Supporting information

Three-dimensional chain-like nickel-based electrocatalyst with hierarchical structure as highly electrocatalyst for hydrogen evolution reaction

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Physical characterization

Scanning electron micrographs (SEM) images were taken on JSM-6330F microscope. Transmission electron microscope (TEM) was performed on a JEOL JEM-2000 FX instrument operated at 200 kV. Energy dispersive spectroscopy (EDS) was used to determine elemental composition. VG Escalab210 spectrometer fitted with Mg 300 W X-ray source was used to get the X-ray photoelectron spectra (XPS). X-ray diffraction was done on Shimadzu XDe3A equipped with Cu-Kα radiation ($\lambda =$ 0.15418 nm).

Electrochemical characterizations

The electrocatalytic properties of as-prepared electrodes were evaluated in a three electrode cell, which was connected to electrochemical workstation (CHI650D, CH Instruments). In the three-electrode cell, the as-prepared electrode (size: 1×1 cm^2) was used as working electrode, graphitic rod as counter electrode, Hg/HgO (1 M KOH) as reference electrode, and 1 M KOH as the electrolyte. All potentials were normalized

to the reversible hydrogen electrode by the equation: $E_{RHE} = E_{Hg/HgO} + 0.059\ pH + 0.14$ V. iR compensation was applied to all the electrochemical tests, $iR = 90\%$.
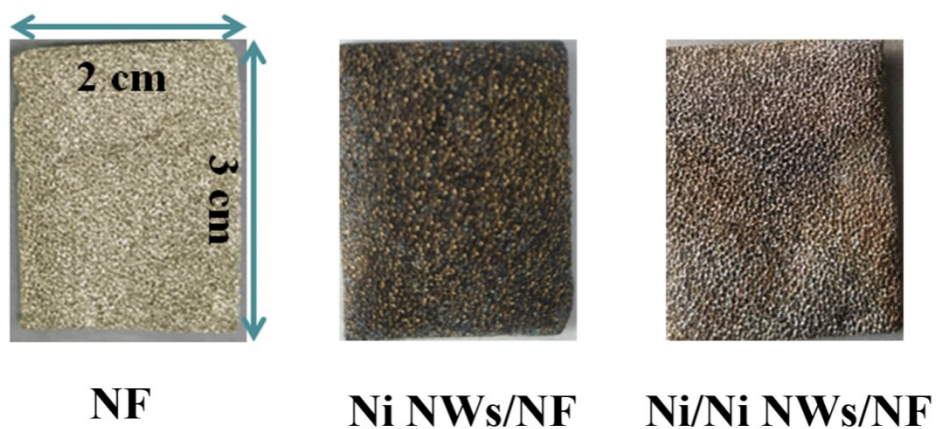

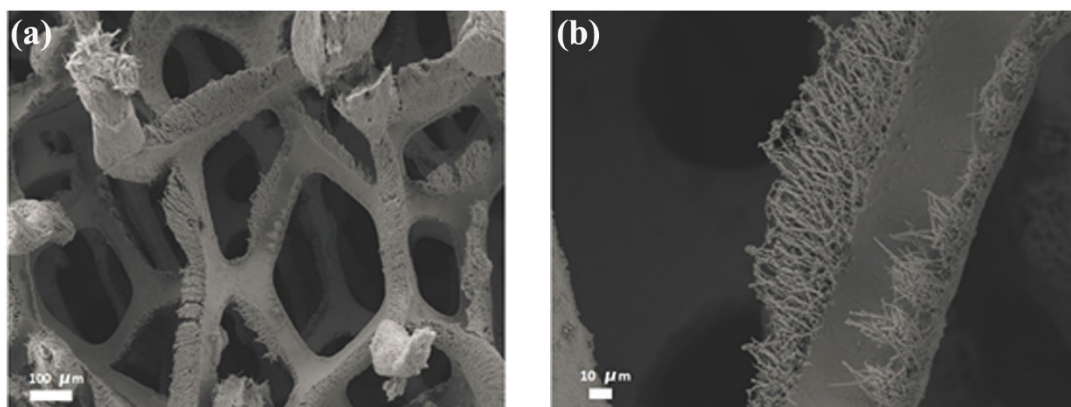**Figure S1.** Picture of NF, Ni NWs/NF, and Ni/Ni NWs/NF.

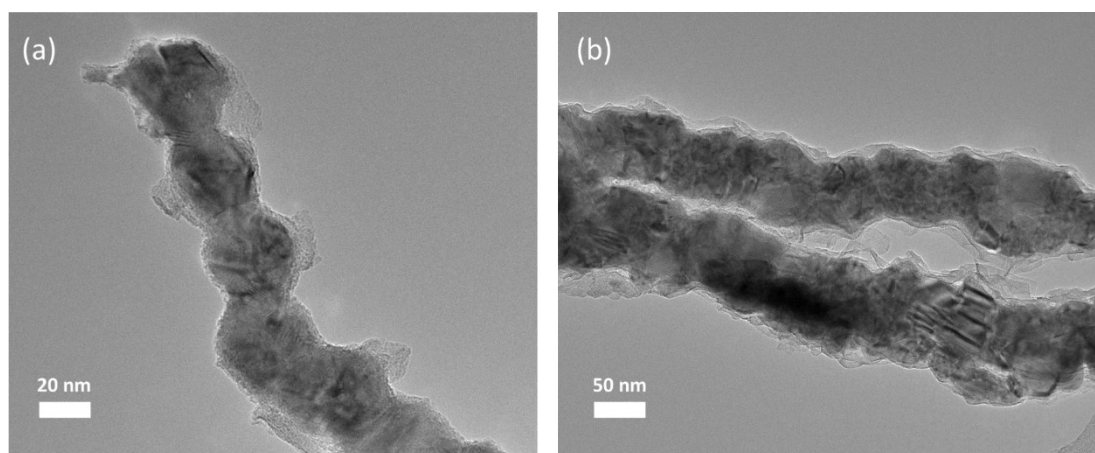**Figure S2.** SEM picture of Ni NWs/NF.

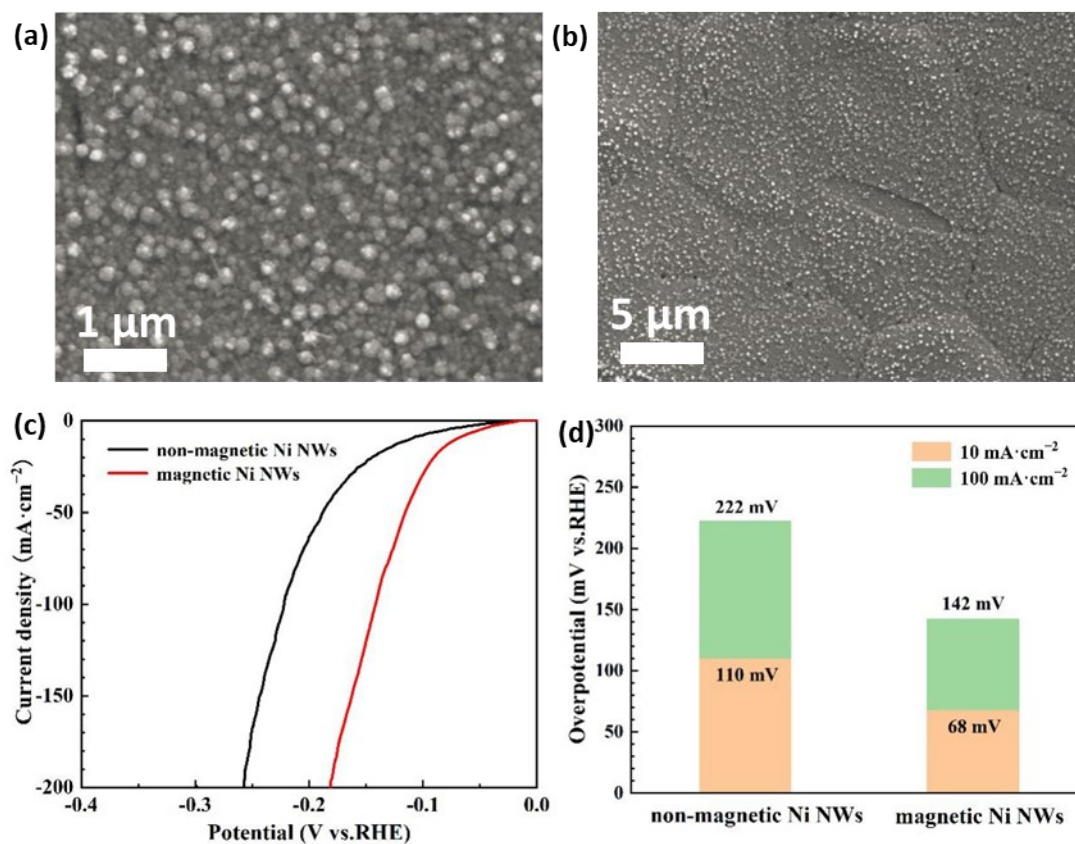**Figure S3.** TEM picture of Ni NWs/NF.

Figure S4. SEM picture of Ni NWs/NF samples prepared without a magnetic field (a) and (b); HER LSV curves of Ni NWs/NF samples prepared with or without a magnetic field (c) and (d).
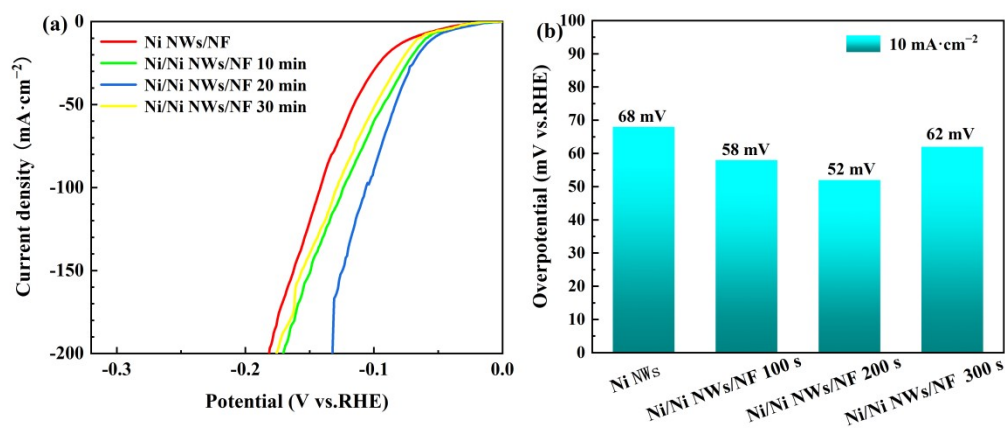

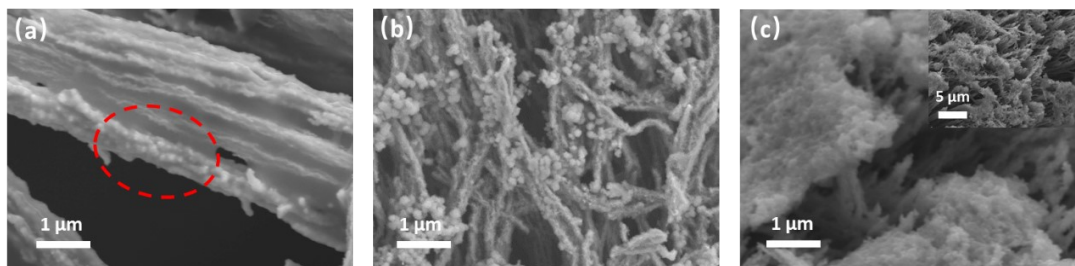**Figure S5.** HER LSV curves of the Ni/Ni NWs/NF samples prepared with different electrodeposition times

Figure S6. SEM picture of the Ni/Ni NWs/NF samples prepared with different electrodeposition times (a) 10 min, (b) 20 min, (c) 30 min.
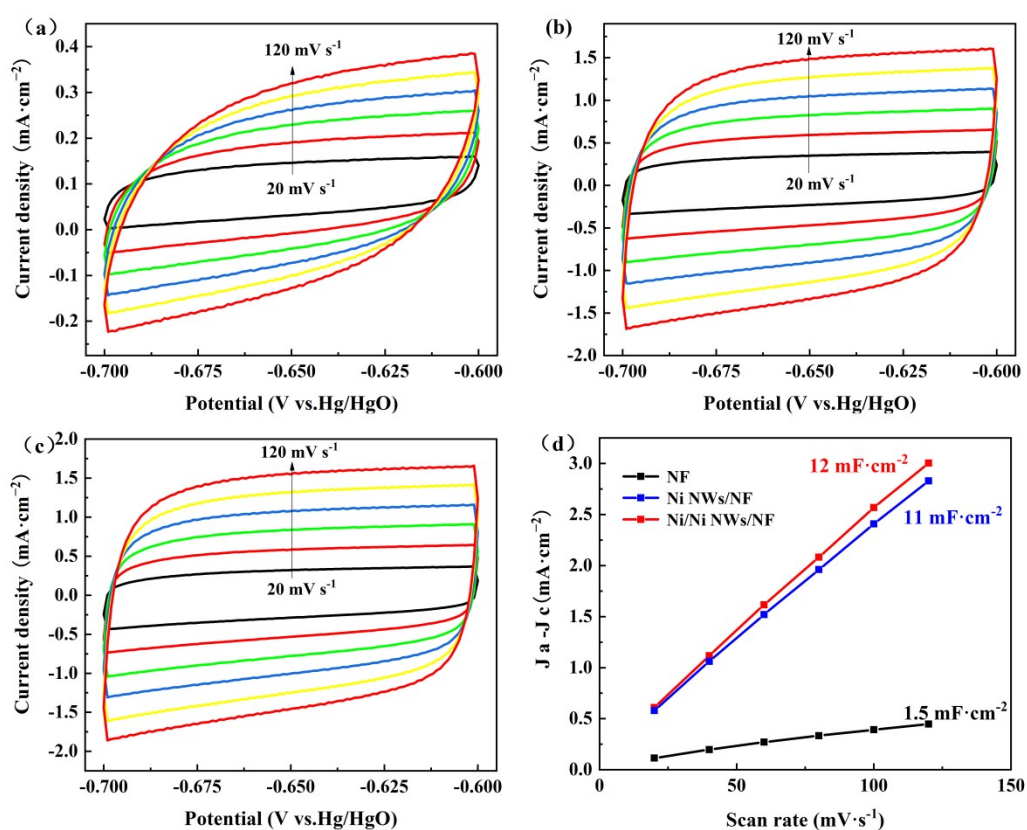

Figure S7. Cyclic Voltammetry plots of (a) NF; (b) Ni NWs/NF; (c) Ni/Ni NWs/NF; (d) linear fitting of HER $\triangle j$ vs. scan rates at +0.316 V *vs.* RHE

Table S1. Fitting values of Pt/C, Ni/ Ni NWs/NF, Ni NWs/NF, Ni/NF, NF

electrochemical composition in Nyquist

Samples	R_s(**ohm**)	R_{ct}(**ohm**)
Pt/C	0.9548	0.20635
Ni/ Ni NWs/NF	0.90878	1.007
Ni NWs/NF	0.9225	1.321
Ni/NF	0.9695	39.43
NF	0.90732	57.54

Table S2. Comparison of HER activities of various catalysts

Catalyst	Electrolyte	Substrate	η10 (mV)	Reference
Ni/ Ni NWs/NF	1 M KOH	Ni foam	52	**This work**
Ni–Ni(OH)$_2$	1 M KOH	Cu foam	57	[1]
Ni$_3$N-V$_2$O$_3$	1 M KOH	Ni foam	57	[2]
NiP$_2$/NiSe$_2$	1 M KOH	carbon fiber cloth	100	[3]
Ni^{III}Co^{II}Fe-O@NF	1 M KOH	Ni foam	58	[4]
Co$_{0.9}$Ni$_{0.1}$Se with vacancies	0.5 M H$_2$SO$_4$	-	185.7	[5]
NiCoFeP	1 M KOH	-	131	[6]
Ni–WSe$_2$	0.5 M KOH	-	215	[7]
Fe-doped NiS$_2$	0.5 M H$_2$SO$_4$	-	198	[8]
MoS$_2$ /Ni$_2$O$_3$H	1 M KOH	carbon fiber paper	84	[9]
CoS|Ni|P	0.5 M H$_2$SO$_4$	Ni foam	41	[10]
MoO$_3$ /Ni–NiO	1 M KOH	carbon cloth	62	[11]

NiCu/C	**0.5 M H$_2$SO$_4$**	Tissue paper	184	[12]
MoO$_2$ –Ni NWs/NF	**1 M KOH**	Ni foam	58.4	[13]
α-Ni(OH)$_2$ •0.75H$_2$O/NF	**1 M KOH**	Ni foam	26	[14]
Ru/c-Ti$_3$C$_2$T$_x$/NF	**1 M KOH**	Ni foam	37	[15]

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