Loading of Individual Se-doped Fe_2O_3 Decorated Ni/NiO Particles on Carbon Cloth: Novel Synthesis and Efficient Electrocatalysis for Oxygen Evolution Reaction

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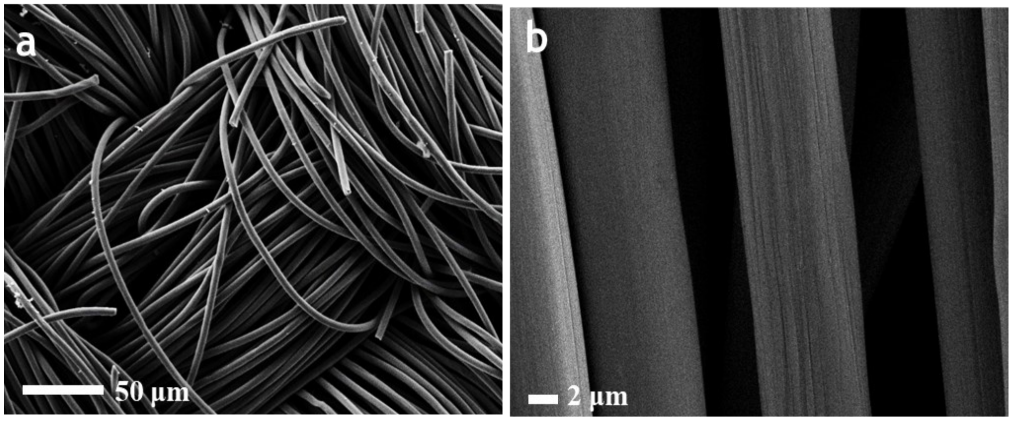

Figure S1. (a and b) SEM images of CC at different magnifications.

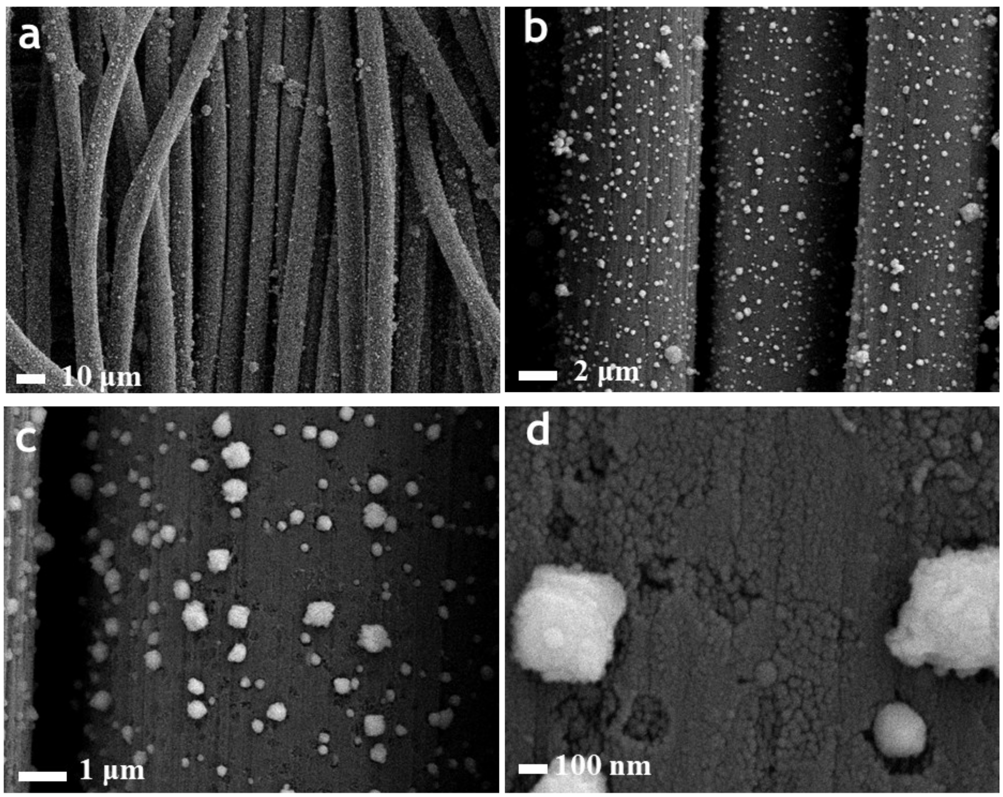

Figure S2. (a-d) SEM images of Se-Fe_2O_3@Ni/NiO/CC-1 composite at different magnifications.

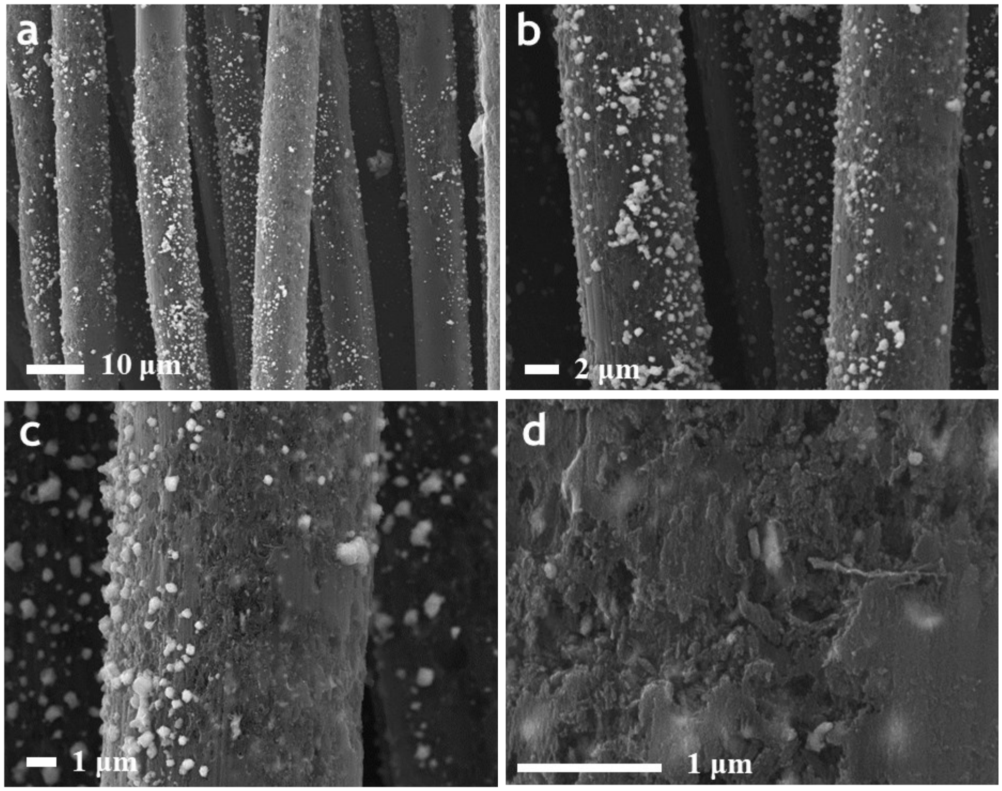

Figure S3. (a-d) SEM images of Se-Fe_2O_3@Ni/NiO/CC-3 composite at different magnifications.

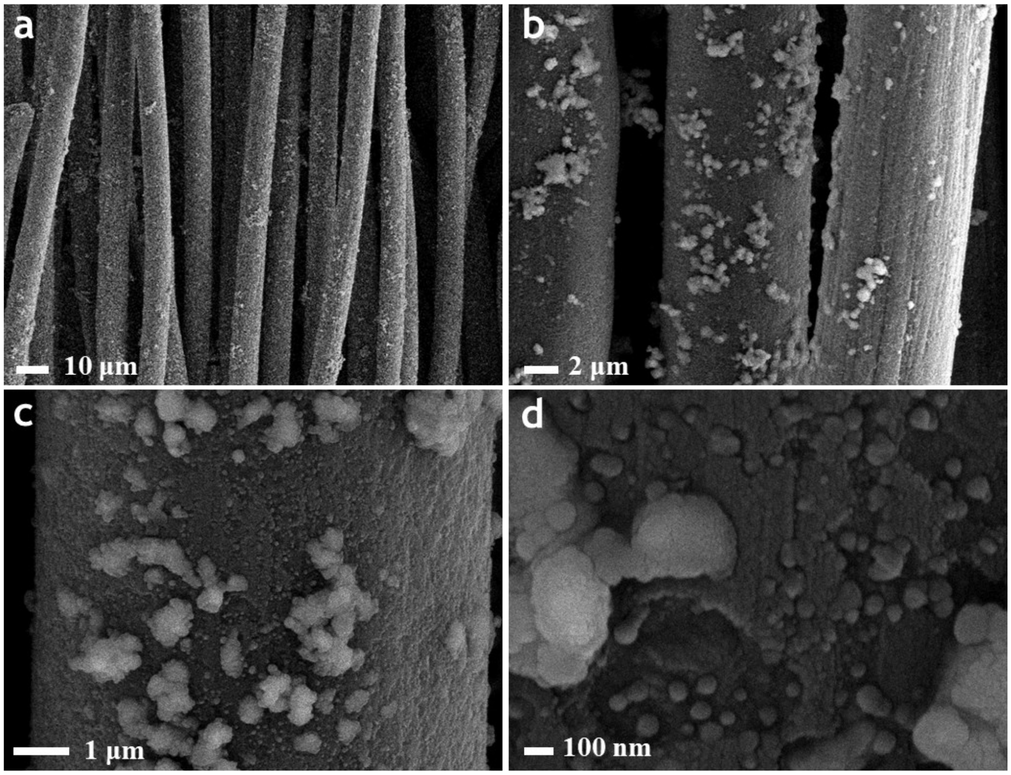

Figure S4. (a-d) SEM images of Se-Fe_2O_3/CC product at different magnifications.

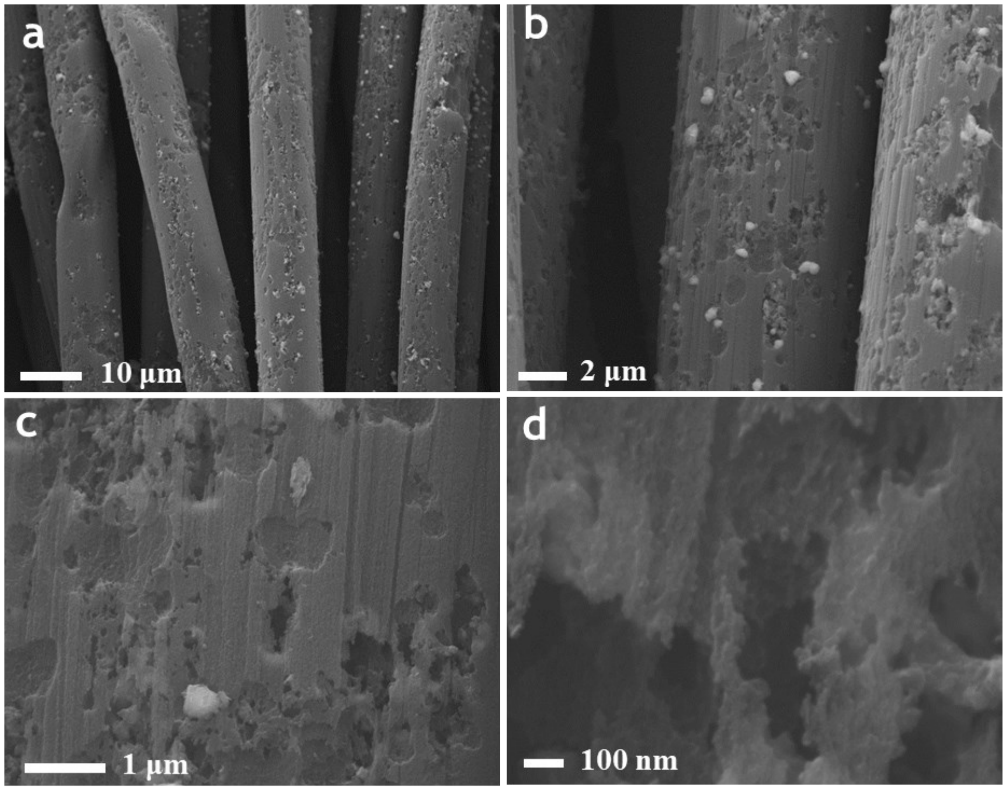

Figure S5. (a-d) SEM images of Se-Ni/NiO/CC-2 composites at different magnifications.

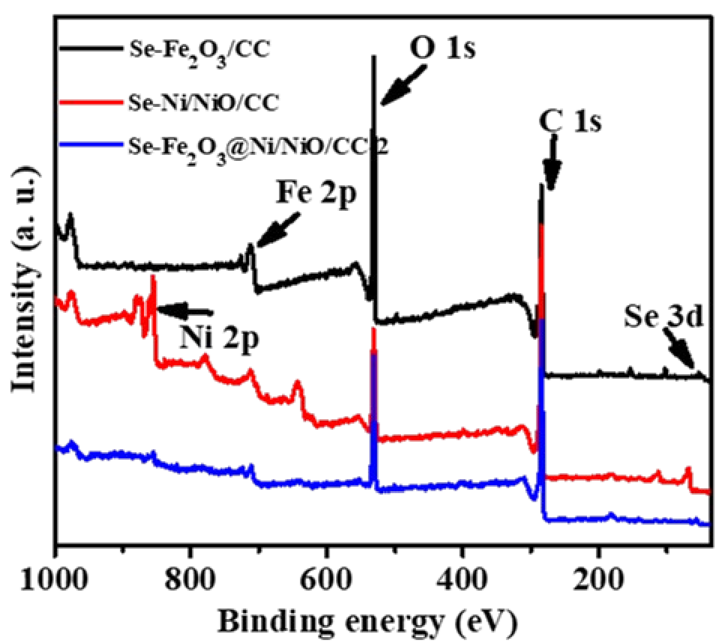

Figure S6. Survey XPS spectra of Se-Fe_2O_3@Ni/NiO/CC-2, Se-Ni/NiO/CC and Se-Fe_2O_3/CC products.

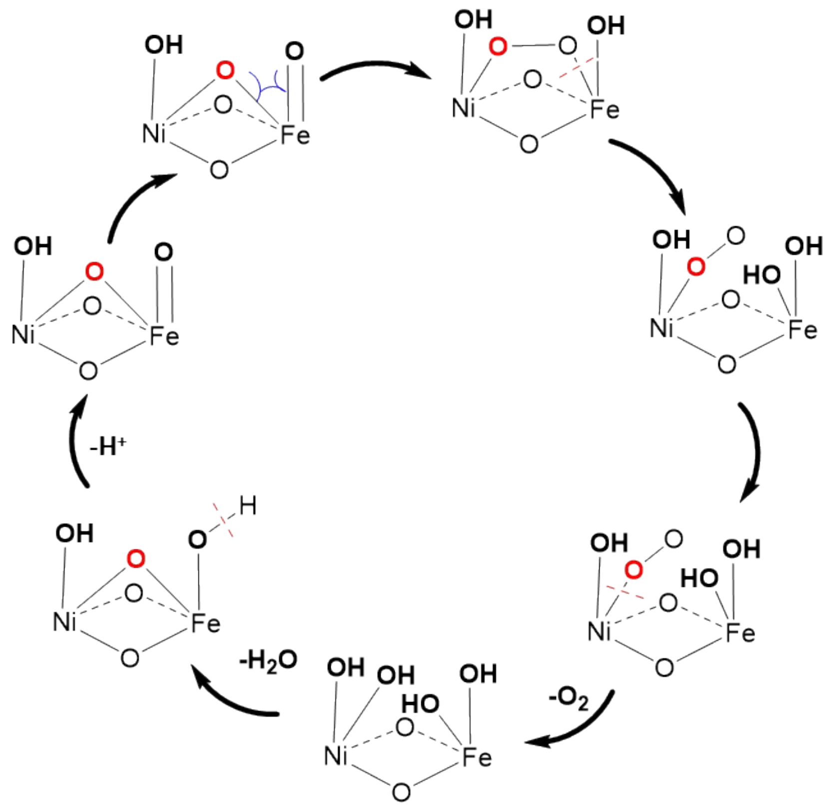

Figure S7. The proposed OER reaction path using Fe_2O_3@Ni/NiO/CC-2 catalyst.

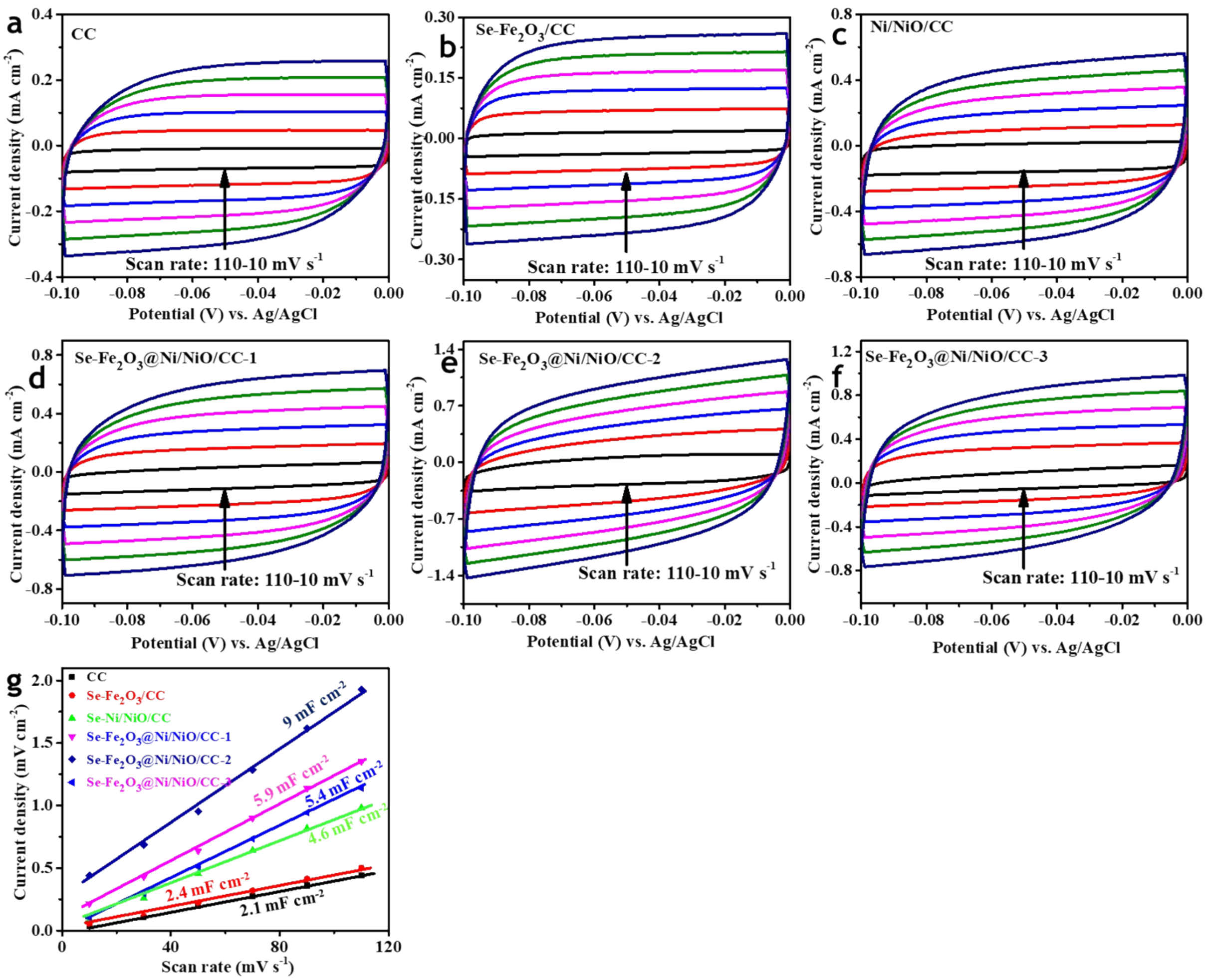

Figure S8. (a-f) CV curves of as-synthesized samples and CC between -0.1 and 0 V *vs*. Ag/AgCl at the scan rates of 10, 30, 50, 70, 90 and 110 mV s^{-1} in 1.0 M KOH solution. (g) The C_{dl} was used to determine electrochemical surface area of catalysts. The C_{dl} values was calculated by plotting the $\Delta J = (J_a - J_c)$ at -0.05 V *vs*. Ag/AgCl against various scan rates, the $2C_{dl}$ is equal to the slope.

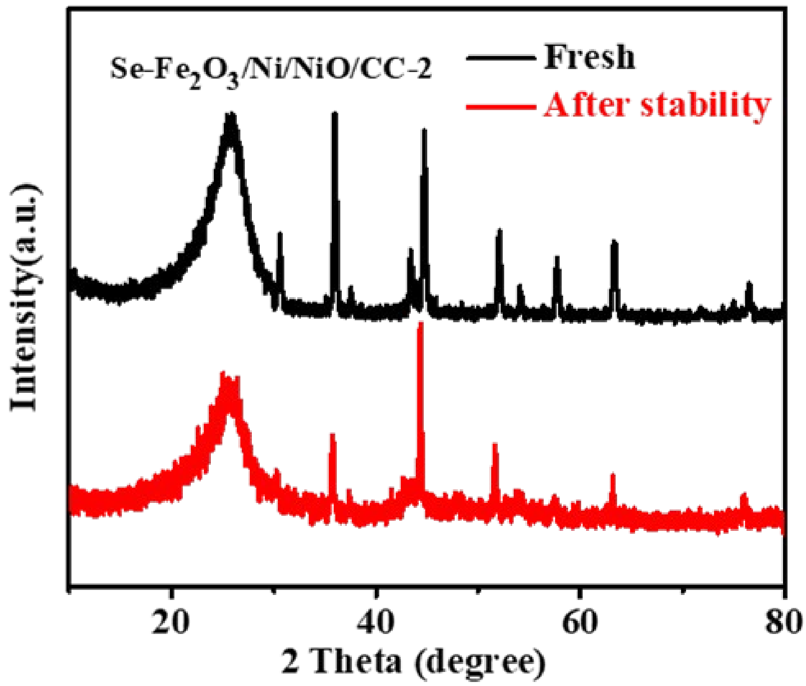

Figure S9. XRD patterns of the fresh and 2000 cycle used Se-Fe_2O_3@Ni/NiO/CC-2 catalyst.

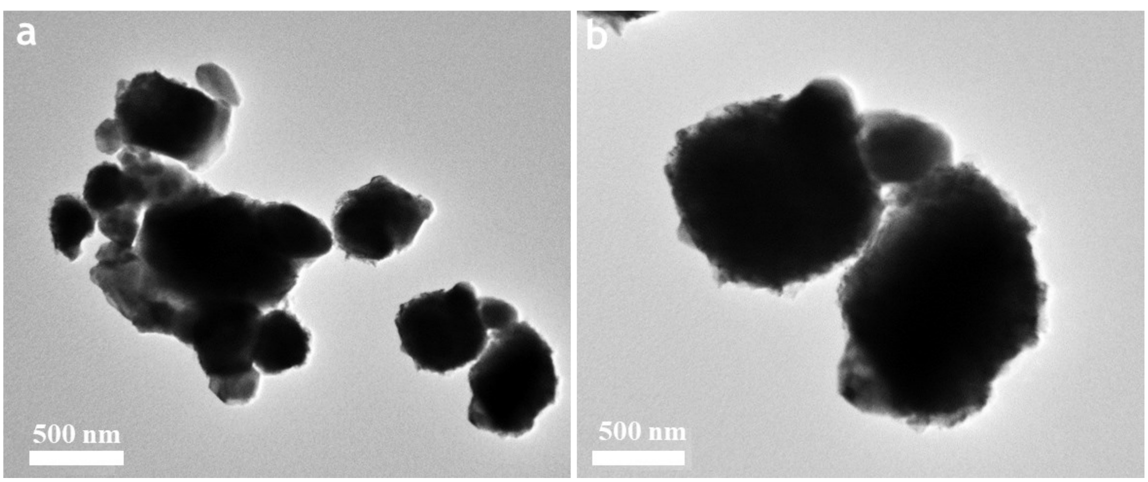

Figure S10. TEM images of Se-Fe_2O_3@Ni/NiO/CC-2 after 2000 CV cycles.

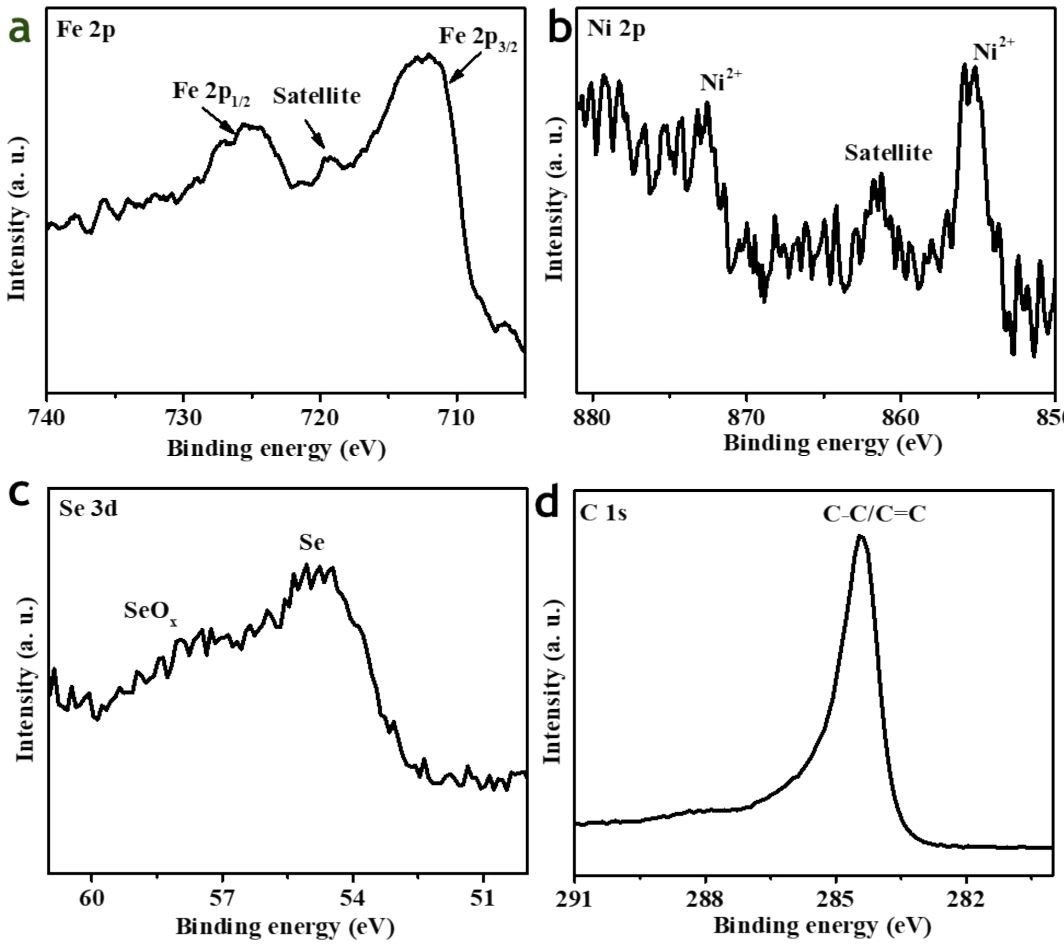

Figure S11. XPS spectra of the Se-Fe_2O_3@Ni/NiO/CC-2 sample after 2000 CV cycles: (a) Fe 2p, (b) Ni 2p, (c) Se 3d and (d) C1s.

Table S1. Electrochemical parameters of the as-synthesized samples and CC.

Catalytic materials	(η) mV@ (*j*)10 mA cm^{-2}	(η) mV@ (*j*) 100 mA cm^{-2}	Tafel slop (mV dec^{-1})	R_{CT} (Ω)	C_{dl} mF cm^{-2}
CC	526	—	169	2.73	2.1
Se-Fe_2O_3@/CC	409	—	92	3.12	2.4
Se-Fe_2O_3@Ni/NiO/CC-1	298	393	51	2.69	5.4
Se-Fe_2O_3@Ni/NiO/CC-2	205	273	36	2.17	9.0
Se-Fe_2O_3@Ni/NiO/CC-3	288	350	38	2.3	5.9
Se-Ni/NiO/CC	320	416	67	2	4.6

Table S2. OER performances of the Fe-Ni-based materials as electrocatalysts in 1.0 M KOH solution.

Catalysts	(η) mV@ (*j*) mA cm^{-2}	Tefel slope ($mV\ dec^{-1}$)	Ref.
Se-Fe_2O_3@Ni/NiO/CC-2	**205@10**	**36**	**This work**
$Ni_xFe_{1-x}Se_2$	195@10	28	Nat. Commun.[S1]
NiO/NiFe LDH on Cu Foam	205@30	30	Adv. Mater. [S2]
MoS_2/NiFe-LDH	210@10	65	Nano Lett. [S3]
Single-crystalline NiFe DLH	210@20	46	J. Mater. Chem. A [S4]
NiFe-LDH/MXene/NF	229@10	44	Nano Energy [S5]
CuO@Ni/NiFe hydroxides	230@10	65	Electrochim. Acta [S6]
CoFeNi oxide	230@10	40.7	Nano Res.[S7]
$Ni_{0.5}Fe_{0.5}Se_2$ nanodendrites	235@10	34.7	Catal. Sci. Technol. [S8]
Ni/NiO/Fe_3O_4	258@10	62	Electrochim. Acta [S9]
NiFe hydroxide	270@10	36.2	Angew. Chem. Int. Ed. [S10]
FeNi@NC	280@10	70	Energy Environ. Sci.[S11]
NiFe−V_M−O	371@10	28	ACS Catal[S12]
Ni_3FeN/NRGO	400@10	62	Small[S13]

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