

Supplementary Information

For

Fe-Co-Ni trimetallic organic framework chrysanthemum-like nanoflowers: efficient and durable oxygen evolution electrocatalysts

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Table S1. Reaction parameters for syntheses of FCN-BTC MOF, CN-BTC MOF, FN-BTC MOF, FC-BTC MOF, Fe-BTC MOF, Co-BTC MOF, and Ni-BTC MOF.

	FCN-BTC MOF	CN-BTC MOF	FN-BTC MOF	FC-BTC MOF	Fe-BTC MOF	Co-BTC MOF	Ni-BTC MOF
Molar ratio	Fe: Co: Ni	Co: Ni =	Fe: Ni =	Fe: Co =	-	-	-

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in precursors	= 1:1:1	1:1	1:1	1:1			
NiCl ₂ .6H ₂ O	159 mg (0.67 mmol)	238 mg (1.00 mmol)	238 mg (1.00 mmol)	-	-	-	475 mg (2.00 mmol)
CoCl ₂ .6H ₂ O	159 mg (0.67 mmol)	238 mg (1.00 mmol)	-	238 mg (1.00 mmol)	-	476 mg (2.00 mmol)	-
FeCl ₃ .6H ₂ O	181 mg (0.67 mmol)	-	270 mg (1.00 mmol)	270 mg (1.00 mmol)	540 mg (2.00 mmol)	-	-
HF	0.15 mL	0.15 mL	0.15 mL	0.15 mL	0.15 mL	0.15 mL	0.15 mL
H ₃ BTC	420 mg (2.00 mmol)	420 mg (2.00 mmol)	420 mg (2.00 mmol)	420 mg (2.00 mmol)	420 mg (2.00 mmol)	420 mg (2.00 mmol)	420 mg (2.00 mmol)
H ₂ O	2.5 mL	2.5 mL	2.5 mL	2.5 mL	2.5 mL	2.5 mL	2.5 mL
DMF	35 mL	35 mL	35 mL	35 mL	35 mL	35 mL	35 mL
Ethanol	2.5 mL	2.5 mL	2.5 mL	2.5 mL	2.5 mL	2.5 mL	2.5 mL
NF (2 x 5 cm ²)	1	1	1	1	1	1	1
Reaction Condition	150 °C / 12 h						
Washing	H ₂ O & ethanol						

Table S2. Comparison of Electrochemical performances of OER of FCN-BTC MOF with recently reported MOF based OER electrocatalysts in 1 M KOH.

Electrocatalyst	Substrate	η (mV@ mA cm ⁻²)	b (mV dec ⁻¹)	Stability test, i-t and/or V-t	Ref.
FCN-BTC MOF/NF	NF	218@10 239@50 250@100	29.3	i-t,50 j@24h	Present work
(Ni ₂ Co ₁) _{0.925} Fe _{0.075} -MOF-NF	NF	257@10	41.3	i-t,10 j@35 h	14
FeNi ₃ -BTC	NF	236@10 284@100	49	i-t,10 j @15h	46
Fe-NiCoP/PBA HNCs	GC	290@10	70	V-t,10 j@40h	47
Ni _{0.82} Co _{0.18} O@C/NF	NF	330@50	65	i-t,50 j@20 h	48
Fe-1-Co-1-MOF	NF	233@10 248@50	24.2	i-t,50 j@10 h	49
Ni-Fe LDH DSNCs	CC	246@20	71	V-t,20 j@50 h;	50

NiCo _{2-x} Fe _x O ₄ NBs	GC	274@10	42	i-t,10,50 j@25 h	51
Fe ₁ Co ₁ Ni ₁ @N-CNTs	GC	249@10	43.47	i-t,10 j@38 h	52

based OER electrocatalysts in 1 M KOH

η = overpotential; b = Tafel slope; i-t = chronoamperometry; V-t = chronopotentiometry; j = mA cm⁻²; NF = nickel foam; GC = glassy carbon; CC = carbon cloth

Comparison of Electrochemical performances of OER of FCN-BTC MOF with recently reported MOF

TableS3. Atomic percentages obtained from ICP-OES analyses of MOFs removed from corresponding MOF/NF electrodes.

MOF	Atomic%			Ratio
	Fe	Co	Ni	
FCN-BTC	4.20	4.08	4.43	1:0.97:1.05
FC-BTC	6.33	3.48	2.27	1:0.55:0.36
FN-BTC	5.53	-	7.14	1:1.29
CN-BTC	-	4.86	7.56	1:1.56

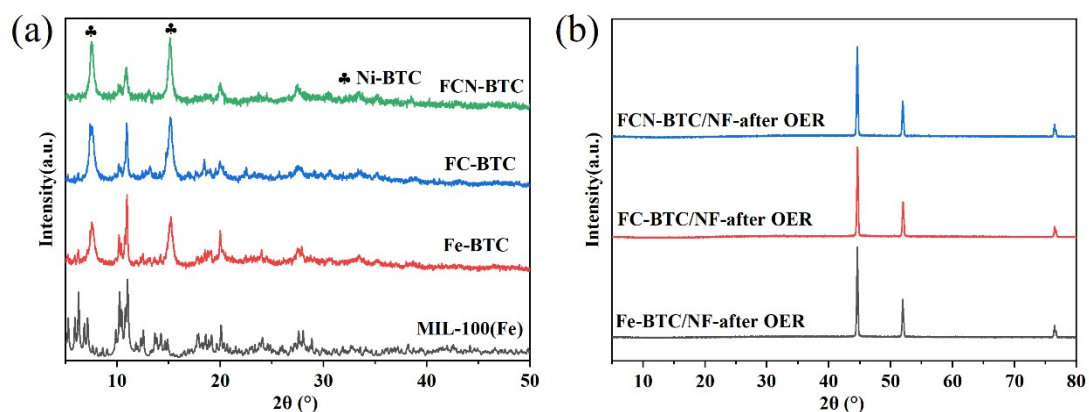


Figure S1. Powder XRD patterns of FCN-BTC MOF, FC-BTC MOF, Fe-BTC MOF (a) before and (b) XRD patterns after OER test.

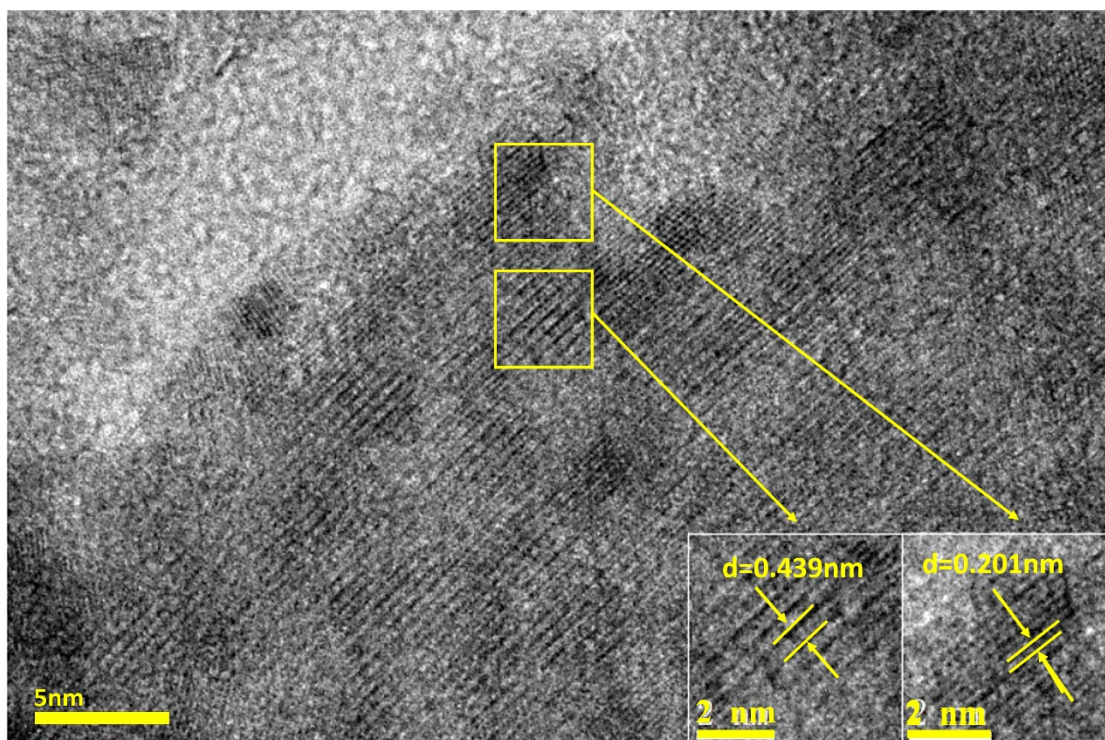


Figure S2. HR-TEM image FCN-BTC MOF before OER test.

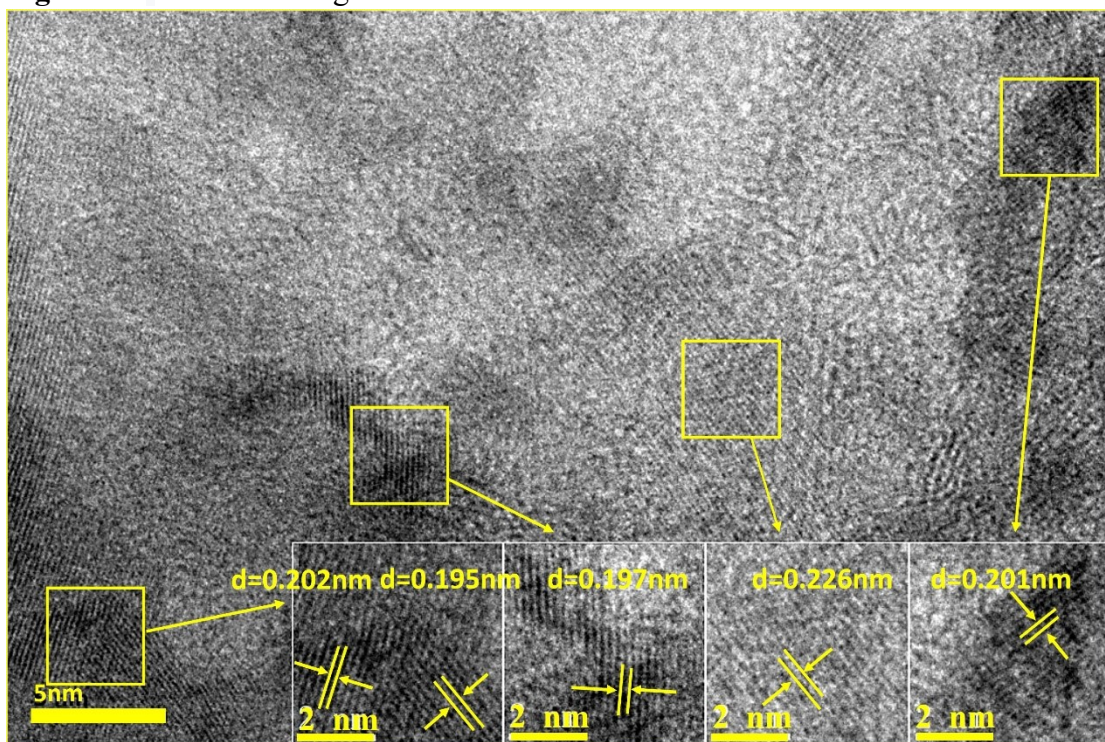


Figure S3. HR-TEM image FCN-BTC MOF after OER test.

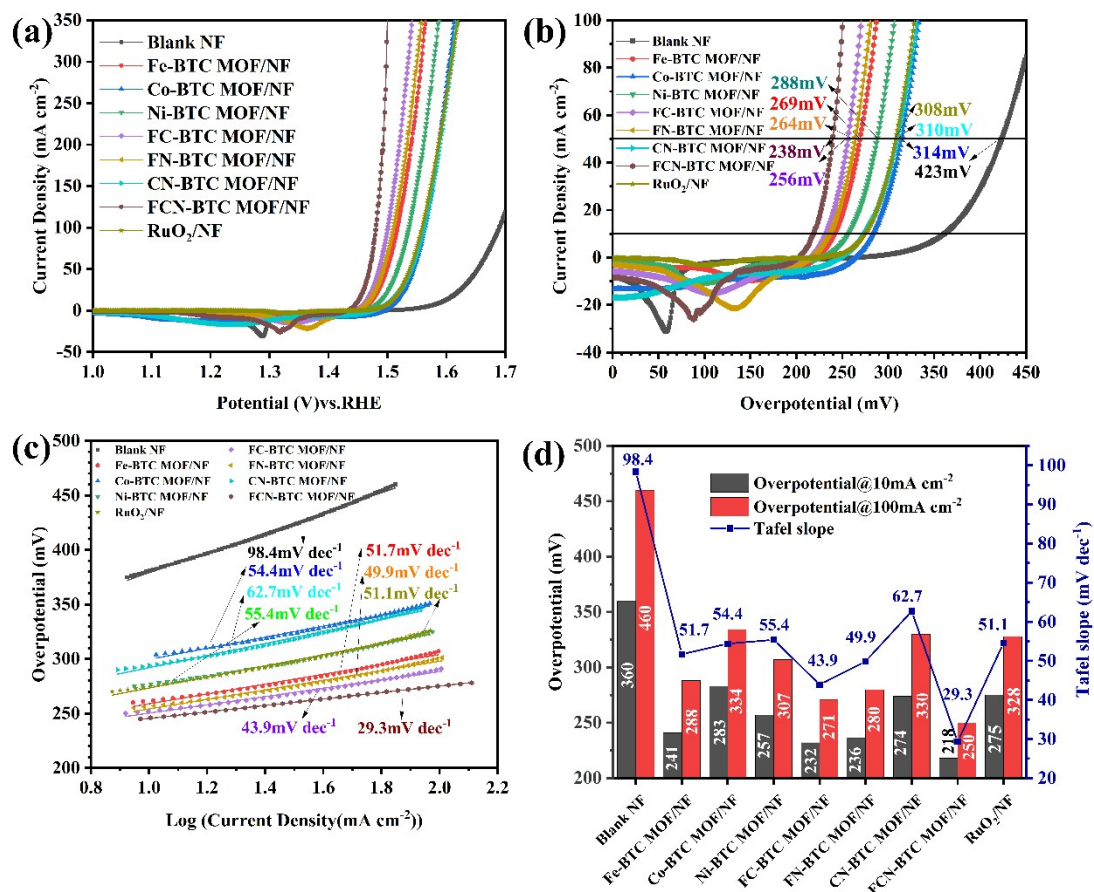


Figure S4. (a, b) LSV polarization curves recorded in 1 M KOH in negative scan mode at scan rate of 5 mV s⁻¹. (c) Tafel plots and (d) composite comparison of overpotential at 10, 100 mA cm⁻² current density and Tafel slope.

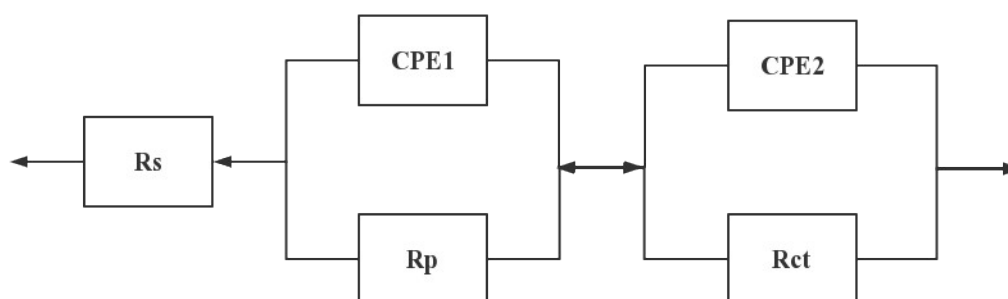


Figure S5. Equivalent circuit model for electrochemical impedance spectroscopy analysis of OER. R_s , R_p , and R_{ct} represent system, electrode porosity, and charge transfer resistances, respectively, whereas CPE_1 and CPE_2 represent constant phase element.

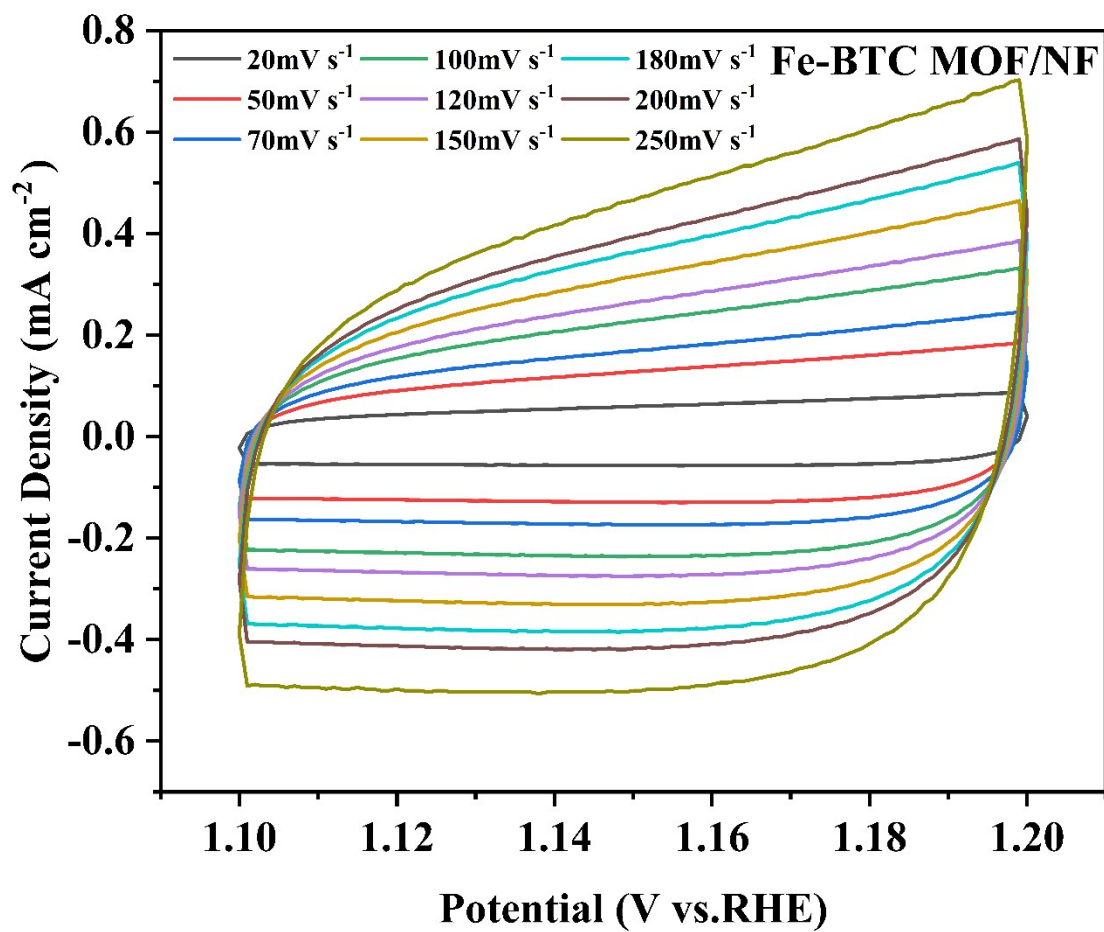


Figure S6. CV curves of Fe-BTC MOF/NF at increasing scan rates (mV s^{-1}).

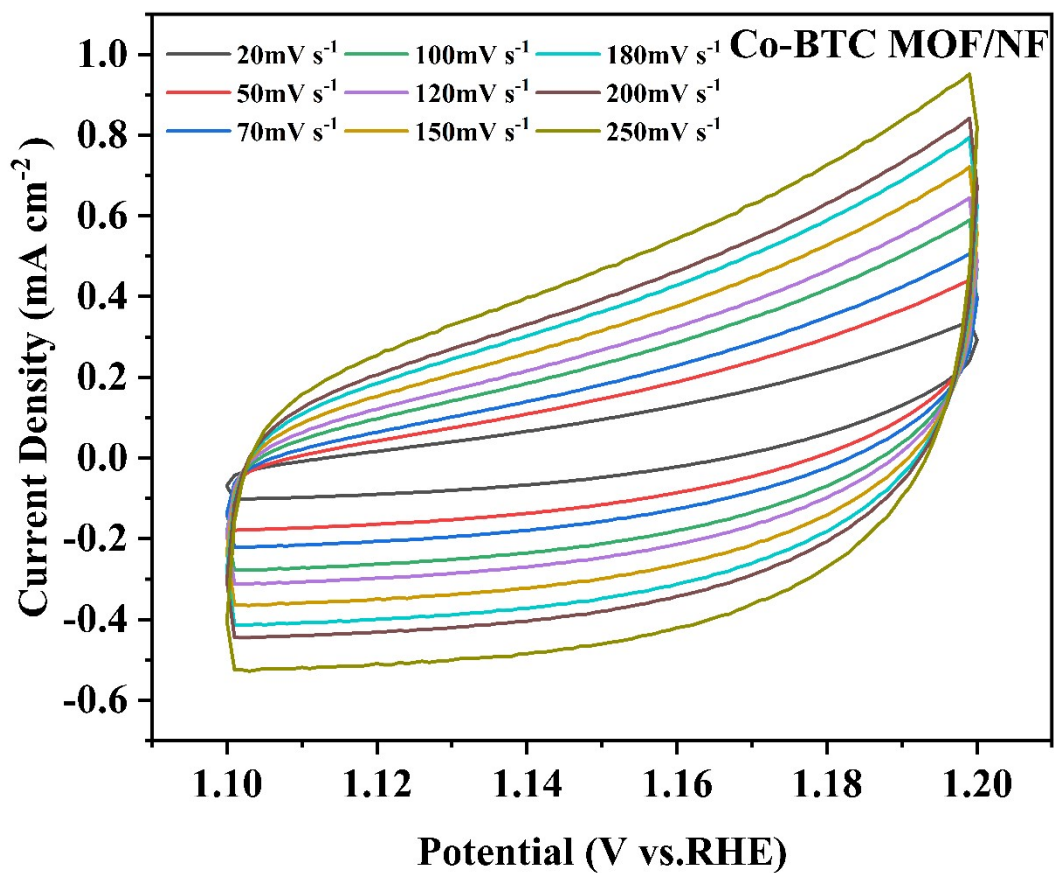


Figure S7. CV curves of Co-BTC MOF/NF at increasing scan rates (mV s^{-1}).

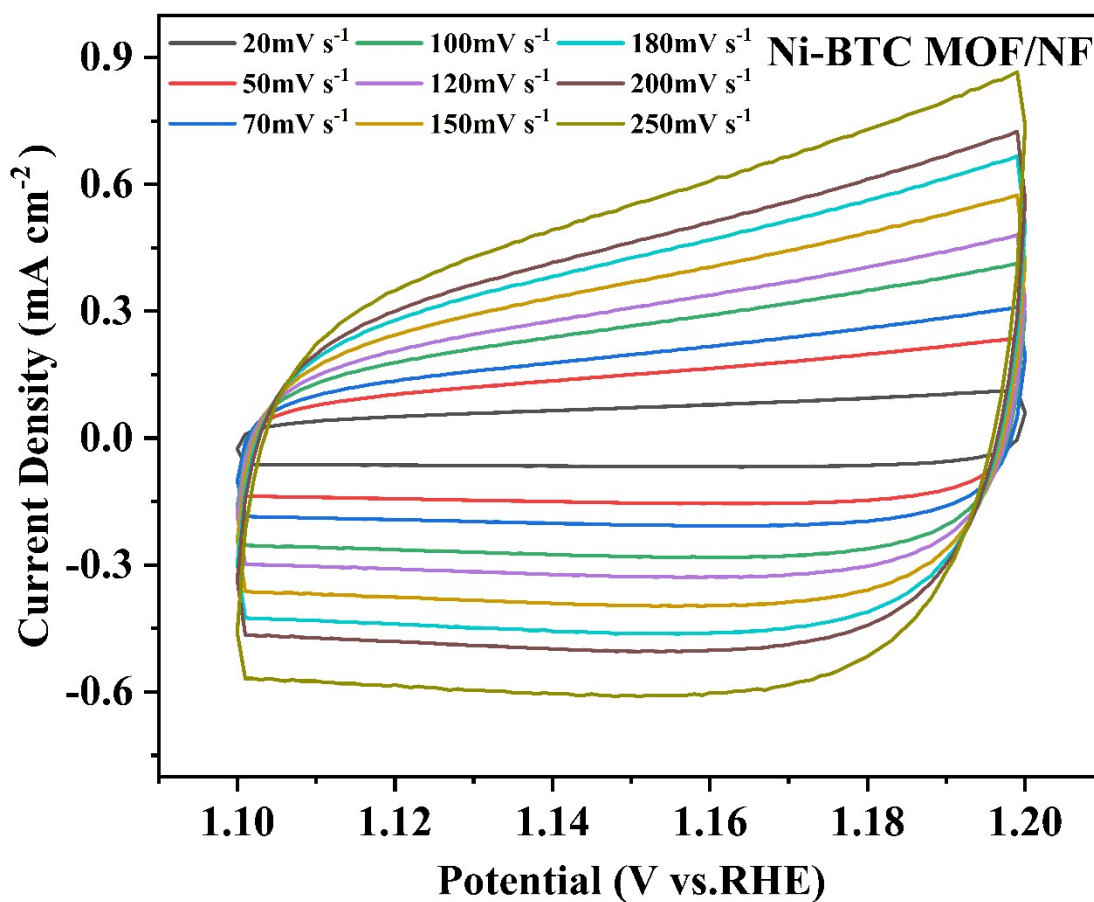


Figure S8. CV curves of Ni-BTC MOF/NF at increasing scan rates (mV s^{-1}).

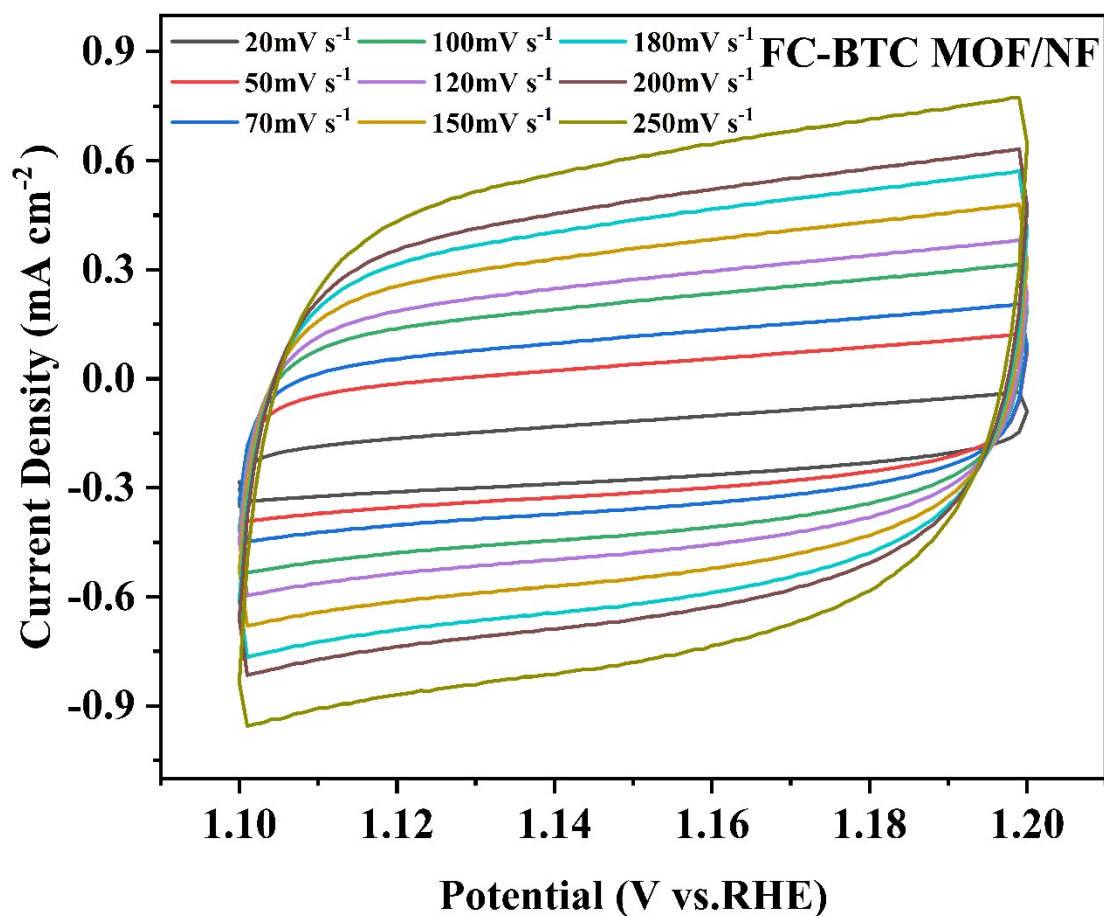


Figure S9. CV curves of FC-BTC MOF/NF at increasing scan rates (mV s^{-1}).

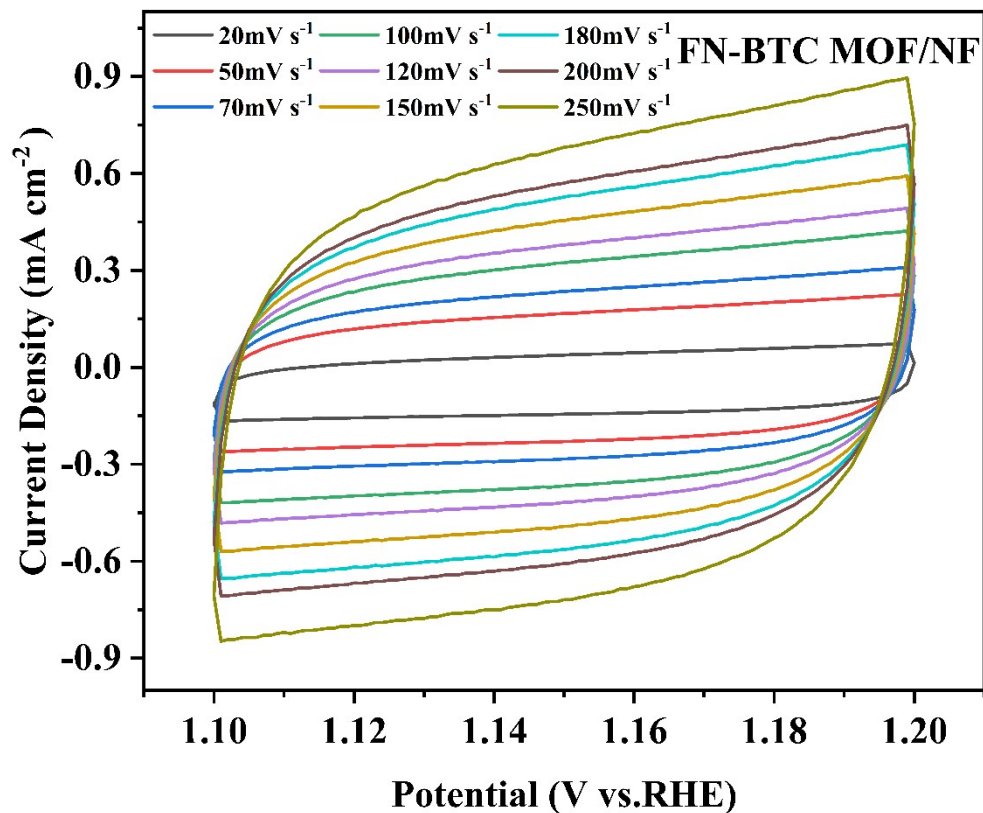


Figure S10. CV curves of FN-BTC MOF/NF at increasing scan rates (mV s^{-1}).

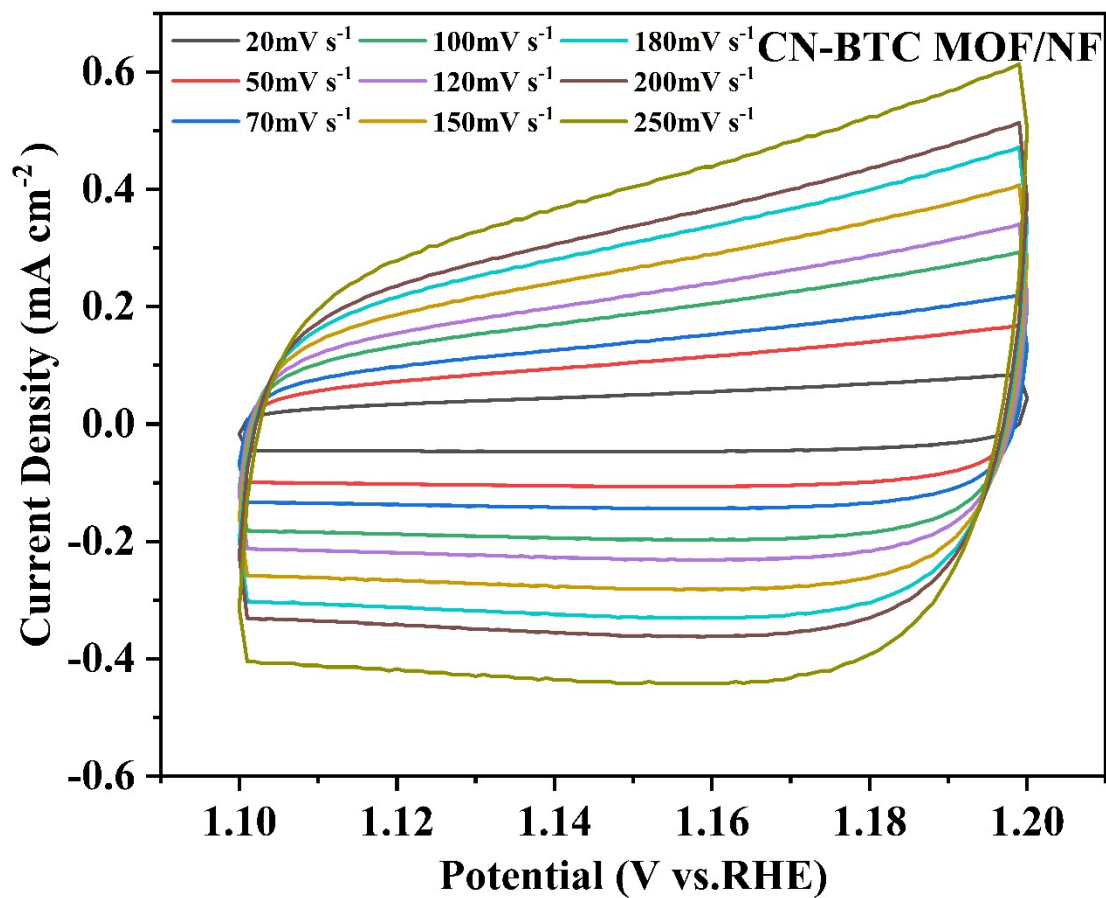


Figure S11. CV curves of CN-BTC MOF/NF at increasing scan rates (mV s^{-1}).

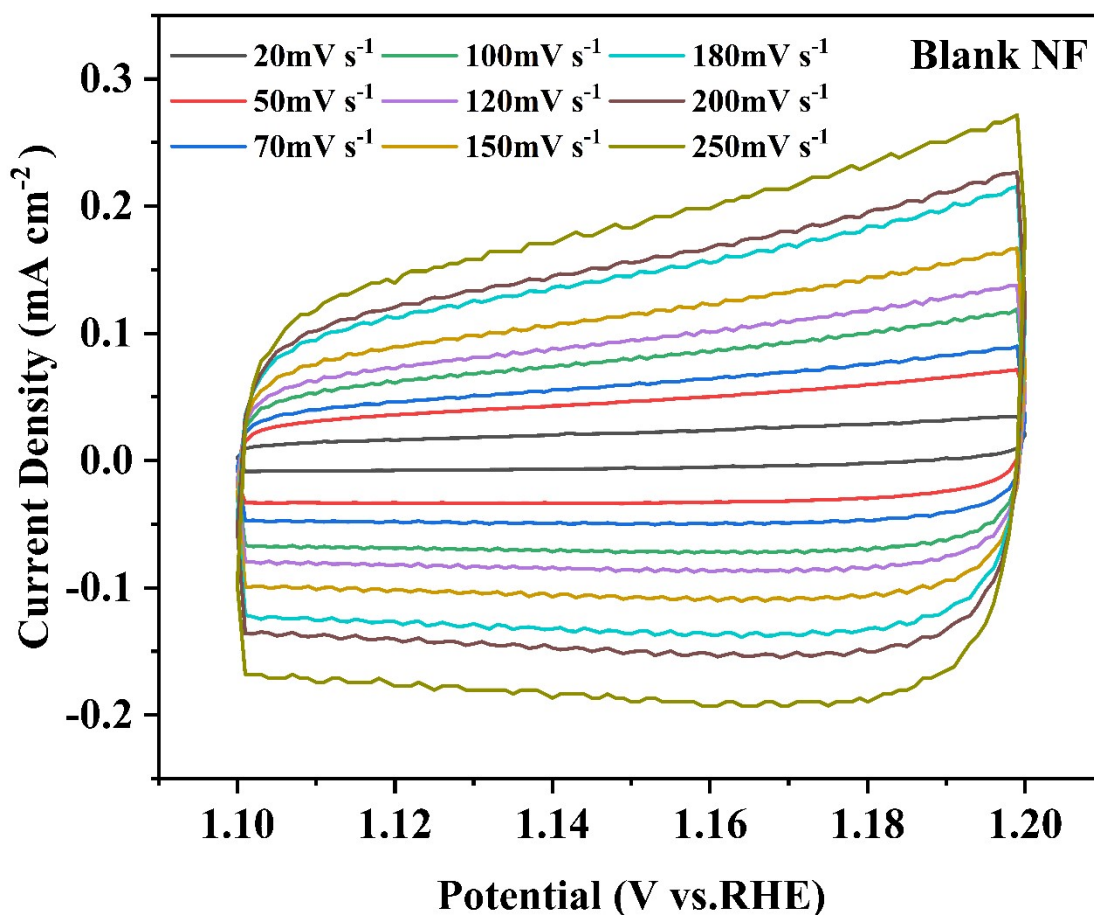


Figure S12. CV curves of Blank NF at increasing scan rates (mV s^{-1}).

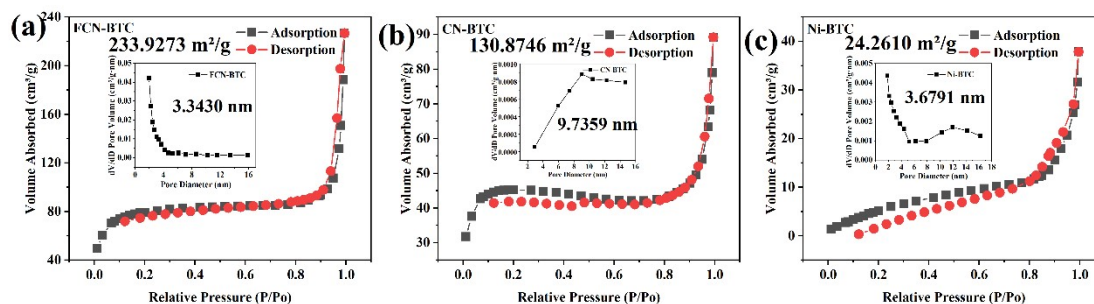


Figure S13. N_2 adsorption-desorption isotherms of (a)FCN-BTC MOF, (b)CN-BTC MOF, and (c)Ni-BTC MOF, illustrated by BJH adsorption curves.

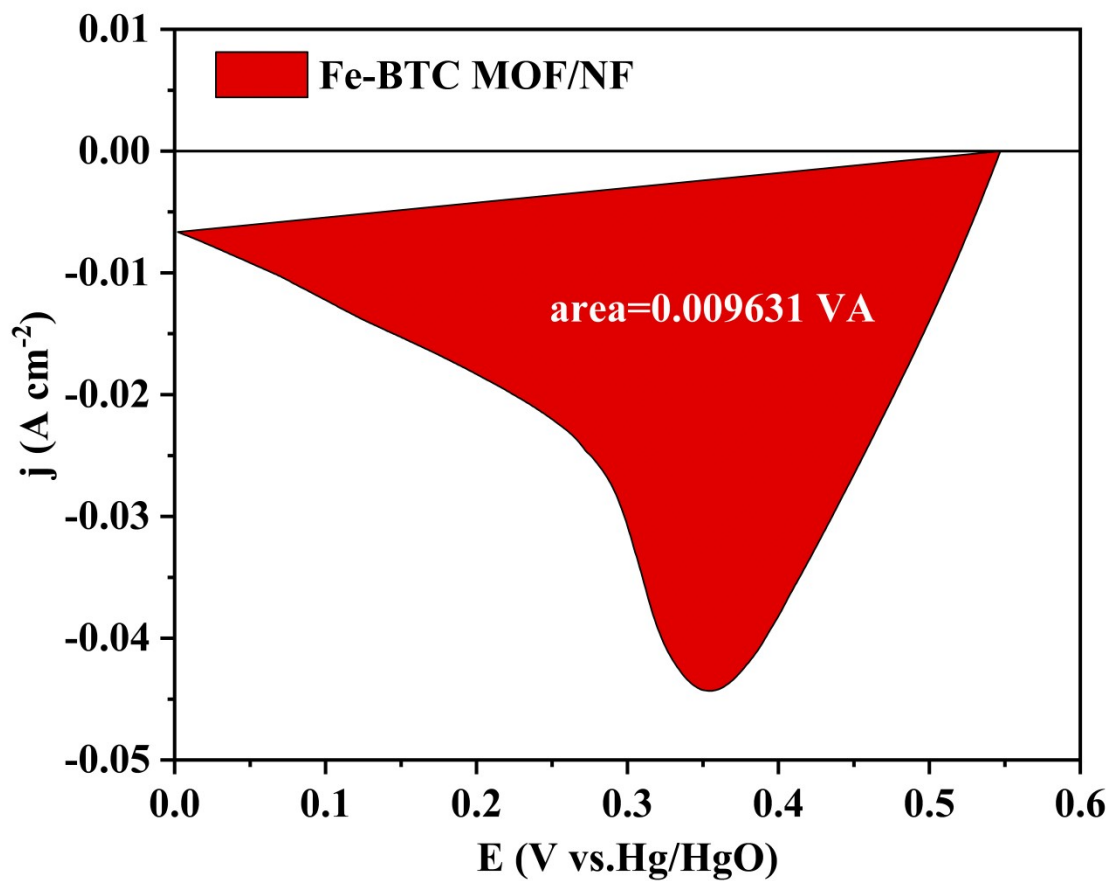


Figure S14. Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for Fe-BTC MOF/NF electrodes.

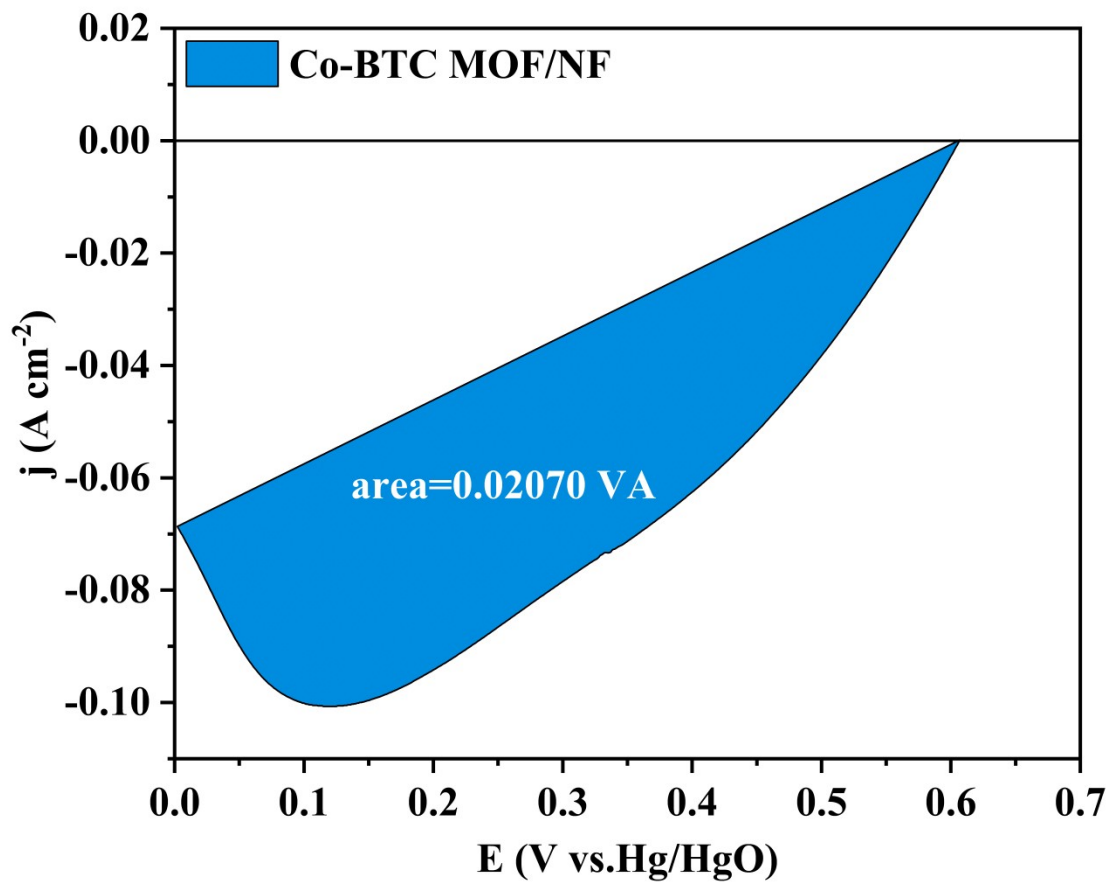


Figure S15.Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for Co-BTC MOF/NF electrodes.

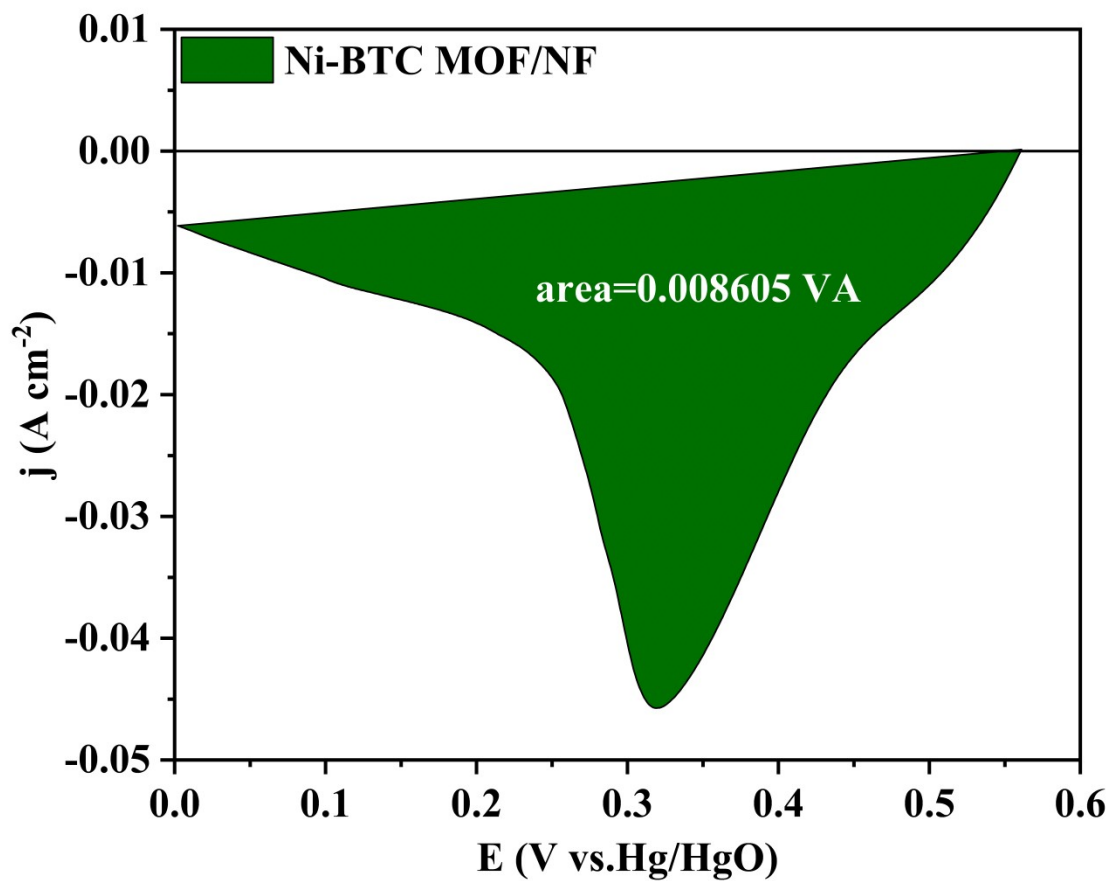


Figure S16.Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for Ni-BTC MOF/NF electrodes.

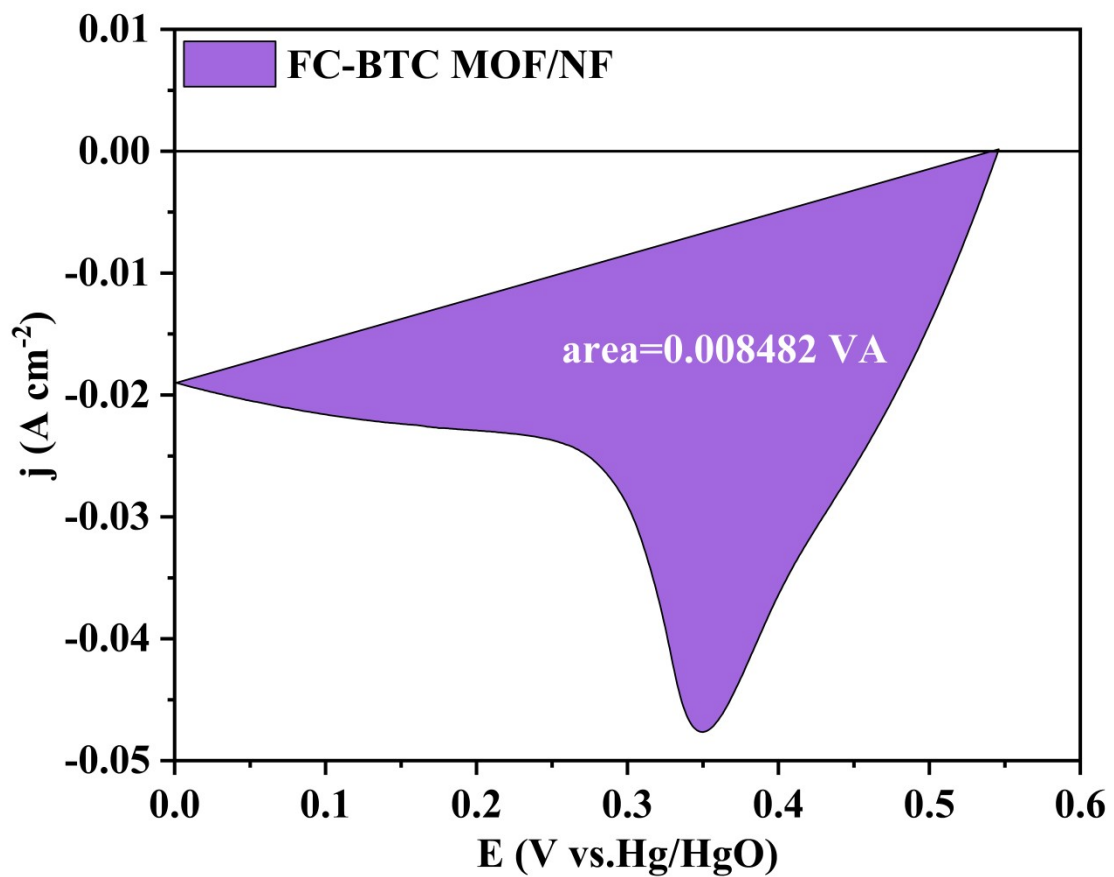


Figure S17.Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for FC-BTC MOF/NF electrodes.

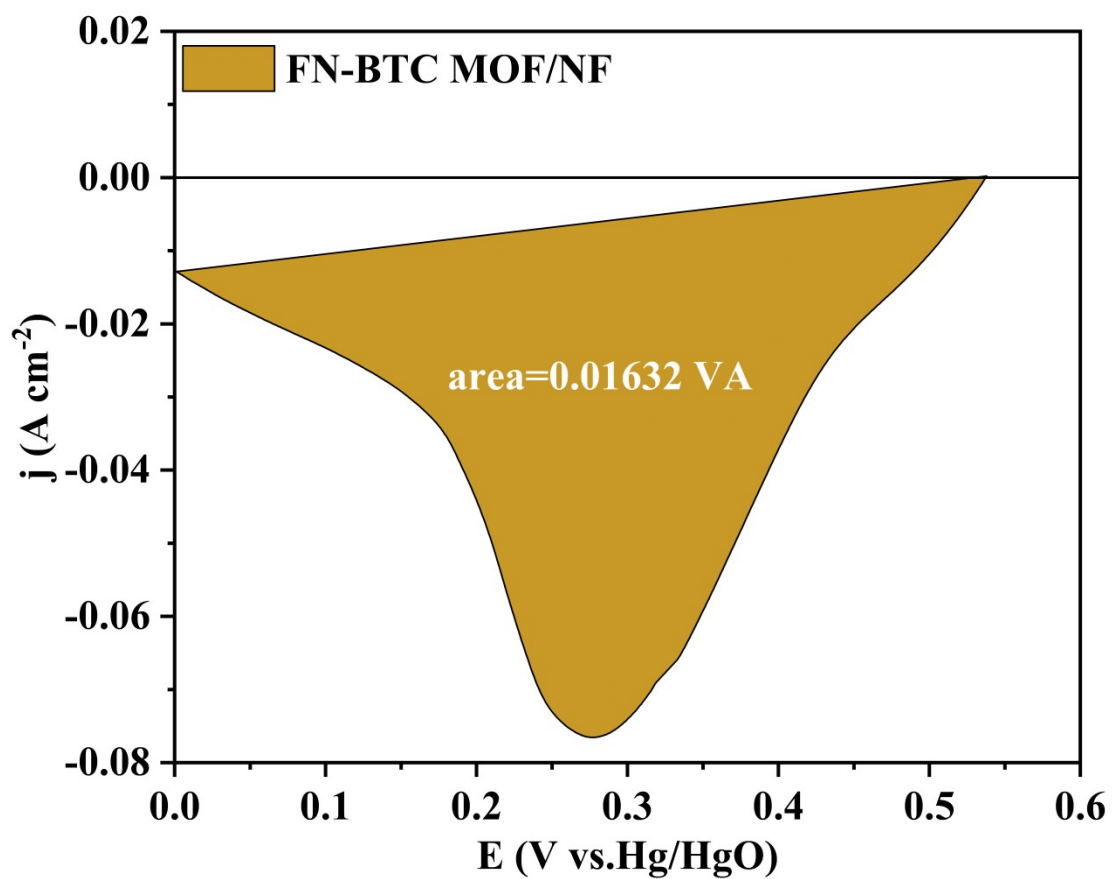


Figure S18.Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for FN-BTC MOF/NF electrodes.

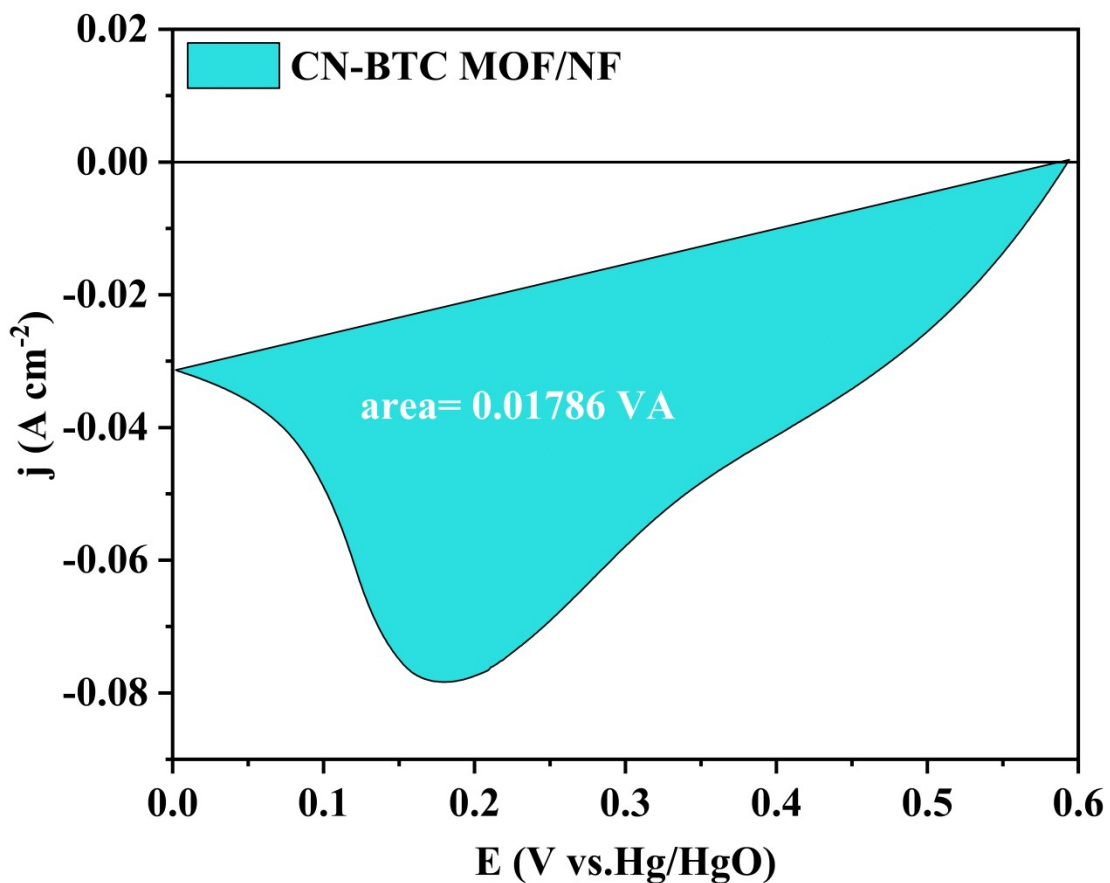


Figure S19.Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for CN-BTC MOF/NF electrodes.

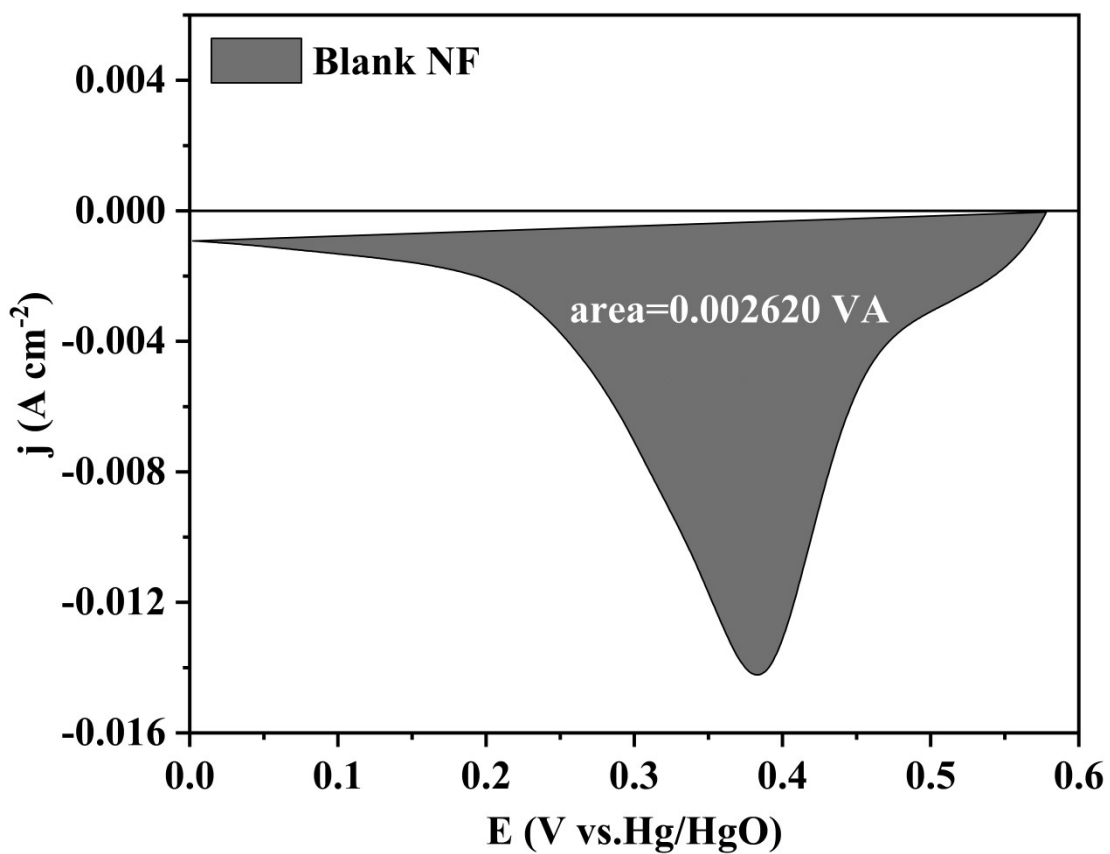


Figure S20. Reduction Peak area of CV curves (100mV s^{-1}) in 1 M KOH for Blank NF electrodes.

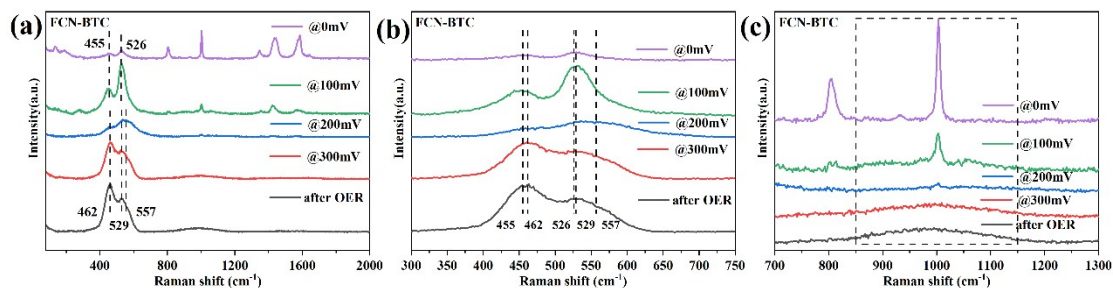


Figure S21. (a) In-situ Raman spectra for FCN-BTCMOF with 532 nm excitation under OER conditions at increasing overpotentials (vs. RHE); (b) Magnification of the corresponding wavelength ($300\text{-}750\text{ cm}^{-1}$) region of (a); (c) Magnification of the corresponding wavelength ($700\text{-}1300\text{ cm}^{-1}$) region of (a).

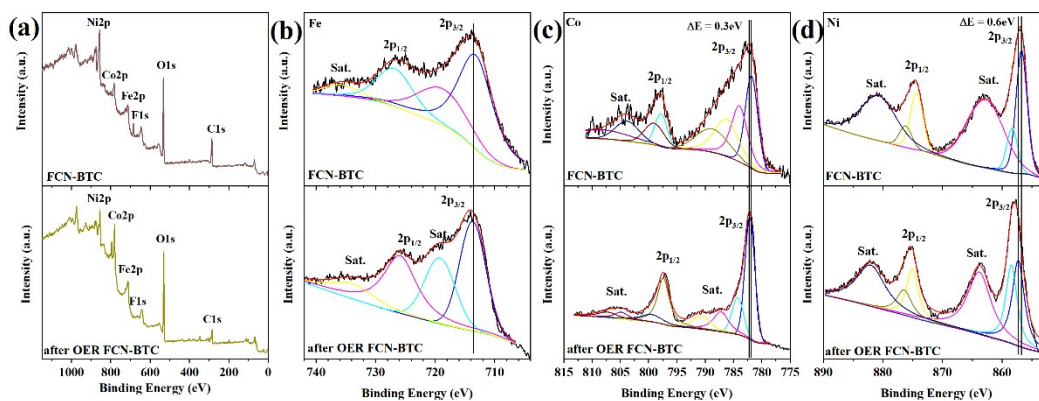


Figure S22. FCN-BTC MOF before and after OER test: (a) XPS full survey, (b) Fe 2p, (c) Co 2p, (d) Ni 2p.