Supporting Information

Nickel nanoparticles oriented on carbon materials as an efficient electrocatalysts for hydrogen evolution reaction

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Electrochemical measurements were tested by the CHI760 chemical workstation at room temperature in a convention three-electrode system with 1.0 M KOH (pH=14) solution. Saturated calomel, carbon and glassy carbon (GC) dropped with catalyst as reference, counter electrodes and working electrode, respectively. The measured potentials with no iR correction and transformed to the reversible hydrogen potential (RHE) according to this formula: $E_{(RHE)=}E_{(SCE)}+0.0592\times pH+0.242$ V. Typically, 20 mg catalyst and 1.0 mg Ketjenblack were dispersed in ethanol-DMF (1 mL) solution of 7:3 volume ratio with 20 μL Nafion by ultrasonication for 30 min. Then, 10 μL dispersion solution was spread on the GC electrode surface dried at room temperature. The HER performance were measured at the scanning window form -0.9 V to -1.5 V with the scanning speed of 2 mV s^{-1} under 1.0 M KOH electrolyte. Cyclic voltammetry (CV) was recorded with the scanning speeds of 20, 40, 60, 80, and 100 mVs^{-1} in non-Faradaic region from -0.40 V to -0.50 V. Electrochemical impedance spectroscopy (EIS) were tested at the frequency area from 1-10^5 Hz under the bias potential of -1.2V. The electrocatalytic stability was measured by i-t test and continuous cyclic voltammograms test.

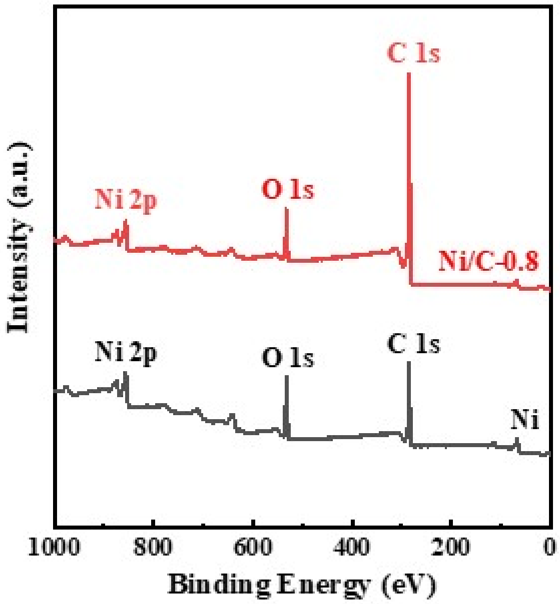

Figure S1. XPS survey spectra of Ni and Ni/C-0.8 samples.

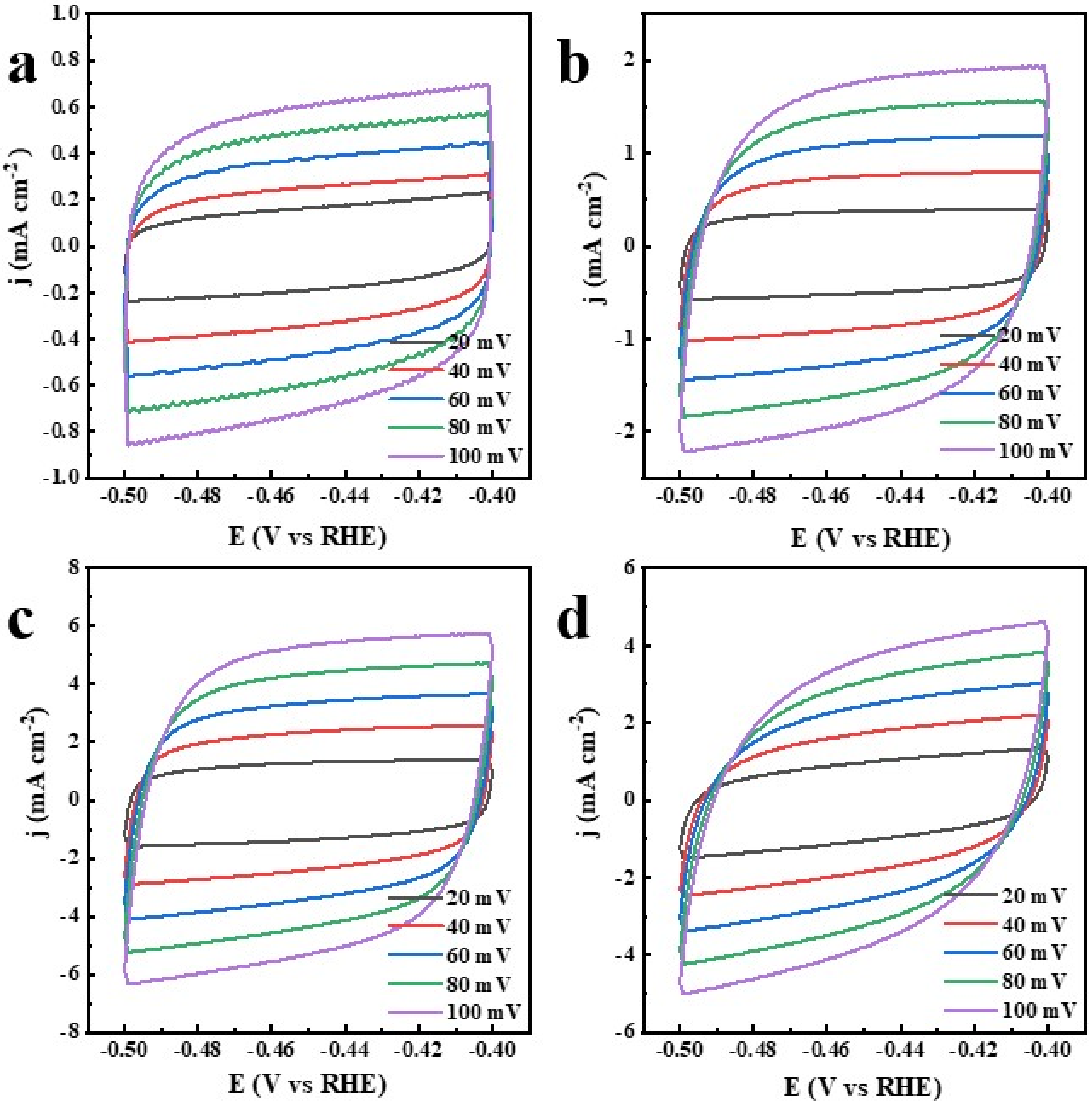

Figure S2. CV curves at different scan rates of (a) Ni. (b) Ni/C-0.6. (c) Ni/C-0.8. (d) Ni/C-1.

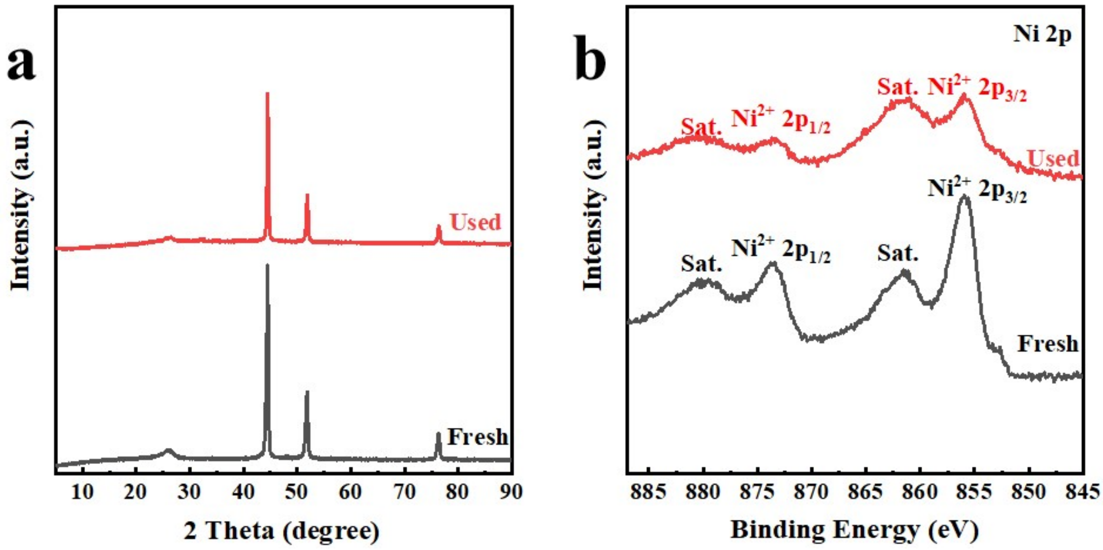

Figure S3. (a) XRD patterns of the Ni/C-0.8 samples before and after the stability test. (b) Ni 2p XPS spectra of the Ni/C-0.8 samples before and after the stability test.

Table 1. Compare electrocatalytic HER performance with other Ni-based electrocatalyst.

Catalysts	**Substrate**	**Electrolyte**	**$^a\eta10$ (mV)**	**$^b\eta100$ (mV)**	**Reference**
Ni@B-C	GC	1 M KOH	176	-	[1]
Ni@NC-800	GC	1 M KOH	205	305	[2]
Ni@CNTs-650	GC	1 M KOH	266	-	[3]
Fe-B@Ni-0.49	GC	1 M KOH	202	379	[4]
Ni-MoO_2@BC	GC	1 M KOH	204	-	[5]
Ni/C-2	GC	1 M KOH	94	-	[6]
Ni/NC-0.35	GC	1 M KOH	133	270	[7]
Ni_2P/CNT	GC	0.5 M H_2SO_4	124	-	[8]
$(LaPO_4)$m/Ni_2P	GC	1 M KOH	191	-	[9]
Co-30Ni-B	GC	1 M KOH	133	233	[10]
Ni/C-0.8	**GC**	**1 M KOH**	**132**	**301**	**This Work**

^{a}Overpotential in electrocatalytic HER at -10 mA cm^{-2}. ^{b}Overpotential in electrocatalytic HER at -100 mA cm^{-2}.

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