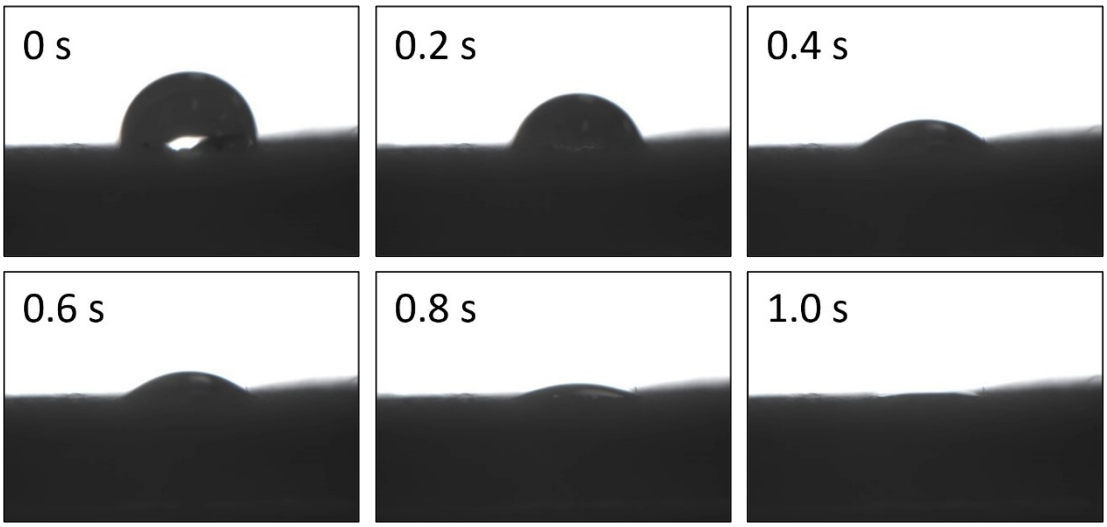

Figure S18. Contact angle of CPNi/AP.

Table S1. Selected summary of the HER performance of some Ni_xP catalysts.

Catalyst	Substrate	Electrolyte	Overpotential (mV)		Synthetic method	Ref.
			η_{10}	η_{100}		
Ni_2P nanosheets	Glassy carbon	1 M KOH	168		Hydrothermal	[1]
Ni_5P_4 Nanocrystalline	Glassy carbon	1 M KOH	49	202	Solvothermal	[2]
$Ni_{12}P_5$ hollow	Glassy carbon	1 M KOH	208		Thermal decomposition	[3]
NiP_x nanospheres	Glassy carbon	0.1 M buffer solution	230	360*	Electrosynthesis	[4]
NiP_2 nanosheet arrays	Carbon cloth	0.5 M H_2SO_4	75	204	Hydrothermal	[5]
Ni_5P_4 nanosheets	Glassy carbon	1 M KOH	147		Ice-templating	[6]
Ni_2P	Carbon cloth	1 M KOH	114	290*	Hydrothermal	[7]
Ni_2P	Ni foam	1 M KOH	207	400*	Hydrothermal	[8]
Fe-Ni_2P	Ni foam	1 M KOH	75	226	Hydrothermal	[9]
Ni-P	Ni foam	1 M KOH	200	310	Hydrothermal	[10]
Ni_2P	Porous carbon	0.5 M H_2SO_4	194		Thermal decomposition	[11]
Ni-P	Carbon nanotubes	1 M KOH	126		Powder sintering	[12]
NiP	Glassy carbon	1 M KOH	155	400*	Hydrothermal	[13]
HP Ni-P	RDE	1 M KOH	99	144	Electrodeposition	[14]
$Ni_2P/Ni_{12}P_5$	Ni foam	1 M KOH	95	203	Hydrothermal	[15]
CPNi/AP	A4 paper	1 M KOH	101	183	Electrodeposition	Current work

***** Based on estimation of the LSV curves in the article.

Table S2. The R_{ct} values for different electrodes in 1 M KOH.

Electrode	Electrolyte	R_{ct} (Ω)
Pt plate	1 M KOH	7.2
Ni plate		12.6
Ni/AP		5.3
CPNi/AP		2.0

Table S3. Table of volume change of $Ni_{27-x}P_x$.

The number of x in $Ni_{27-x}P_x$	**The volume of lattice （Å³）**					**Average volume(Å³)**
	Atomic structure model 1	Atomic structure model 2	Atomic structure model 3	Atomic structure model 4	Atomic structure model 5	
0	291.33					291.33
1	290.80	290.42	290.77	290.42		290.60
2	289.54	289.54	289.54	289.54	287.89	289.21
3	288.33	288.63				288.48

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