Supporting Information

Amorphous Ni-Fe-Se Hollow Nanospheres Electrodeposited on Nickel Foam as the Highly Active and Bifunctional Catalyst for Alkaline Water Splitting

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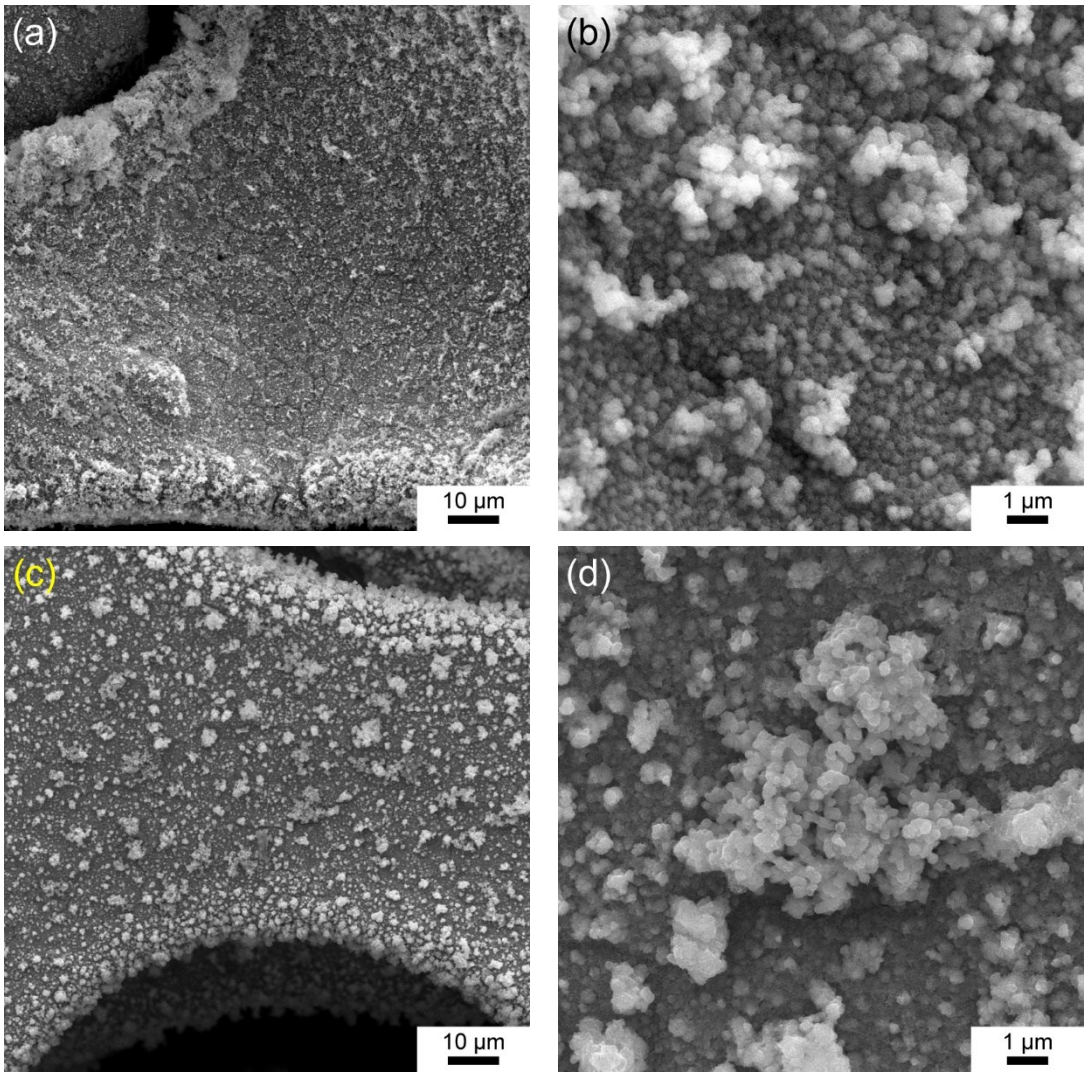

Fig. S1 SEM images of (a, b) Ni-Fe-Se/NF(-1.9) and (c, d) Ni-Fe-Se/NF(-1.1).

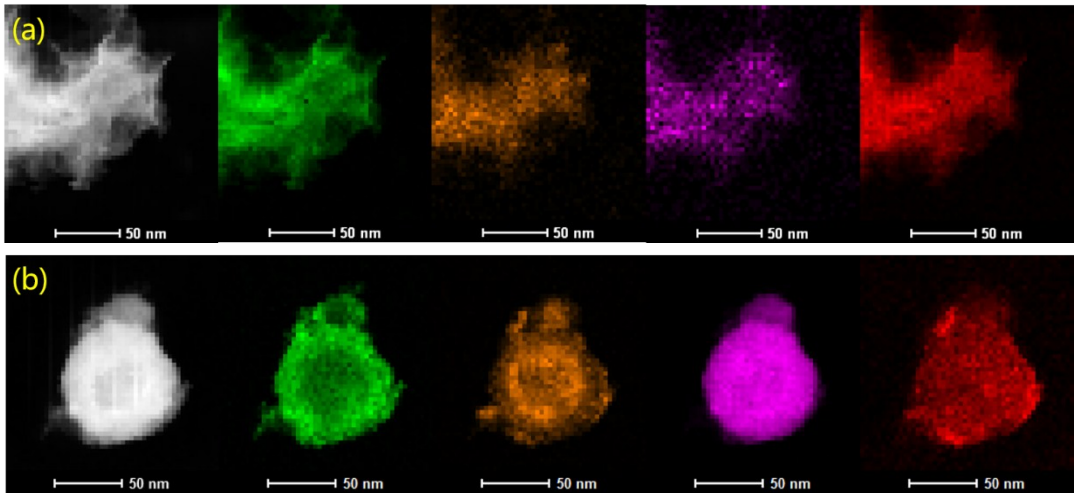

Fig. S2 High-angle annular dark field (HAADF) image (grey), Ni (green), Fe (brown), Se (purple) and O (red) mapping images of (a) Ni-Se/NF and (b) Fe-Se/NF.

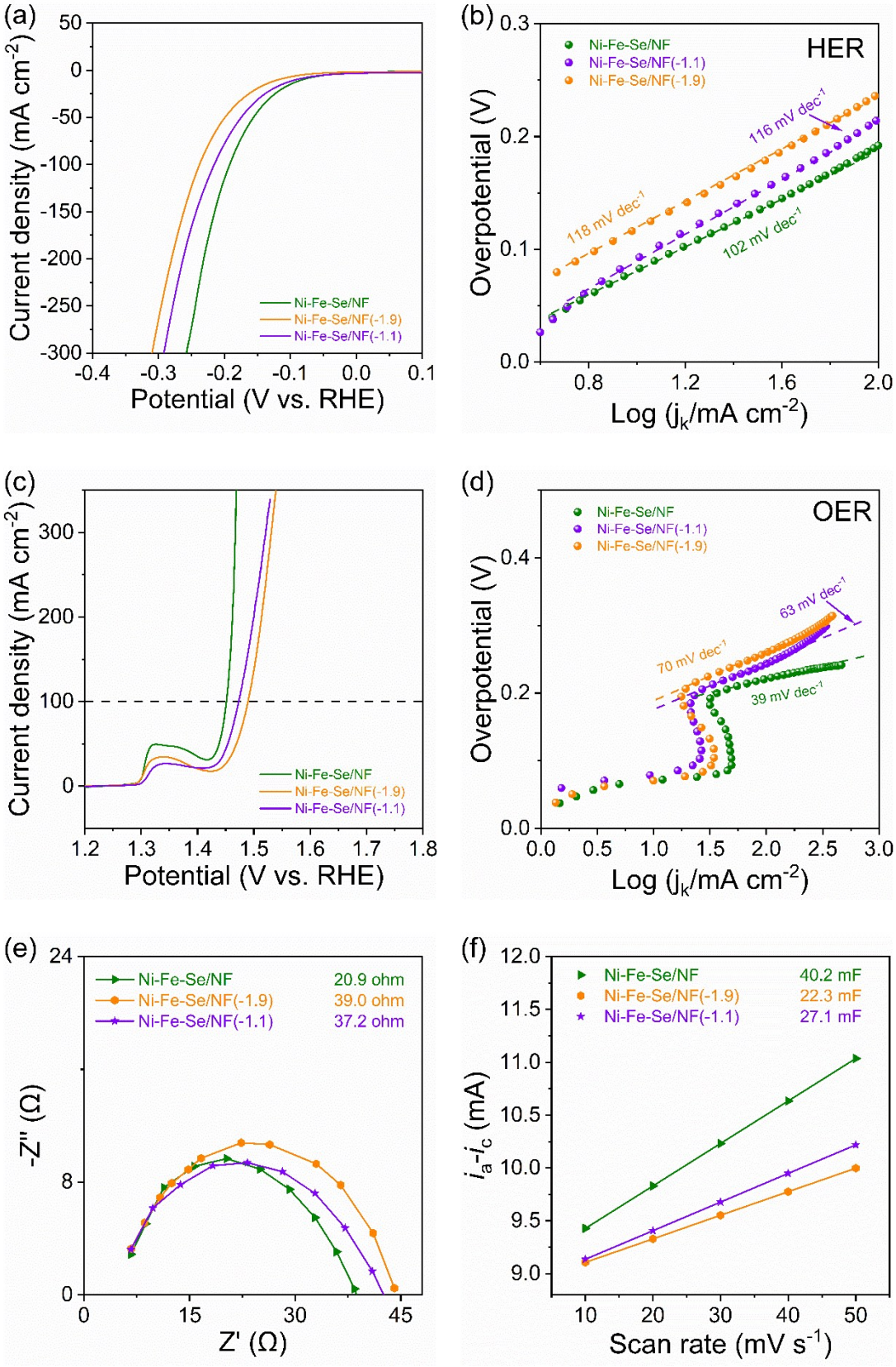

Fig. S3 Electrochemical performance of the resultant catalysts. (a, c) LSV curves; (b,

d) Corresponding Tafel plots. (e) Nyquist plots. (f) Double-layer charging currents plotted as a function of scan rate.

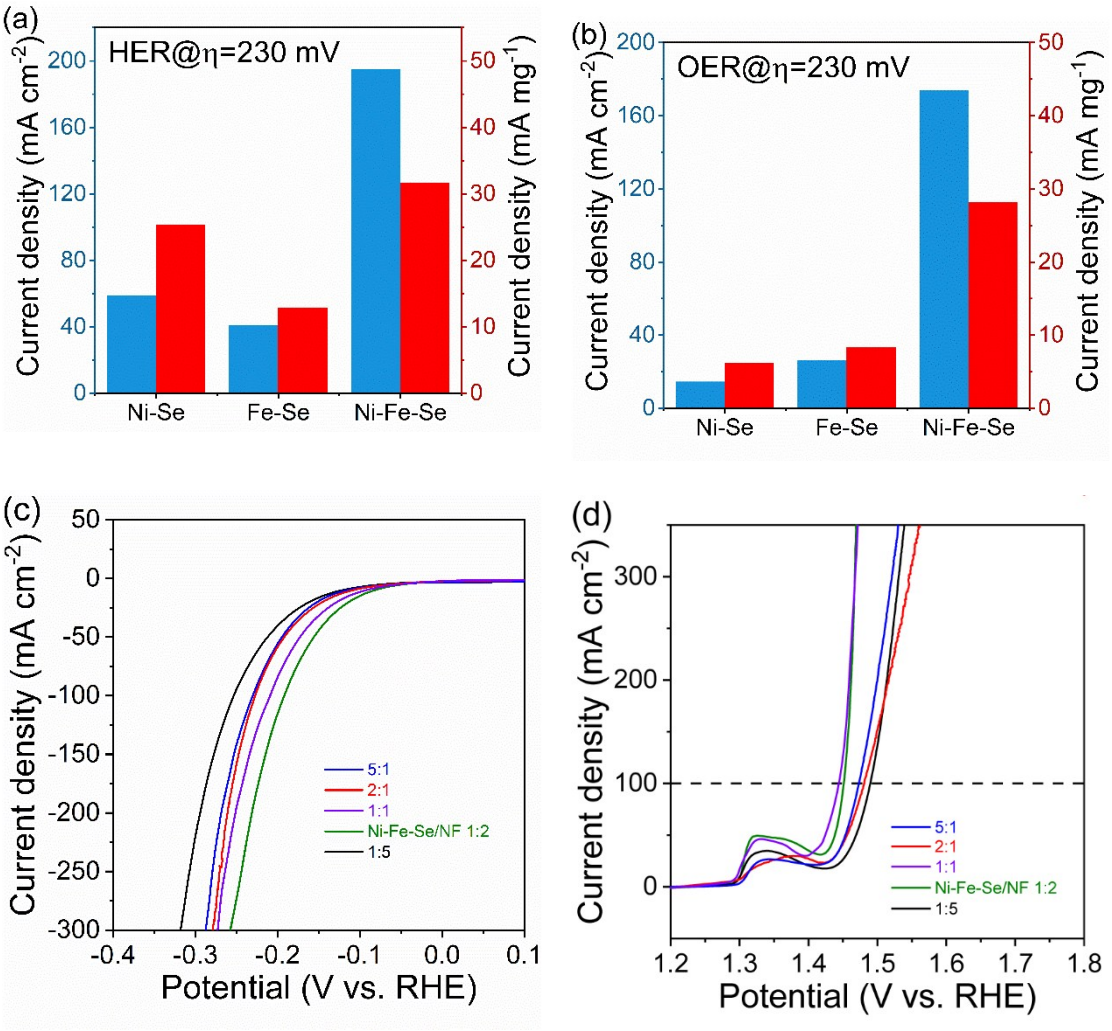

Fig. S4 Electrode geometric surface area normalized current density (blue) and catalysts loading mass normalized current density (red) for (a) HER and (b) OER. LSV curves of Ni-Fe-Se samples with various Ni:Fe feeding ratios for (c) HER and (d) OER.

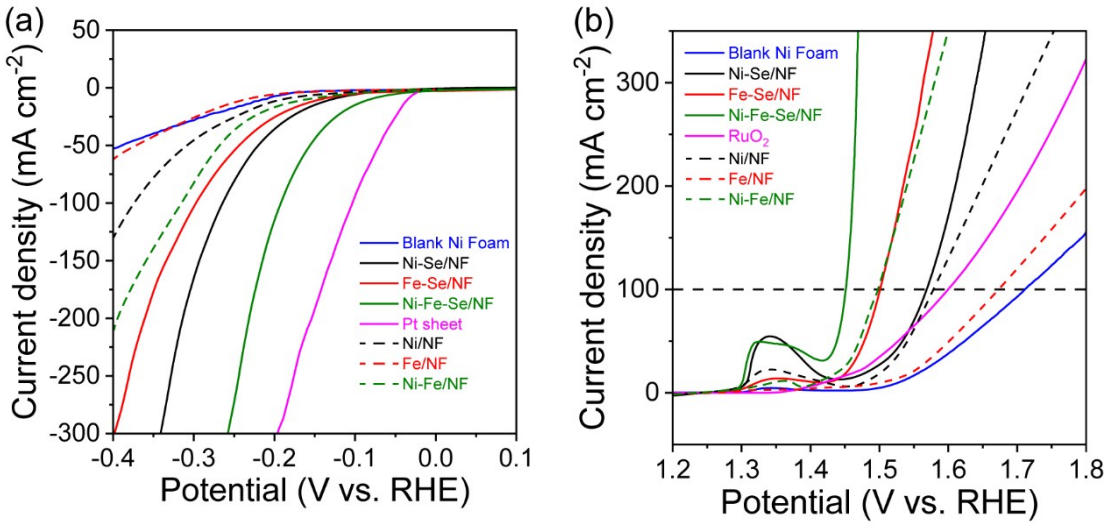

Fig. S5 LSV curves of the resulting samples with Se (Ni-Se/NF, Fe-Se/NF and Ni-Fe-Se/NF) and without Se (Ni/NF, Fe/NF and Ni-Fe/NF) for (a) HER and (b) OER.

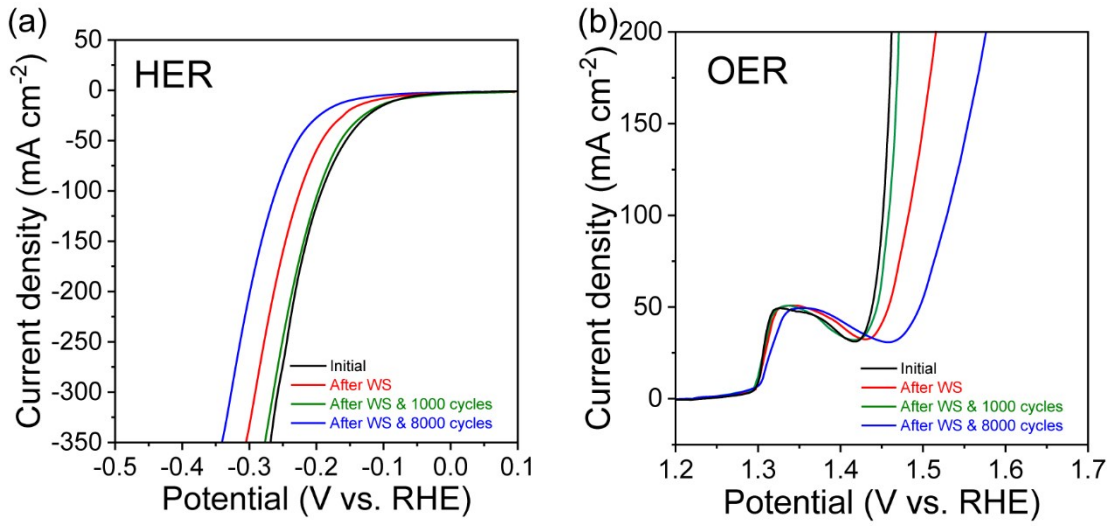

Fig. S6 LSV curves of Ni-Fe-Se/NF for HER (a) and OER (b) after chronopotentiometric water splitting tests and CV scans.

Table S1. The surface composition of the resultant samples determined by XPS.

Samples	C (at. %)	Ni (at. %)	Fe (at. %)	Se (at. %)	O (at. %)
Ni-Se/NF	16.25	35.91	--	26.67	21.26
Ni-Fe-Se/NF(-1.1)	18.09	25.36	7.67	29.73	19.19
Ni-Fe-Se/NF	16.39	26.27	8.49	26.91	21.94
Ni-Fe-Se/NF(-1.9)	15.39	24.71	8.93	27.95	23.09
Fe-Se/NF	18.75	10.16	16.52	28.33	26.24

Table S2. Summary of HER and OER activity for the resultant samples.

Samples	HER Overpotential @10 mA cm^{-2} (mV)	HER Tafel slope (mV dec^{-1})	OER Overpotential @100 mA cm^{-2} (mV)	OER Tafel slope (mV dec^{-1})
Ni-Fe-Se/NF	~82	~102	~222	~39
Ni-Fe-Se/NF(-1.9)	~118	~118	~261	~70
Ni-Fe-Se/NF(-1.1)	~92	~116	~244	~63

Table S3 Comparison of the HER activity in 1 M KOH for the recently reported catalysts.

Catalyst	Overpotential @10 mA cm^{-2} (mV)	Overpotential @100 mA cm^{-2} (mV)	Refs.
NiFe-LDH/MXene/NF	~132	~192	S1
Pt/C/NF	~70	~205	S1
MoS_2/NiS on carbon cloth	62	131	S2
Ni_2P embedded in N-doped carbon nanofibers	104	~200	S3
Ni_3N-$Ni(OH)_2$ interface on Ti mesh	~60	181	S4
NiMoN/Ni_3N nanosheets on carbon cloth	31	200	S5
Ni_3N-Co	194	~290	S6
Ni_3FeN/reduced graphene oxide	94	~210	S7
Ni_3FeN/carbon cloth	105	~450	S8
$MoNi_4/MoO_2$@Ni foam	15	~39	S9
Mn-doped CoP nanosheets Ti mesh	76	150	S10

Co_3Se_4 nanowires on Co foam	179	262	S11
Ni-Fe-Se/NF	~85	~192	This work

Table S4 Comparison of the OER activity in 1 M KOH for the recently reported catalysts.

Catalyst	Overpotential @10 mA cm^{-2} (mV)	Overpotential @100 mA cm^{-2} (mV)	Refs.
Ni_3Se_2/NF	--	315	S12
NiSe/NF	--	411	S12
$Ni_{0.85}Se$	302	364	S13
$Ni_{2.3\%}$-CoS_2/CC	270	370	S14
Co-S/Ti	361	430	S15
N-graphene-CoO	340	490	S16
NiSe/Ni	270	314	S17
Co-P film	345	413	S18
Co_3O_4/rm-GO	310	370	S19
Ni-Fe-Se/NF	--	~222	This work

Supplementary References

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