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Electronic Supplementary Information

Simultaneous phase transformation and doping via a unique photochemical-electrochemical strategy to highly active Fe-doped Ni oxyhydroxide oxygen evolution catalyst

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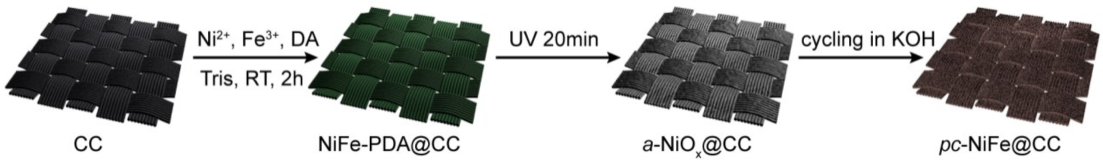

Fig. S1 Schematic depiction of the synthesis of *pc*-NiFe@CC electrocatalyst.

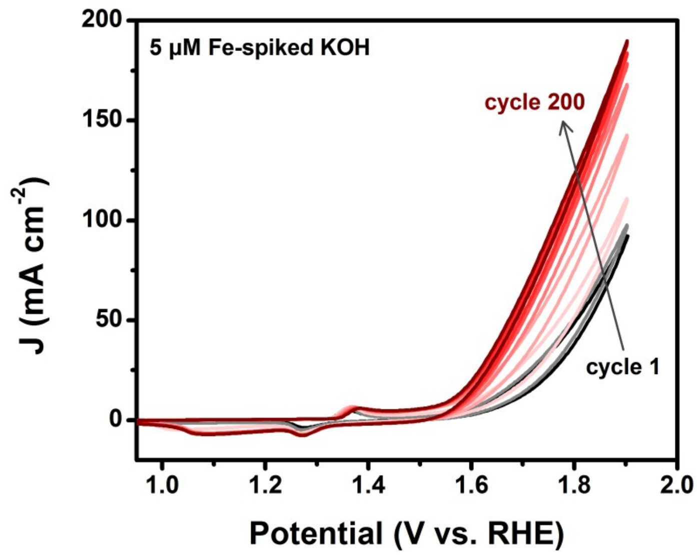

Fig. S2 CV scans of *a*-NiO_x@CC in 5 μM Fe^{3+} spiked 1.0 M KOH, scan rate: 100 mV s^{-1}.

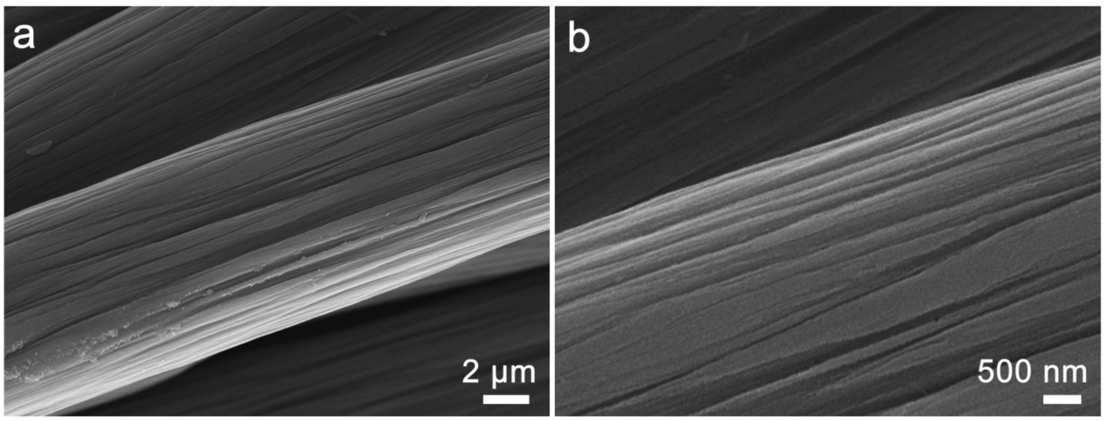

Fig. S3 SEM images of bare CC. a, low magnification; b, high magnification.

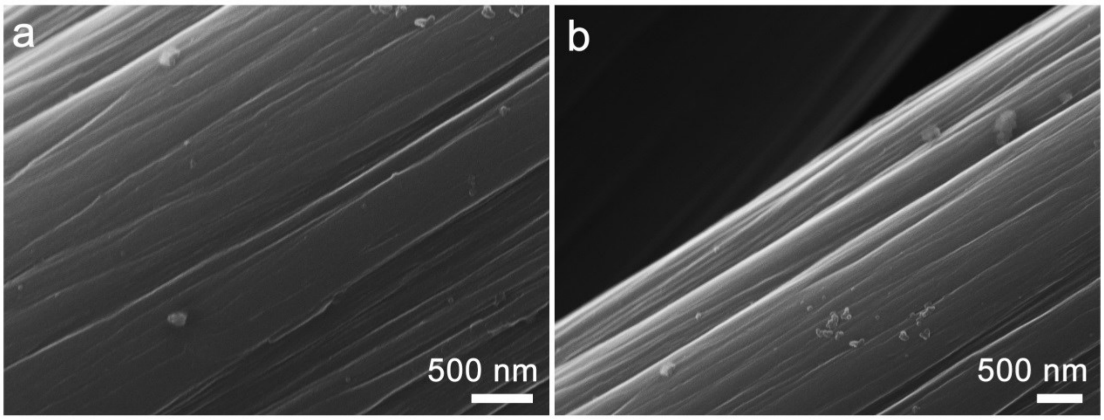

Fig. S4 SEM images of Ni-PDA@CC. a, high magnification; b, low magnification.

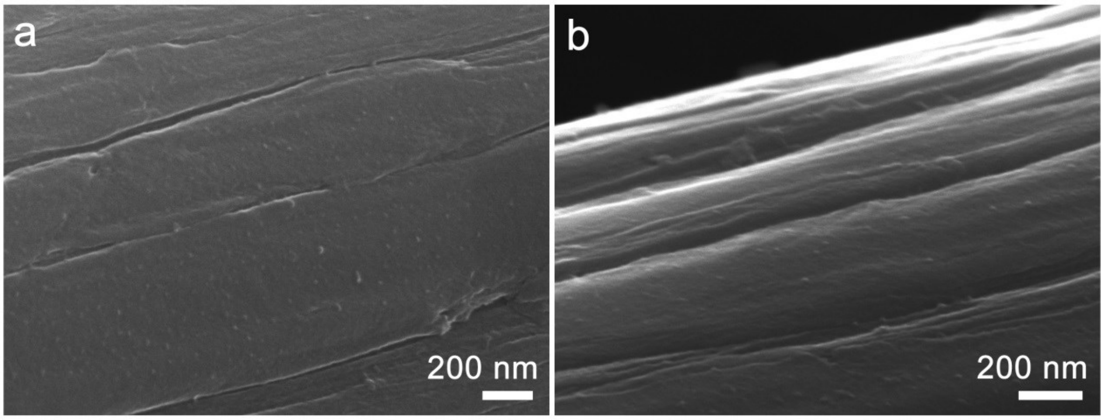

Fig. S5 SEM images of *a*-NiO_x@CC. a, high magnification; b, low magnification.

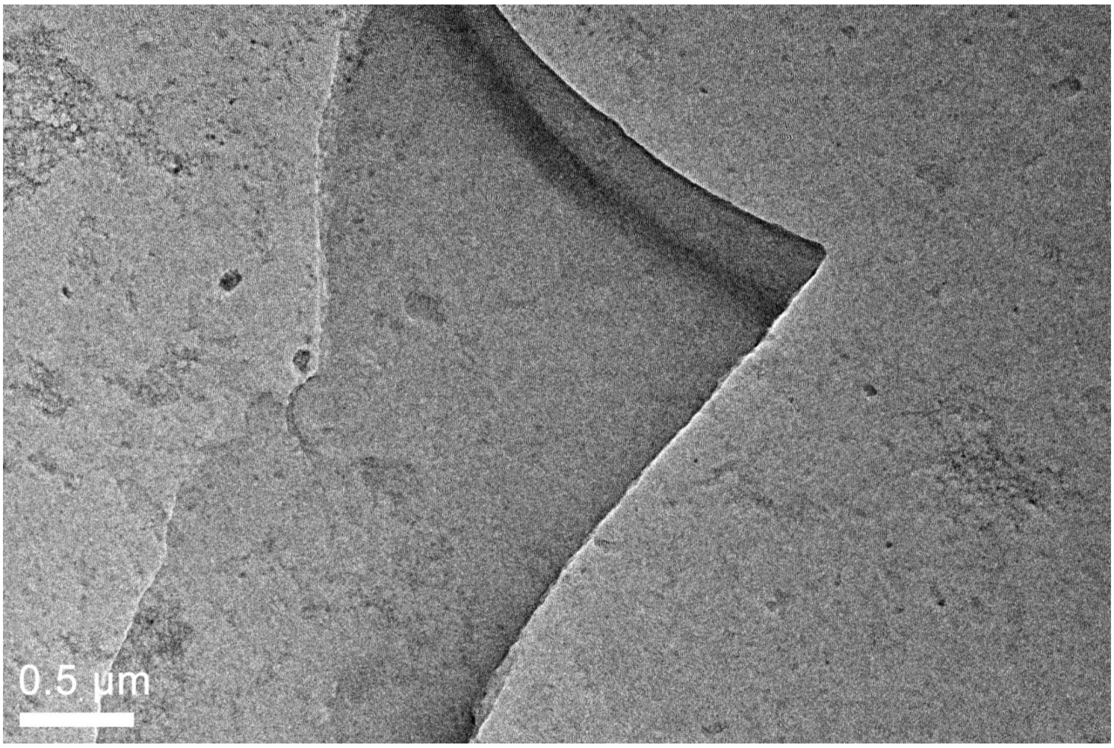

Fig. S6 TEM image of nanosheets ultrasonically peeled from Fe-NiOOH@CC.

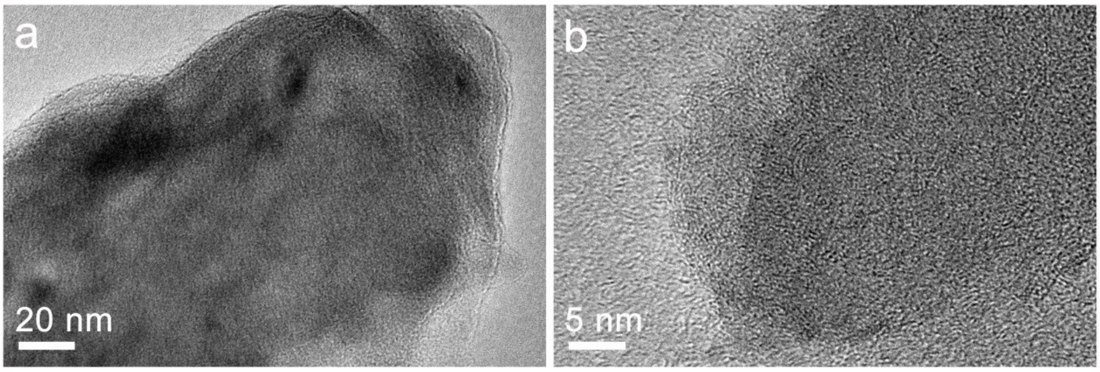

Fig. S7 TEM images of ultrasonically peeled *a*-NiO_x. a, low magnification; b, high magnification.

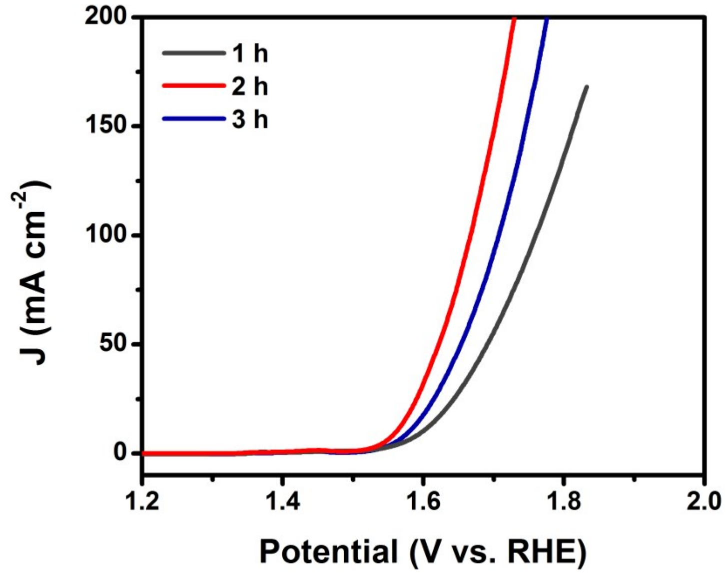

Fig. S8 OER activity of Fe-NiOOH@CC synthesized with different duration of Ni-PDA deposition.

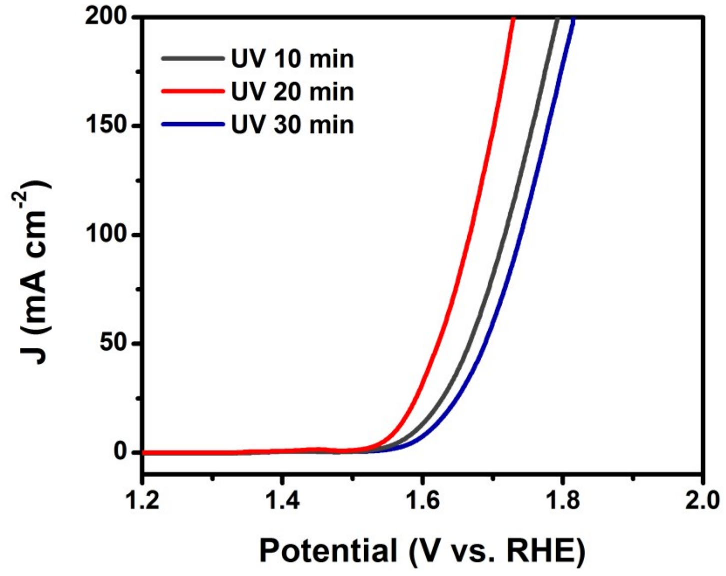

Fig. S9 OER activity of Fe-NiOOH@CC synthesized with different duration of UV irradiation.

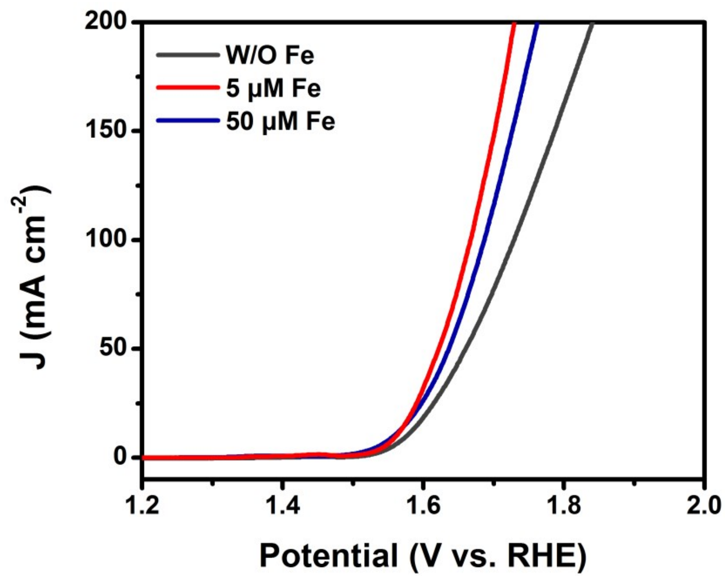

Fig. S10 OER activity of Fe-NiOOH@CC synthesized with different Fe spiking concentration for cycling.

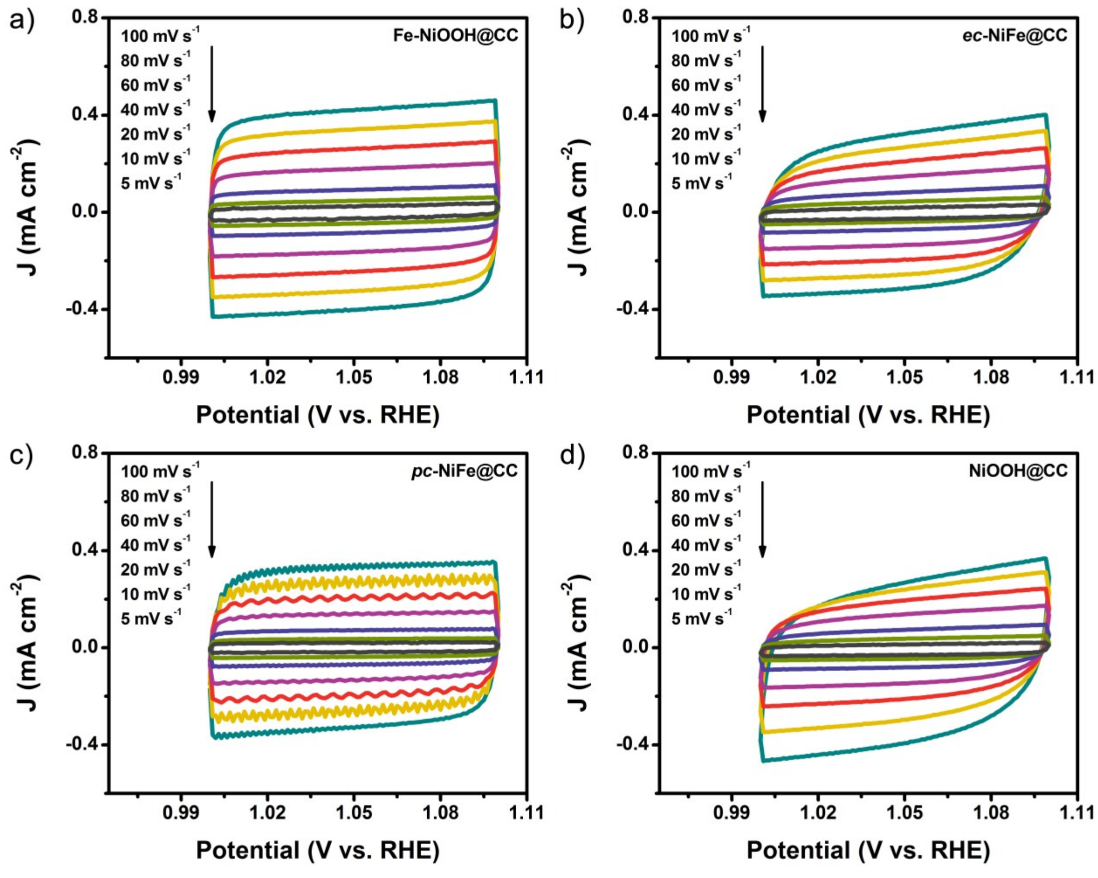

Fig. S11 CV curves of Fe-NiOOH@CC (a), *ec*-NiFe@CC (b), *pc*-NiFe@CC (c) and NiOOH@CC (d) in 1.0 M KOH solution at different scanning rates.

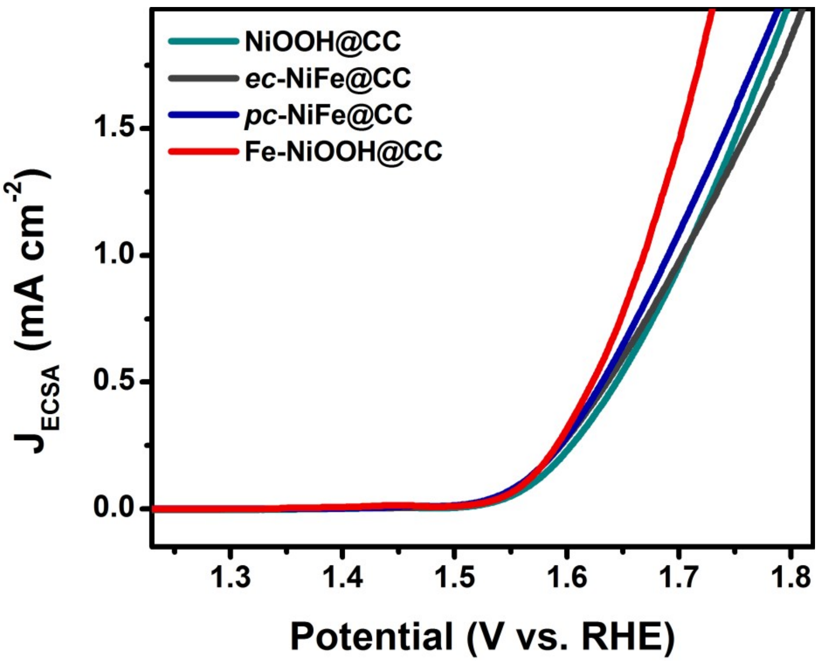

Fig. S12 ECSA-normalized LSV curves of Fe-NiOOH@CC, *ec*-NiFe@CC, *pc*-NiFe@CC and NiOOH@CC with iR compensation. The ECSA of catalysts is calculated from the double-layer capacitance according to equation: $ECSA = \frac{C_{dl}}{C_s}$, where C_{dl} is the double-layer capacitance, estimated by the slope of a linear curve that obtained by plotting the non-Faradaic capacitive current (△J/2, i.e. $(J_a - J_c)/2$) against scanning rate; C_s is the specific capacitance of a planar surface. The C_s value is selected as 0.04 mF cm^{-2} in present work (see e.g., J. Am. Chem. Soc., 2013, 135, 16977).

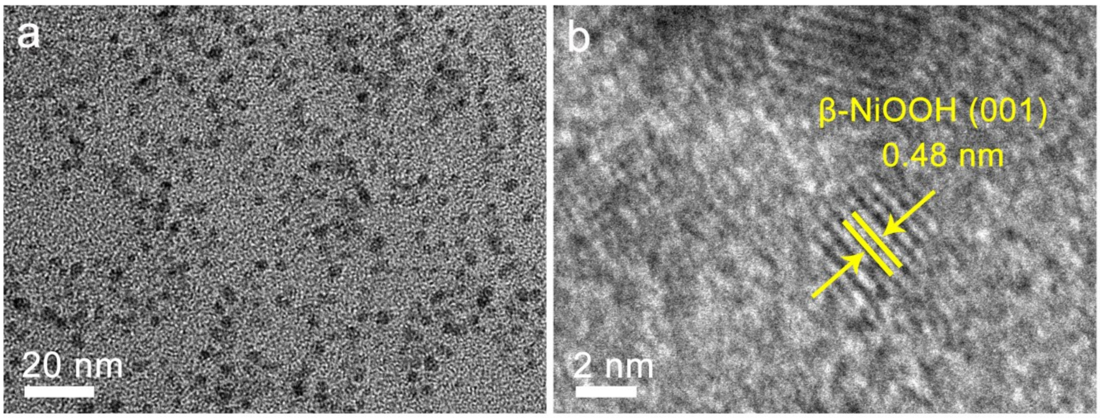

Fig. S13 TEM images of Fe-NiOOH@CC after OER electrolysis.

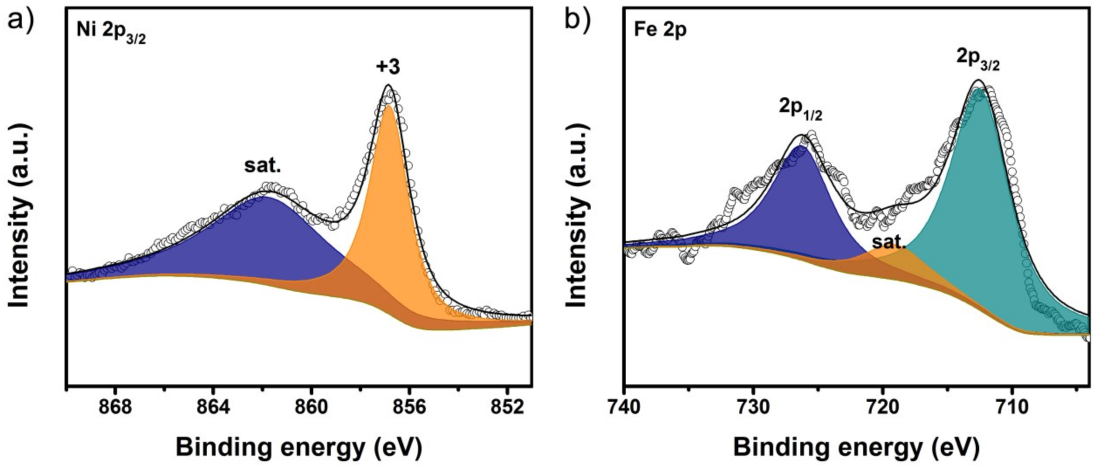

Fig. S14 Ni 2p (a) and Fe 2p (b) XPS spectra of Fe-NiOOH@CC after OER.

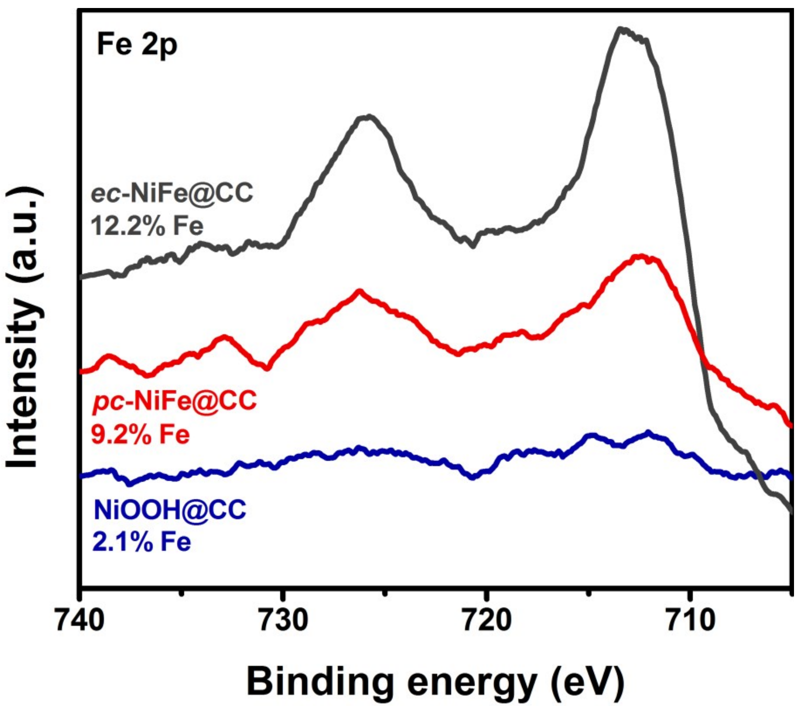

Fig. S15 XPS Fe 2p spectra of NiOOH@CC, *pc*-NiFe@CC and *ec*-NiFe@CC.

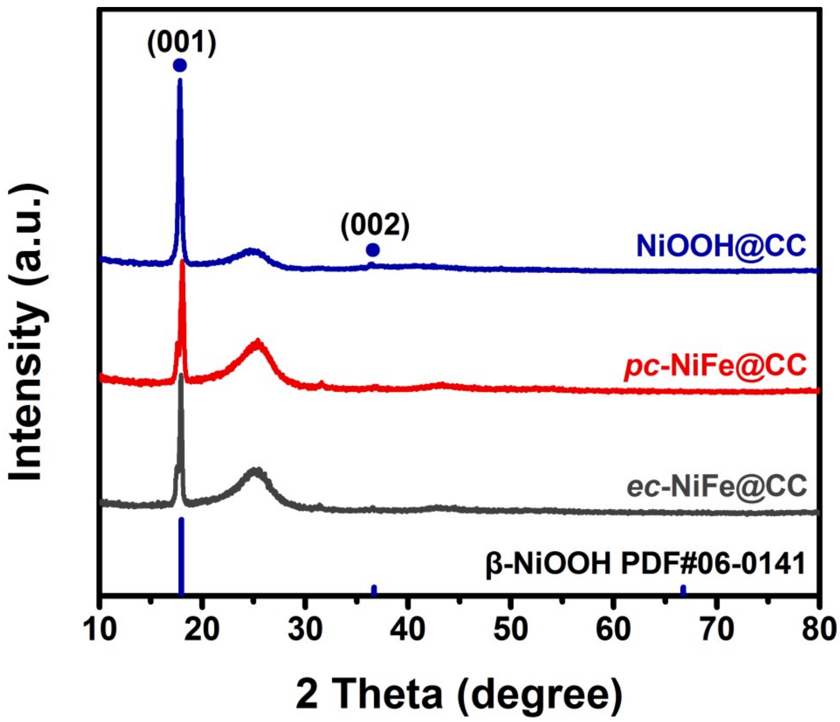

Fig. S16 XRD patterns of NiOOH@CC, *pc*-NiFe@CC and *ec*-NiFe@CC.

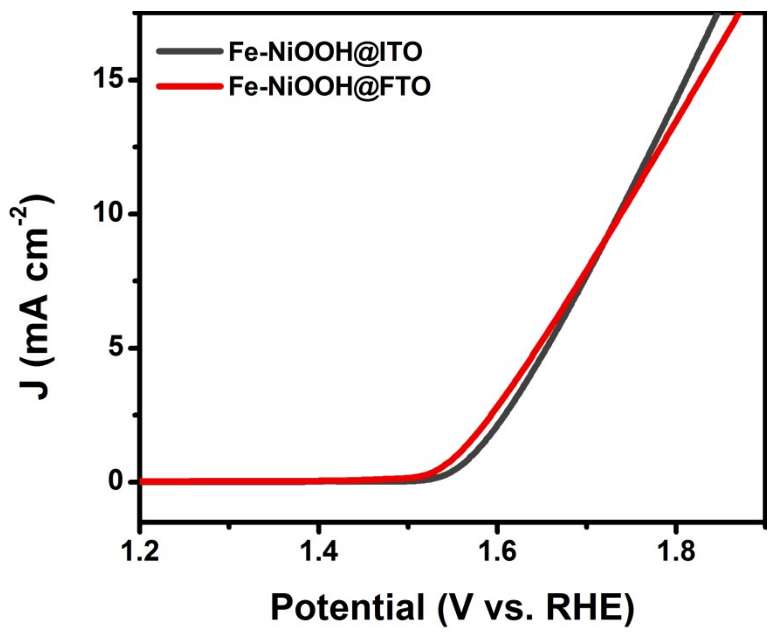

Fig. S17 LSV curves of Fe-NiOOH@ITO and Fe-NiOOH@FTO at 5 mV s^{-1} in 1.0 M KOH.

Table S1. OER activity of NiFe-base catalysts in alkaline media reported in recent literature.

Catalyst	η@10 mA cm^{-2} (mV)	Tafel slope (mV dec^{-1})	Stability	Electrolyte	Morphology	Substrate	Ref.
Fe-NiOOH@CC	331	64	150 mA cm^{-2} for 55 h	1.0 M KOH	nanoparticle	CC	This work
r-FeOOH/α-$Ni(OH)_2$/NF	168	51.4	2000 mA cm^{-2} for 10 h	1.0 M KOH	particle	NF [a]	1
NiFe LDH@NiCoP/NF	220	48.6	10 mA cm^{-2} for 100 h	1.0 M KOH	nanosheet on nanowire	NF	2
NiFe LDH/NiTe	228 @50 mA cm^{-2}	51.04	20 mA cm^{-2} for 30 h	1.0 M KOH	nanosheet on nanorod	NF	3
Ni-Fe-OH@Ni_3S_2/NF	165	93	500 mA cm^{-2} for 50 h	1.0 M KOH	nanosheet	NF	4
NiFe/N-CNT	290	79	5000 cycles	0.1 M KOH (1600 rpm)	nanoparticle	CNT [b]	5

CoFe@NiFe-200/NF	190	45.71	36 mA cm^{-2} for 30 h	1.0 M KOH	nanosheet on nanosheet	NF	6
NiFe-LDH/NF	270	67.44	/	1.0 M KOH	nanosheet	NF	6
NiFe LDH	182	34.34	1.7 V for 100 h	1.0 M KOH	nanosheet	NF	7
NiFeRu-LDH	225	32.4	10 mA cm^{-2} for 10 h	1.0 M KOH	nanosheet	NF	8
NiFe-LDH	230	36.2	N.A.	1.0 M KOH	nanosheet	NF	8
MIL-53(FeNi)/NF	233 @50 mA cm^{-2}	31.3	20, 50, 100 mA cm^{-2} for 16000 s, respectively	1.0 M KOH	nanosheet	NF	9
4.3%-strained NiFe MOFs	210 @200 mA cm^{-2}	68	200 mA cm^{-2} for 200 h	0.1 M KOH	nanosheet	NF	10
pristine NiFe MOFs	600 @200 mA cm^{-2}	167	N.A.	0.1 M KOH	nanosheet	NF	10

a-LaNiFe(t-d) hydroxide	189	36	10 mA cm^{-2} for 100 h	1.0 M KOH	nanostructured amorphous	NF	11
ball-milled NiFe-LDH	270	36.2	N.A.	1.0 M KOH	nanosheet	GC [c]	12
NiFe-NFF	227	38.9	10~20 mA cm^{-2} for 15 h	1.0 M KOH	nanocluster on nanosheet	NFF [d]	13

[a] NF: nickel foam, [b] CNT: carbon nanotubes, [c] GC: glassy carbon electrode, [d] NFF: NiFe alloy foam.

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