Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Boosting the water splitting activity of cobalt nitride through the morphological design: a comparation for the influences of structures towards hydrogen and oxygen evolution reactions

Tingting Liu [a], Sheng Cai [a], Zhiyuan Mei [a], Genfu Zhao [a], Lufu Xu [a], Qi An [a], Yao Fu [a], Han Wang [a], Mian Li [b, *], Hong Guo [a, *]

[a] School of Materials Science and Engineering, Green Energy Key Laboratory of All-Solid Ion Battery in Yunnan Province University, Yunnan University, No. 2, Green Lake North Road, Kunming, 650091, China

[b] National and Local Joint Engineering Laboratory for Lithium-ion Batteries and Materials Preparation Technology, Key Laboratory of Advanced Battery Materials of Yunnan Province, Faculty of Metallurgical and Energy Engineering, Kunming University of Science and Technology, Kunming, 650093, China

Corresponding author:

E-mail addresses: mianzi2009@126.com (M. Li), guohongcom@126.com (H. Guo).

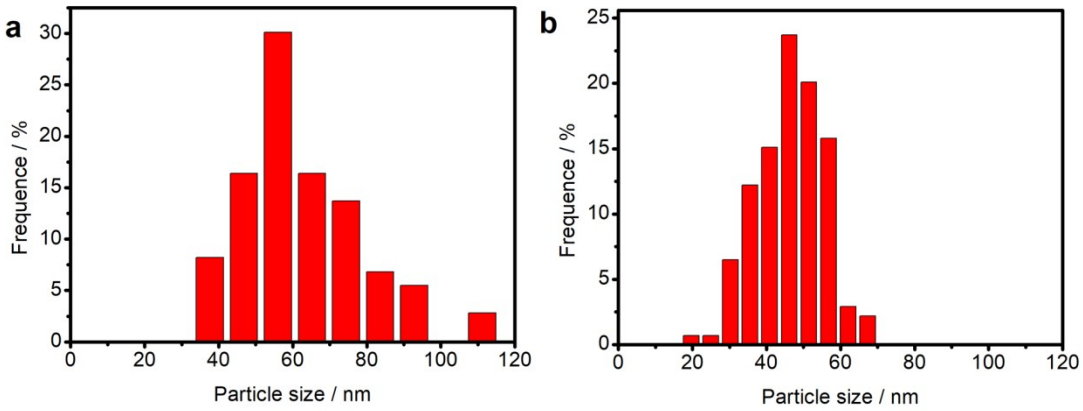

Figure S1. The histograms of the particle size distributions for the CoN-S (a) and CoN-F (b).

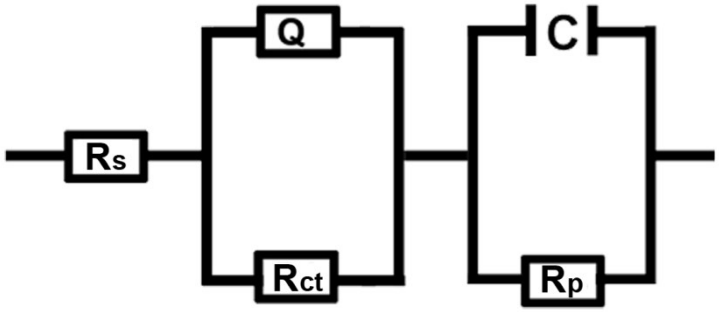

Figure S2. The equivalent circuit utilized for analyzing the HER EIS data for CoN-P, CoN-S and CoN-F.

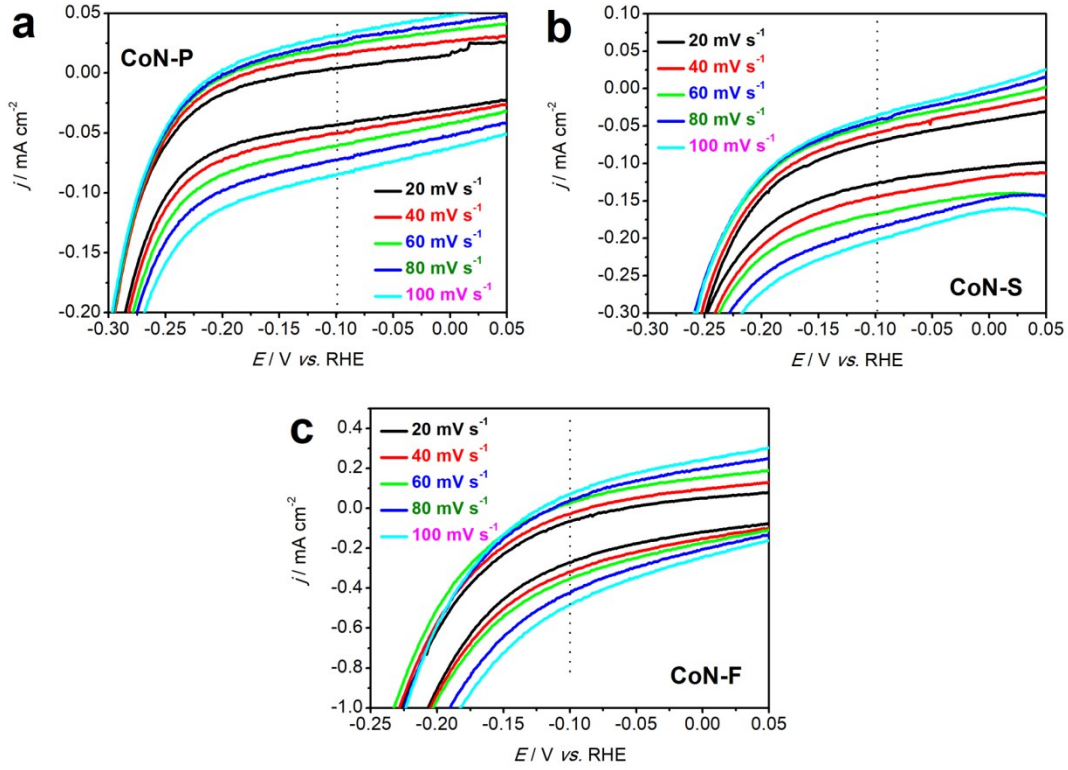

Figure S3. CV curves recorded at different scan rates from 20 to 100 mV s^{-1} for CoN-P (**a**), CoN-S (**b**) and CoN-F (**c**).

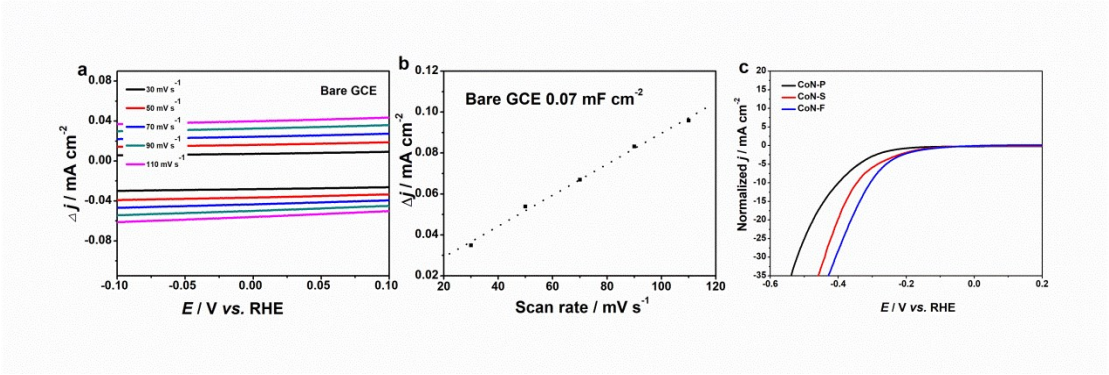

Figure S4. (a) C_{dl} tests of bare GCE by CV method: CV curves of bare GCE recorded at different scan rates of 30, 50, 70, 90, and 110 mV s^{-1}; (b) Capacitive current densities as a function of scan rates recorded from **Figure S4a**; (c) HER LSV polarization curves for CoN-F, CoN-S and CoN-P in a 1.0 M KOH medium. The current densities of all catalysts have been normalized by electrochemically active surface area (ECSA).

Table S1. C, R and ECSA values for HER modified electrodes and bare RDE.

Samples	C (mF cm^{-2})	R	ECSA (cm^2)
Bare GCE	0.07	—	—
CoN-F	2.16	30.85	6.05
CoN-S	0.71	10.14	1.99
CoN-P	0.44	6.28	1.23

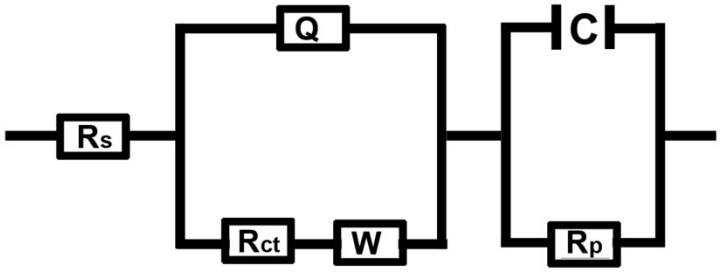

Figure S5. The equivalent circuit utilized for analyzing the OER EIS data for CoN-P, CoN-S and CoN-F.

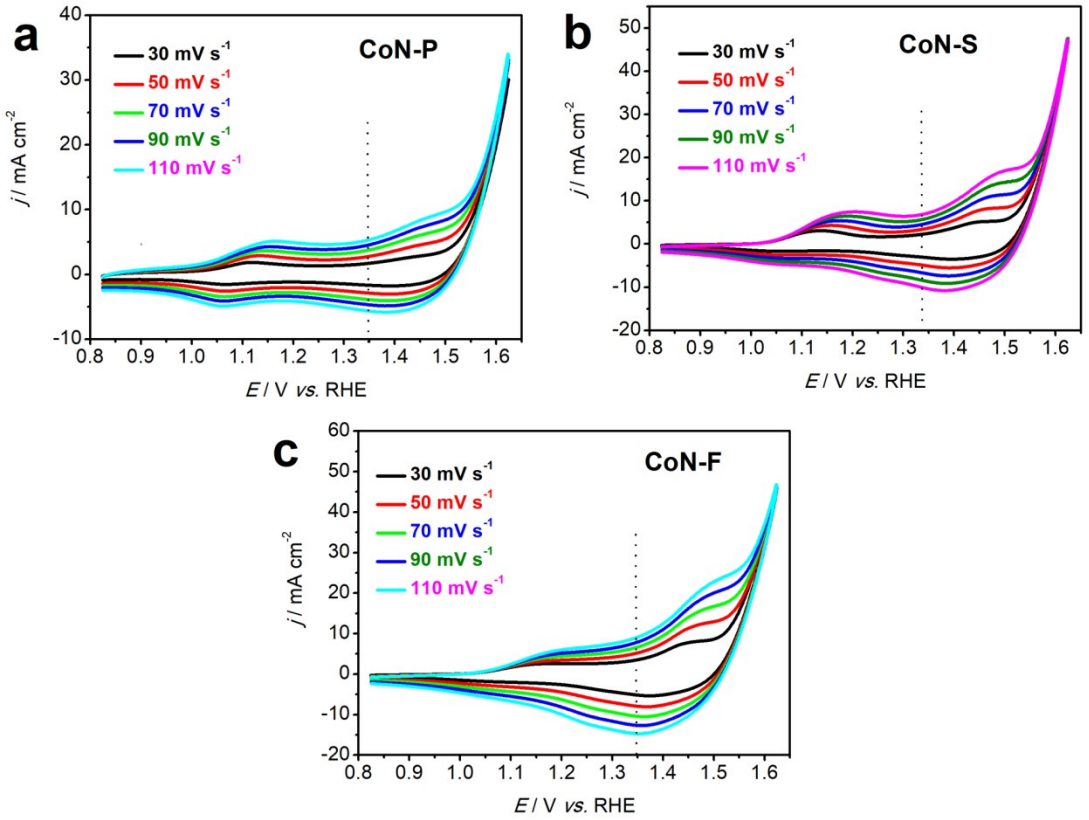

Figure S6. CV curves recorded at different scan rates from 30 to 110 mV s^{-1} for CoN-P (**a**), CoN-S (**b**) and CoN-F (**c**).

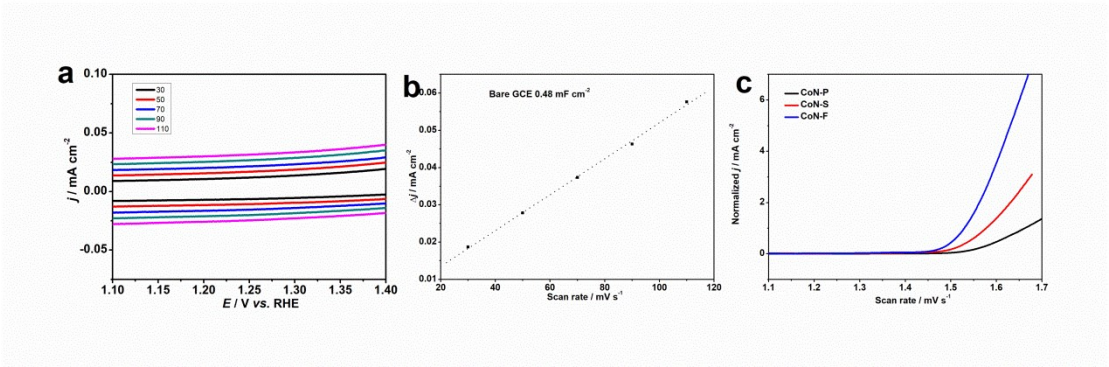

Figure S7. (a) OER C_{dl} tests of bare GCE by CV method: CV curves of bare GCE recorded at different scan rates of 30, 50, 70, 90, and 110 mV s^{-1}; (b) Capacitive current densities as a function of scan rates recorded from Figure SX(a); (c) OER LSV polarization curves for CoN-F, CoN-S and CoN-P in a 1.0 M KOH medium. The current densities of all catalysts have been normalized by electrochemically active surface area (ECSA).

Table S2. C, R and ECSA values for OER modified electrodes and bare RDE.

Samples	C (mF cm^{-2})	R	ECSA (cm^2)
Bare GCE	0.48	—	—
CoN-F	94.87	197.64	38.78
CoN-S	57.58	119.96	23.54
CoN-P	44.05	91.77	18.01

Table S3 Comparison of cell voltage to achieve a current density of 10 mA cm^{-2} for CoN-F||CoN-F cell and other reported water splitting cells.

Catalysts	E_{10} (V)	References
CoN-F||CoN-F	1.613	This work
Pt/C||RuO_2	1.592	
Co_4N@NC||Co_4N@NC-700	1.561	ACS Energy Lett. 2020, 5, 3, 692–700
$Co_{1-x}S$@CoN||$Co_{1-x}S$@CoN	1.55	Small 2020, 16, 2002432
CoN@CC||CoN@CC	1.59	Electrochim. Acta 2018, 273, 229-238
Co_3O_4 NWs/CC||CoP NWs/CC	1.63	Mater. Chem. Front., 2018, 2, 323--330
FeOOH@Co_4N || FeOOH@Co_4N	1.59	ACS Appl. Mater. Interfaces 2019, 11,

		5152−5158
CoS_2 NS||CoS_2 NS	1.58	Mater. Chem. Front., 2018, 2, 1732--1738
CoO-Co_4N||CoO-Co_4N	1.79	J. Mater. Chem. A 2018, 6 (48), 24767-24772
Co_2P/CoN-NCNTs|| Co_2P/CoN-NCNTs	1.64	Adv. Funct. Mater. 2018, 28, 1805641
CoN@VON||CoN@VON	1.64	Appl. Catal. B: Environ. 2019, 241, 521-527
$Co_{5.47}N$ NP@N-PC||$Co_{5.47}N$ NP@N-PC	1.62	ACS Appl. Mater. Interfaces 2018, 10 (8), 7134-7144

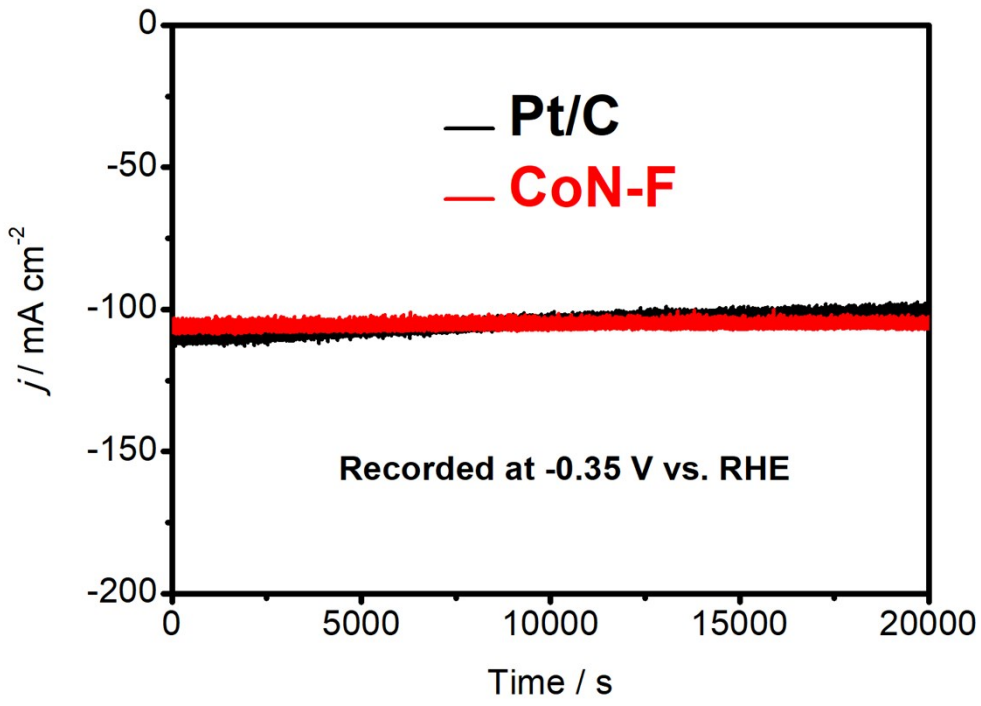

Figure S8. the raw data of chronoamperometry measurement in **Figure 5**.

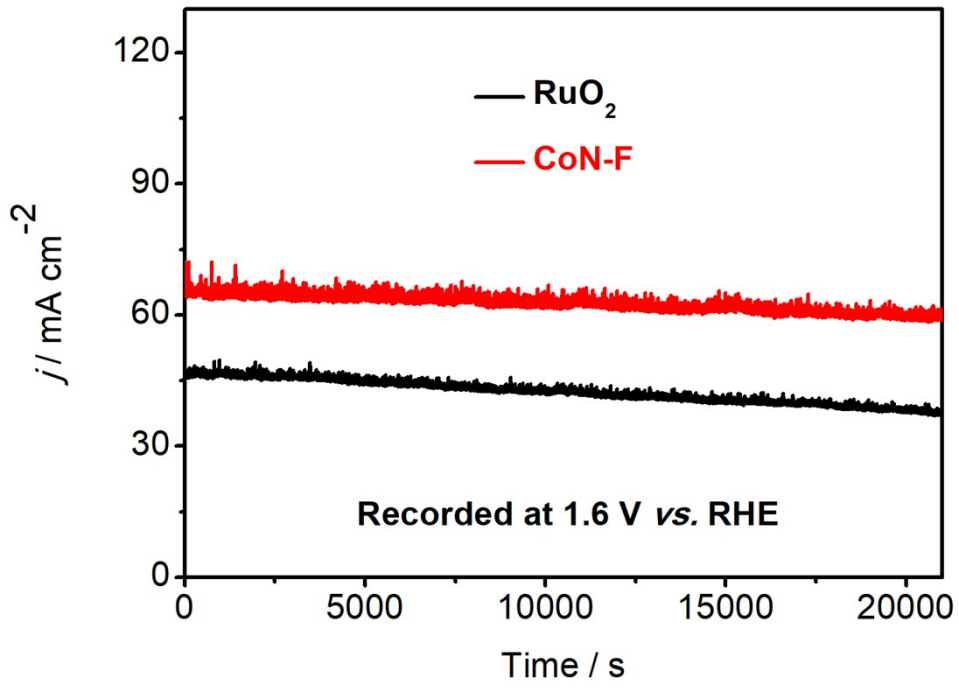

Figure S9. the raw data of chronoamperometry measurement in **Figure 6**.

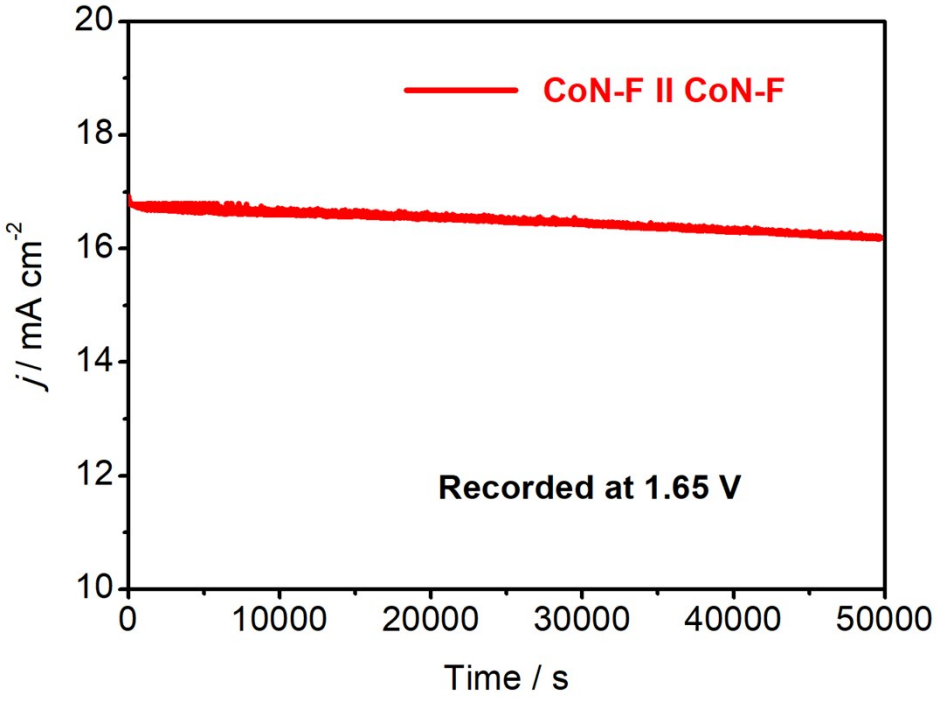

Figure S10. the raw data of chronoamperometry measurement in **Figure 7**.

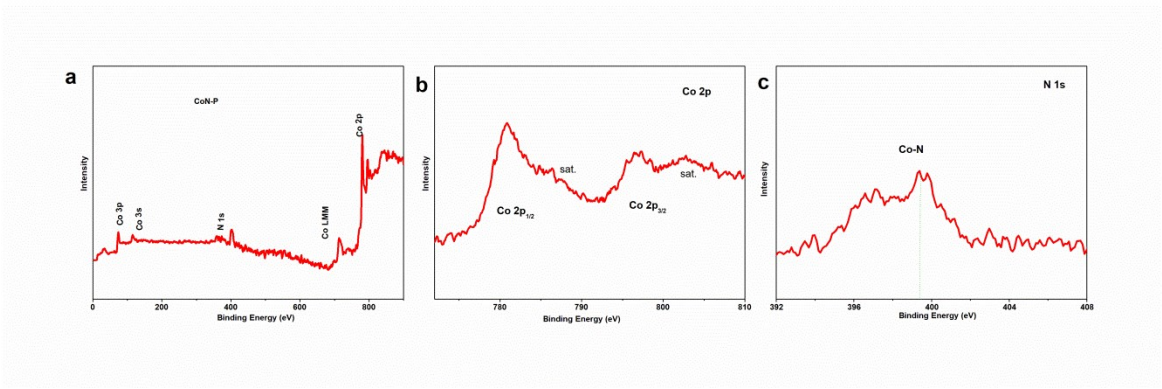

Figure S11. The XPS survey (a), Co 2p (b) and N 1s (c) spectra of CoN-P sample.

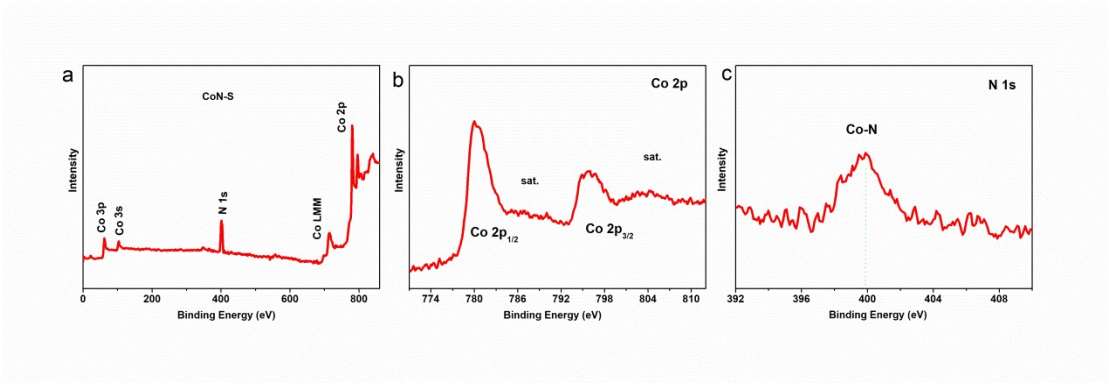

Figure S12. The XPS survey (a), Co 2p (b) and N 1s (c) spectra of CoN-S sample.

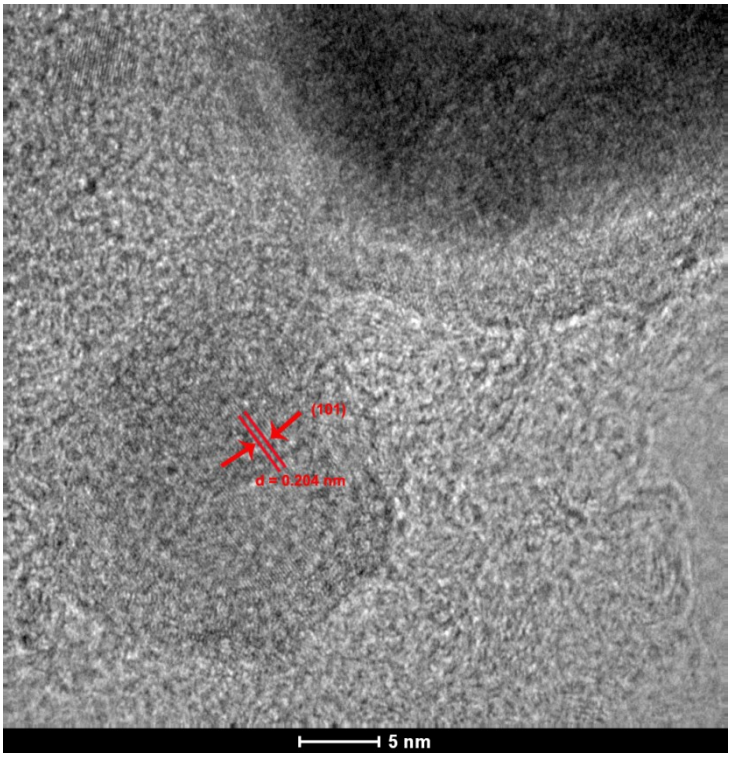

Figure S13.The high-resolution TEM image of 500 cycles CV tset for CoN-F.