

Supporting Information

MOF-derived coral-like NiSe@NC nanohybrid: an efficient electrocatalyst for hydrogen evolution reaction under all-pH values

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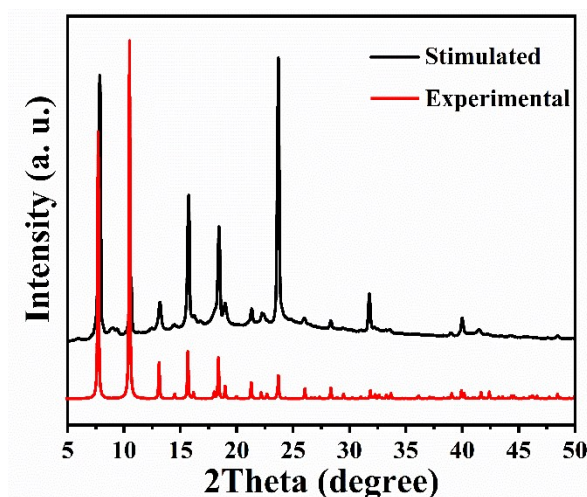


Fig. S1. The XRD patterns of Ni-MOFs.

Table S1. The approximate contents of NiSe and carbon for NiSe@NC-500, NiSe@NC-550,

NiSe@NC-600, NiSe@NC-650, NiSe@NC-700.

Catalysts	NiSe (%)	C (%)
NiSe@NC-500	88.08	11.92
NiSe@NC-550	62.33	37.67
NiSe@NC-600	67.27	32.73
NiSe@NC-650	86.25	13.75
NiSe@NC-700	90.33	9.67

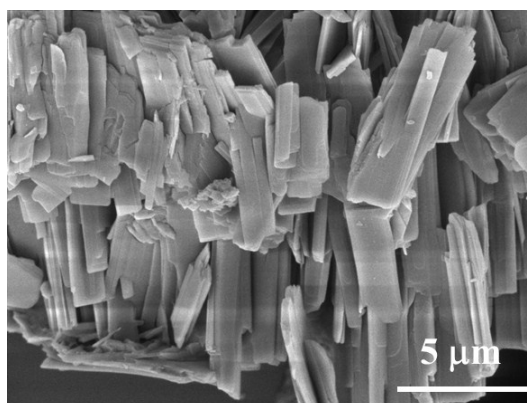


Fig. S2. The SEM image of Ni-MOFs.

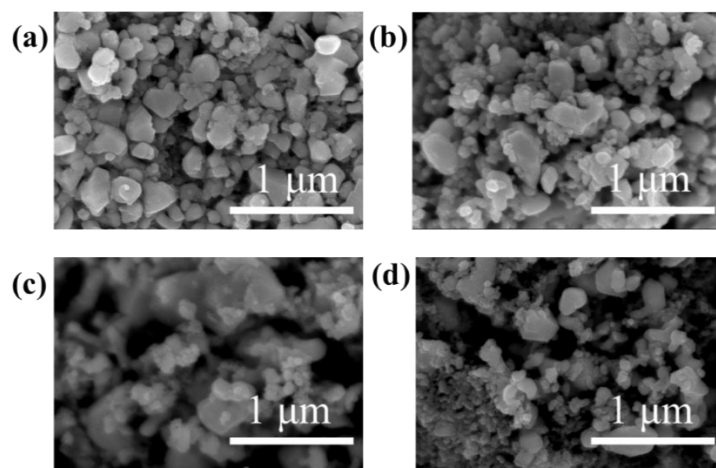


Fig. S3. The SEM images of (a) NiSe@NC-500, (b) NiSe@NC-550, (c) NiSe@NC-650, (d)

NiSe@NC-700.

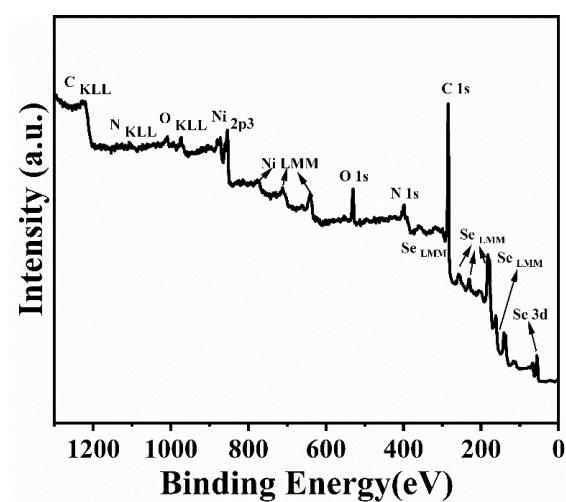


Fig. S4. XPS survey of NiSe@NC-600.

Table S2. Element contents of NiSe@NC-600 obtained by XPS spectrum.

Elements	Se (At. %)	Ni (At. %)	C (At. %)	N (At. %)
Contents	24.1	26.5	44.5	4.9

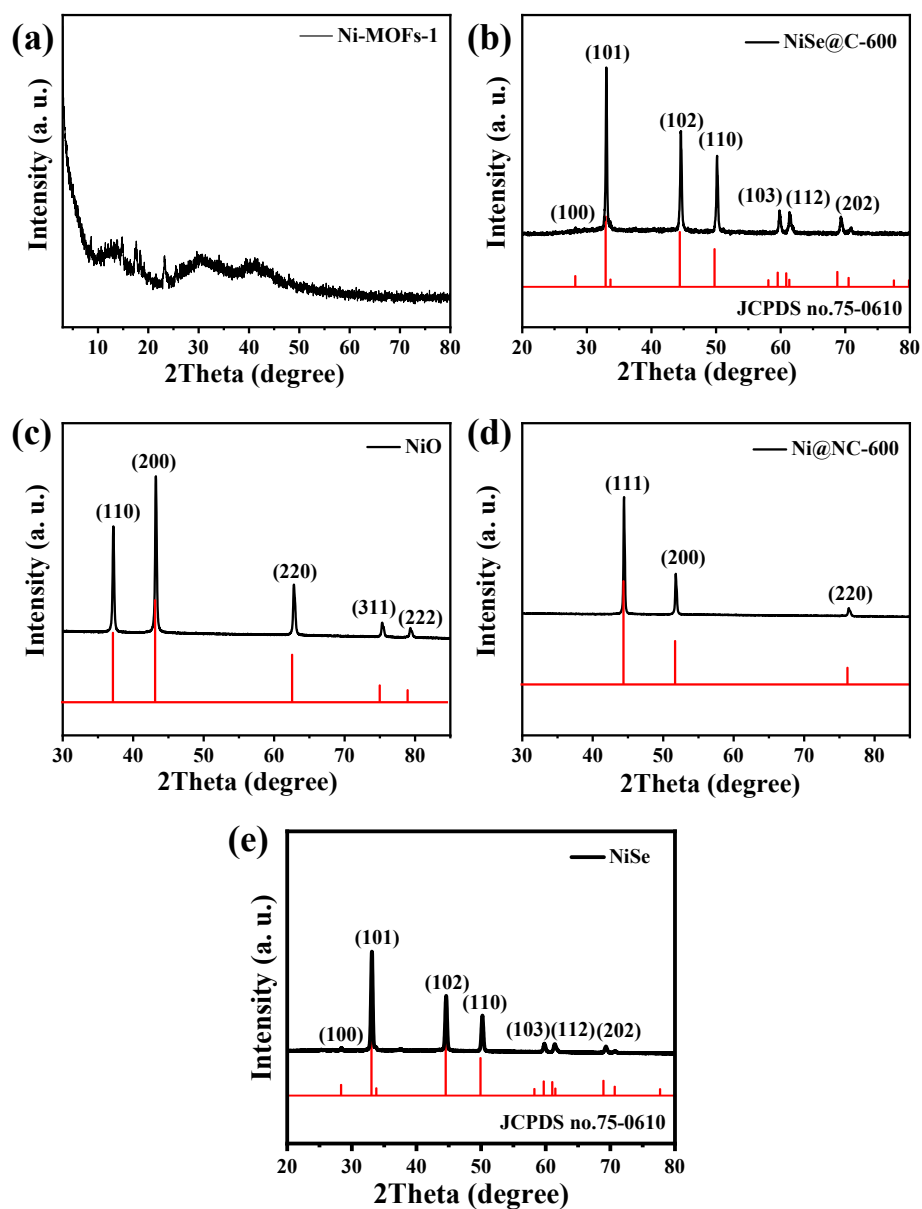


Fig. S5. XRD patterns of (a) Ni-MOFs-1, (b) NiSe@C-600, (c) NiO, (d) Ni@NC-600 and (e)

NiSe.

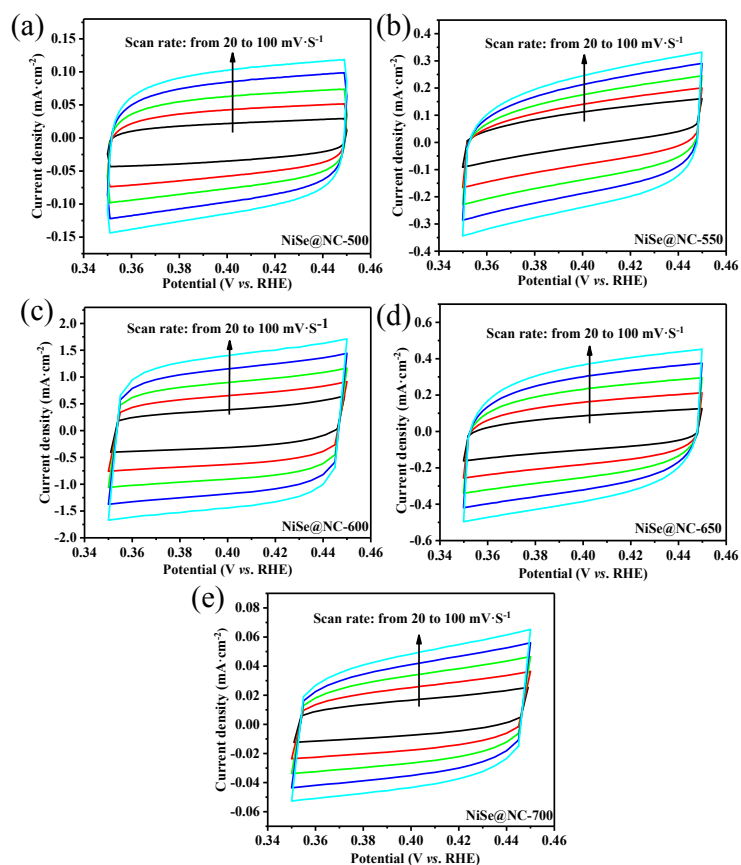


Fig. S6. Cyclic voltammograms (CV) at various scan rate of (a) NiSe@NC-500 (b) NiSe@NC-550. (c) NiSe@NC-600. (d) NiSe@NC-650. (e) NiSe@NC-700 for HER.

Table S3. Comparison of catalytic performance of different HER electrocatalysts in 0.5 M H₂SO₄.

Electrocatalyst	η_0 (mV)	Tafel (mV dec ⁻¹)	C_{dl} (mF·cm ⁻²)	ECSA (cm ²)	R_{ct} (Ω)
NiSe@NC-500	140	62.1	1.0	28.6	100.2
NiSe@NC-550	80	61.3	4.4	125.7	44.1
NiSe@NC-600	60	53.3	13.4	383	38.5
NiSe@NC-650	100	62.7	3.5	100	65.2
NiSe@NC-700	150	76.8	0.4	11.4	167.1

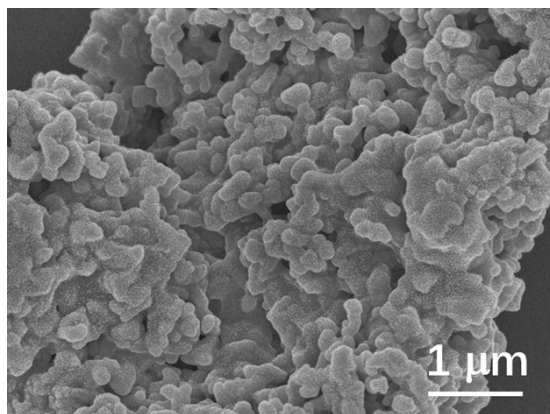


Fig. S7. SEM image of NiSe@NC-600 after 2000 CV cycles.

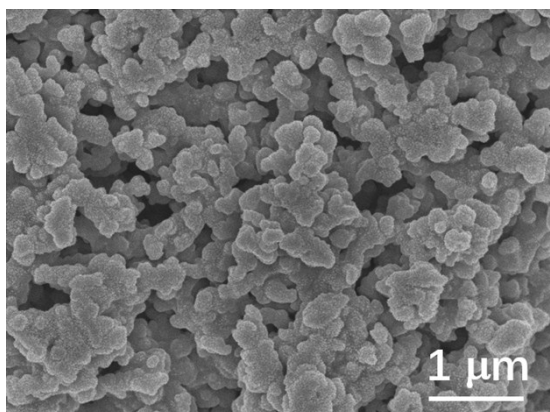


Fig. S8. SEM image of NiSe@NC-600 after 20h at 10 mA·cm⁻² in 0.5 M H₂SO₄ solution.

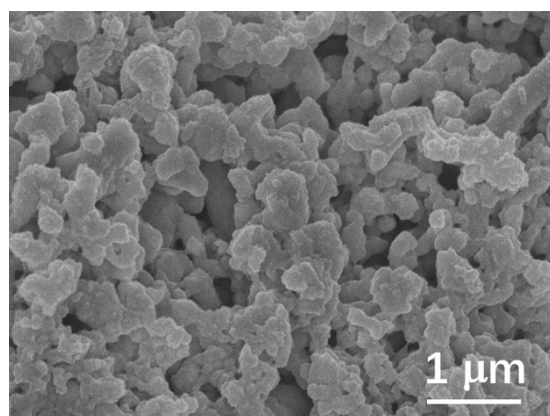


Fig. S9. SEM image of NiSe@NC-600 after 12h at 20 mA·cm⁻² in 0.5 M H₂SO₄ solution.

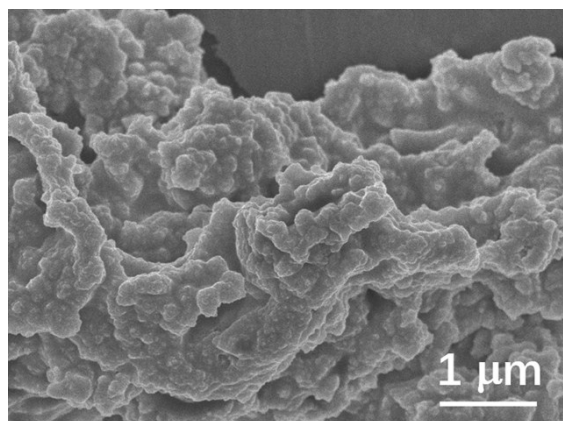


Fig. S10. SEM image of NiSe@NC-600 after 12h at $35 \text{ mA} \cdot \text{cm}^{-2}$ in $0.5 \text{ M H}_2\text{SO}_4$ solution.

Table S4. Comparison of electrocatalytic activity for recently reported HER catalysts.

Electrocatalyst	Electrolyte	$\eta_{10} (\text{mA} \cdot \text{cm}^{-2})$	References
NiSe@NC-600	0.5 M H_2SO_4	123	This work
CoSe ₂ NP/CP	0.5 M H_2SO_4	139	1 [1]
NiSe nanofibers	0.5 M H_2SO_4	270	2 [2]
NiSe ₂ NPs	0.5 M H_2SO_4	180	3 [3]
CoSe ₂ NPs	0.5 M H_2SO_4	193	4 [4]
NiSe ₂ NSs	0.5 M H_2SO_4	173	5 [5]
CoSe ₂ NP/CP	0.5 M H_2SO_4	139	6 [6]
NiSe ₂ /CNT	0.5 M H_2SO_4	200	7 [7]
CoSe ₂ NP	0.5 M H_2SO_4	250	8 [8]
Co _{0.85} Se	0.5 M H_2SO_4	180	9 [9]
NiSe ₂ /C	0.5 M H_2SO_4	200	10 [10]

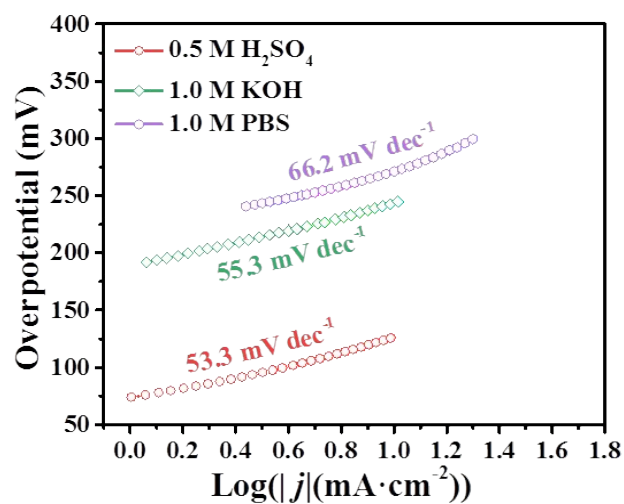


Fig. S11. Tafel plots of NiSe@NC-600 at different pH range.

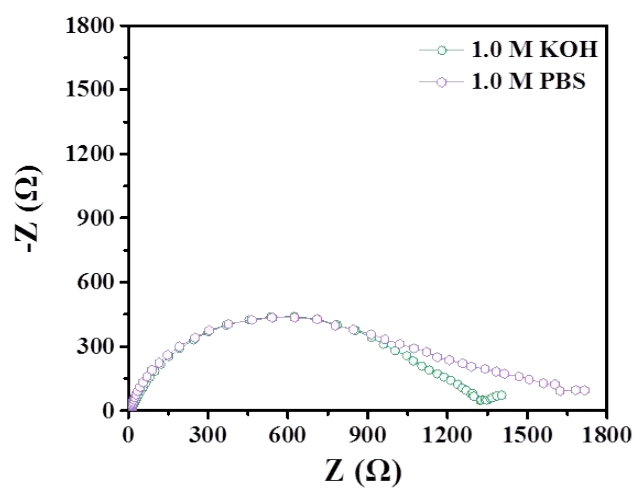


Fig. S12. Electrochemical impedance spectroscopy (EIS) of NiSe@NC-600 in neutral and alkaline solutions.

References

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