Supporting Information

Trifunctional catalytic activities of trimetallic FeCoNi alloy nanoparticles embedded in carbon shell and for efficient overall water splitting

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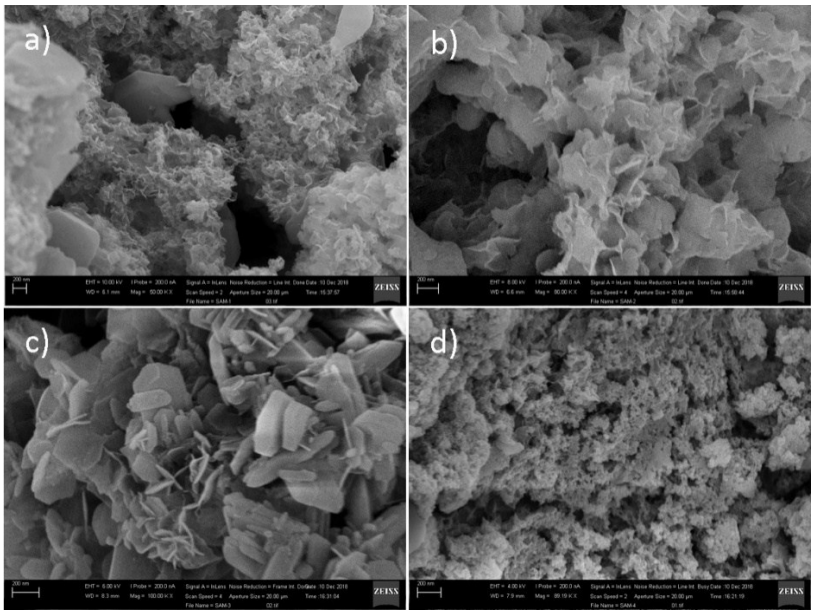

Fig. S1 SEM images of sample 1,2,3&4 before carbonization.

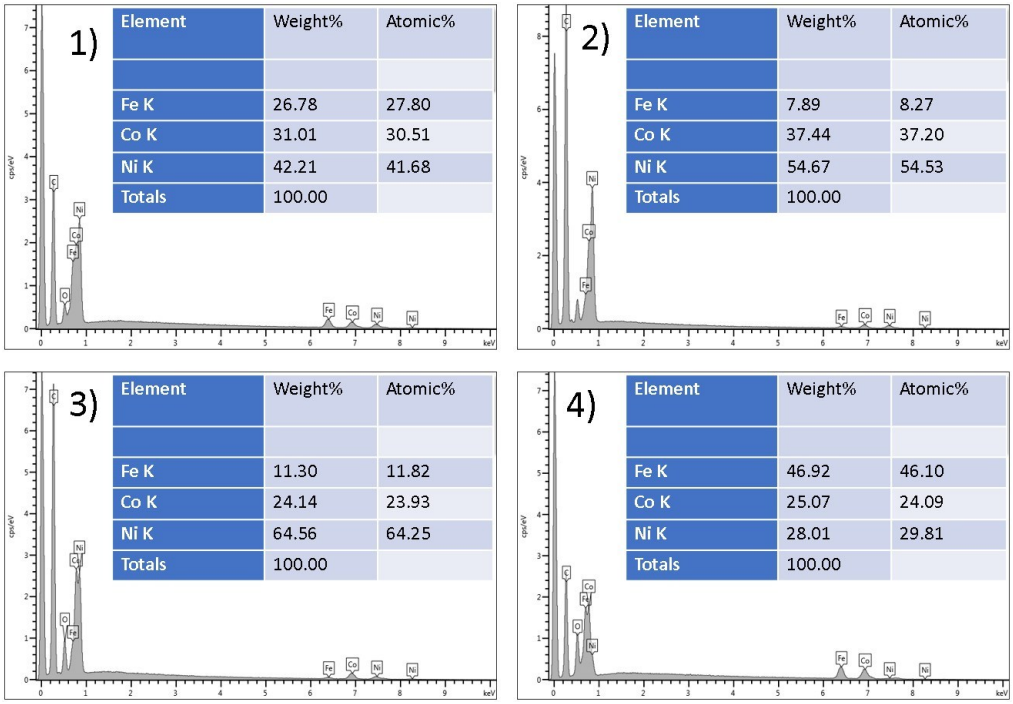

Fig. S2 EDX patterns and weight/atomic percentage of carbonized sample 1,2,3,&4.

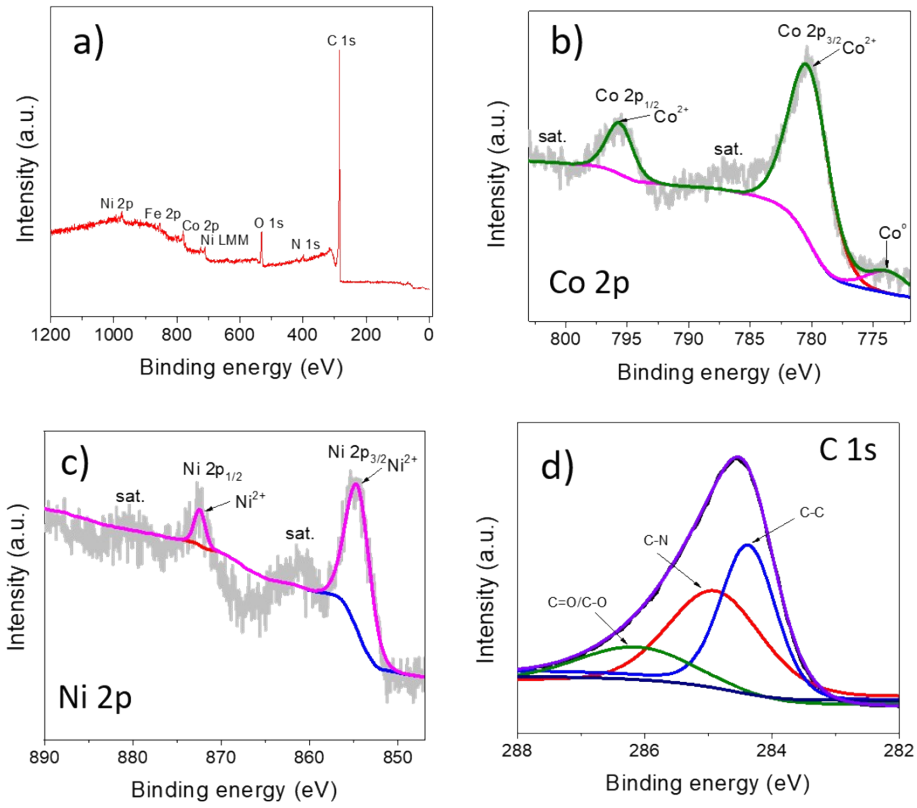

Fig. S3 a) XPS survey spectrum and b) XPS spectrum of Co 2p, c) XPS spectrum of Ni 2p, and d) XPS spectrum of C 1s for $Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC.

The calculated ECSAs of $Fe_{1.0}Co_{2.0}Ni_{5.4}$-NC, $Fe_{1.0}Co_{0.5}Ni_{0.6}$-NC, $Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC, $Fe_{1.0}Co_{4.4}Ni_{6.5}$-NC, and RuO_2 were 0.38, 0.24, 0.16, 0.12, and 0.03 cm^2, respectively.

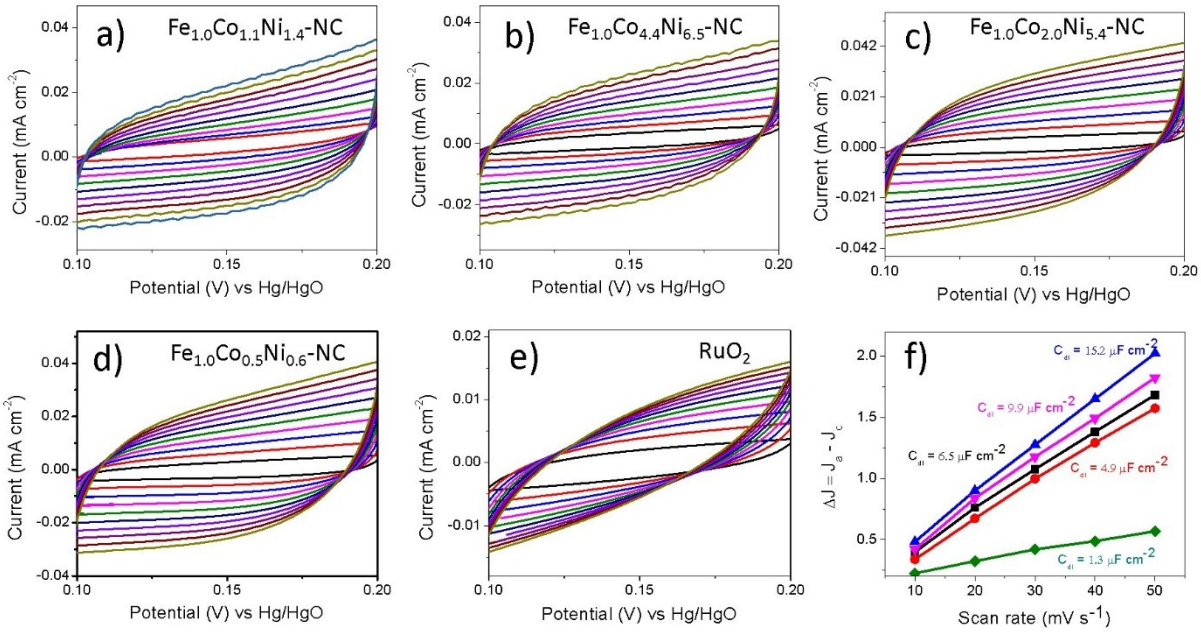

Fig. S4. Electrochemical active surface area. a) to d) CV cycles of pyrolyzed samples 1,2,3,&4 respectively, and f) Charging current density differences *($\Delta j = j_a - j_b$)* at an overpotential of 0.15 V plotted against scan rates to estimation C_{dl}.

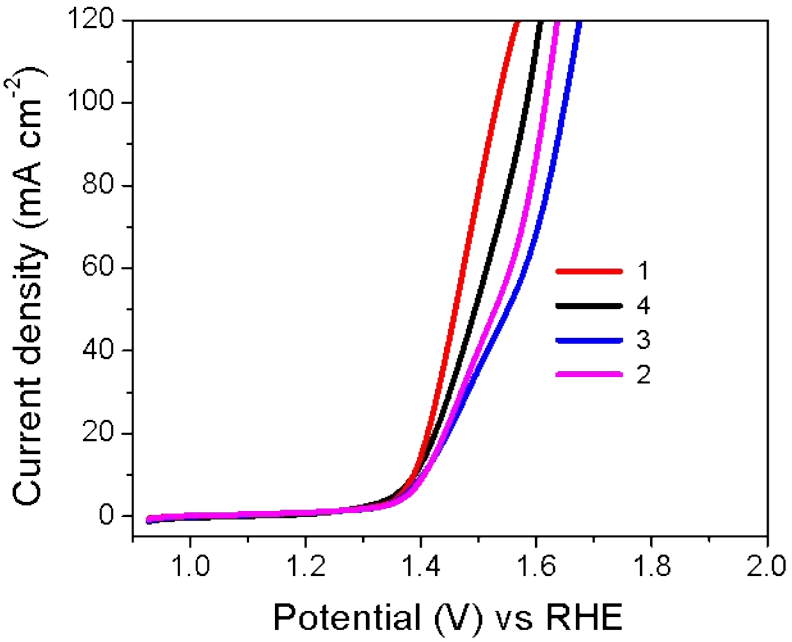

Fig. S5. EOR curves of 1 for $Fe_{1.0}Co_{2.0}Ni_{5.4}$-NC, 2 for $Fe_{1.0}Co_{0.5}Ni_{0.6}$-NC, 3 for $Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC, 4 for $Fe_{1.0}Co_{4.4}Ni_{6.5}$-NC in 1 M KOH + 1 M C_2H_5OH electrolyte.

Table S1. Comparison of the OER electrocatalytic activities of $Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC with some lately reported non-noble based electrocatalysts.

Catalysts	**Overpotential at 10 mA cm^{-2} (vs. RHE)**	**Mass loading mg cm^{-2}**	**Electrolyte**	**References**
$Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC	**270 mV**	**~ 0.025**	**1 M KOH**	**This work**
IrO_2	338 mV	0.21	1 M KOH	S1
RuO_2	380 mV	0.146	1 M KOH	S2
CoFe@NC/rGO	278 mV	NA	1 M KOH	S3
$CoNi(OH)_x$	280 mV	0.72	1 M KOH	S4
FeNi@Graphene	280 mV	0.32	1 M NaOH	S5
Ni_3FeN-NPs	280 mV	0.20	1 M KOH	S6
NiFe LDH-NS	300 mV	0.07	1 M KOH	S1
NiFe-SW	240 mV	NA	1 M KOH	S7
$NiCo_{2.7}(OH)x$	350 mV	0.20	1 M KOH	S8
FeCoNi-ATNs/NF FeCoNi-ATNs (H)/NF	290 mV 225 mV	0.016 0.016	1 M KOH 1 M KOH	S9
$W_{0.5}Co_{0.4}Fe_{0.1}$/NF	310 mV	NA	1 M KOH	S10
Ni_3Se_2-GC	290 mV	0.217	0.3 M KOH	S11
N-$NiMoO_4/NiS_2$	283 mV	0.2	1 M KOH	S12

Table S2. Turnover frequency (TOF) values of samples.

	$Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC	$Fe_{1.0}Co_{4.4}Ni_{6.5}$-NC	$Fe_{1.0}Co_{2.0}Ni_{5.4}$-NC	$Fe_{1.0}Co_{0.5}Ni_{0.6}$-NC	FeNi-NC
TOF@1.53	0.006 s^{-1}	0.002 s^{-1}	0.0027 s^{-1}	0.0059 s^{-1}	0.0038 s^{-1}

Table S3. Comparison of the HER electrocatalytic activities of $Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC with some lately reported non-noble based electrocatalysts

Catalysts	**Overpotential at 10 mA cm^{-2} (vs. RHE)**	**Mass loading mg cm^{-2}**	**Electrolyte**	**References**
$Fe_{1.0}Co_{1.1}Ni_{1.4}$-NC	**175 mV**	**~ 0.025**	**1 M KOH**	**This work**
$Co(OH)_2$/Pt(111)	248 mV	NA	1 M KOH	S13
NiFe LDH/NF	210 mV	NA	1 M KOH	S14
NiFe-MOF	196 mV	NA	1 M KOH	S15
CoP/CC	209 mV	0.92	1 M KOH	S16
NiFeOx/CFP	88 mV	1.6	1 M NaOH	S17
NiCoP/rGO	270 mV	0.15	1 M KOH	S18
CuCo@NC	145 mV	0.182	1 M KOH	S19
NiFeV-LDHs/NF	125 mV	NA	1 M KOH	S20
CoSe/NiFe LDH	260 mV	4	1 M KOH	S21
MoS_2/Ni_2S_3	110 mV	9.7	1 M KOH	S22
Ni_3FeN-NPs	158 mV	0.2	1 M KOH	S6

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