Electronic Supplementary Material (ESI) for Journal of Materials Chemistry A.

Supporting Information

Efficient Water Oxidation through Strongly Coupled Graphitic C_3N_4 Coated Cobalt Hydroxide Nanowires

Muhammad Tahir[a,b], Nasir Mahmood[c], Lun Pan[a], Zhen-Feng Huang[a], ZheLv[a], Jingwen Zhang[a], Faheem. K. Butt[b], Guoqiang Shen[a], Xiangwen Zhang[a], Shi Xue Dou[c] and Ji-Jun Zou[a*]

[a] Key Laboratory for Green Chemical Technology of the Ministry of Education, School of Chemical Engineering and Technology, Tianjin University; Collaborative Innovative Center of Chemical Science and Engineering (Tianjin), Tianjin 300072, China

*E-mail: jj_zou@tju.edu.cn

[b] Department of Physics, The University of Lahore, 1-Km Raiwind Road, Lahore 53700, Pakistan

[c] Institute of Superconducting and Electronic Materials, Australian Institute of Innovative Materials, University of Wollongong, Squires Way, North Wollongong, NSW 2500, Australia.

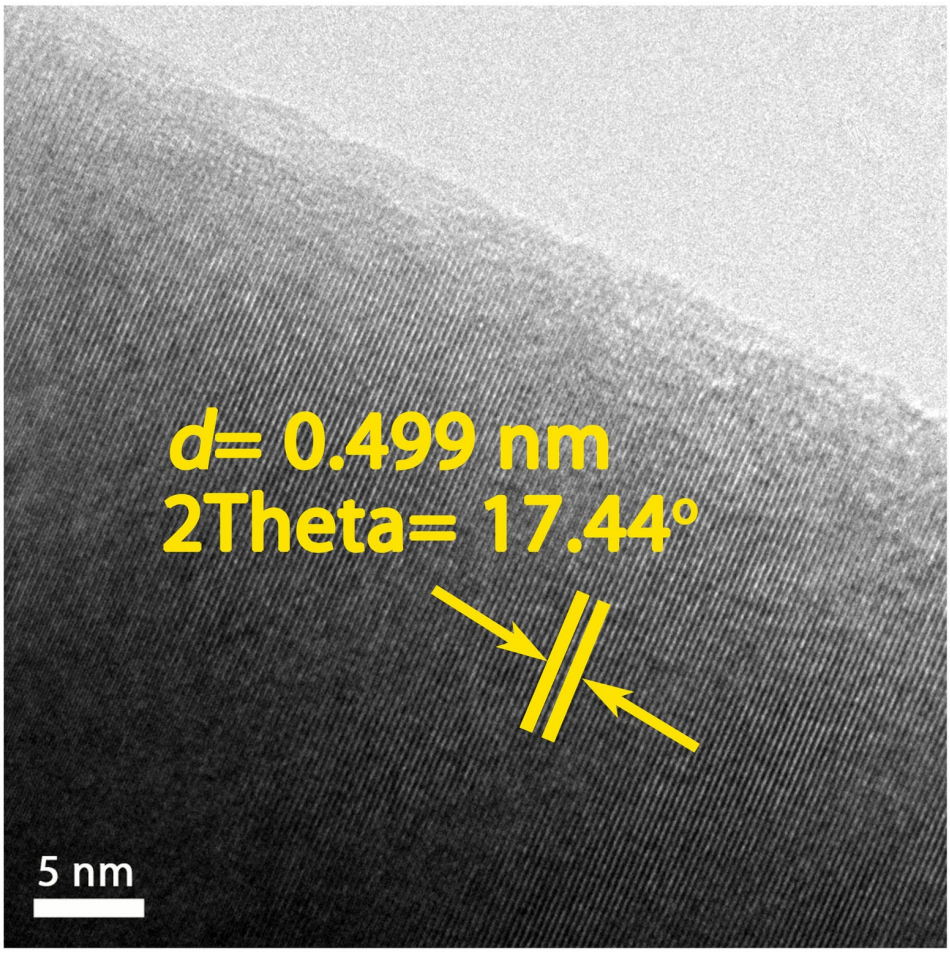

Figure S1 HRTEM image of $Co(OH)_2$ NWs.

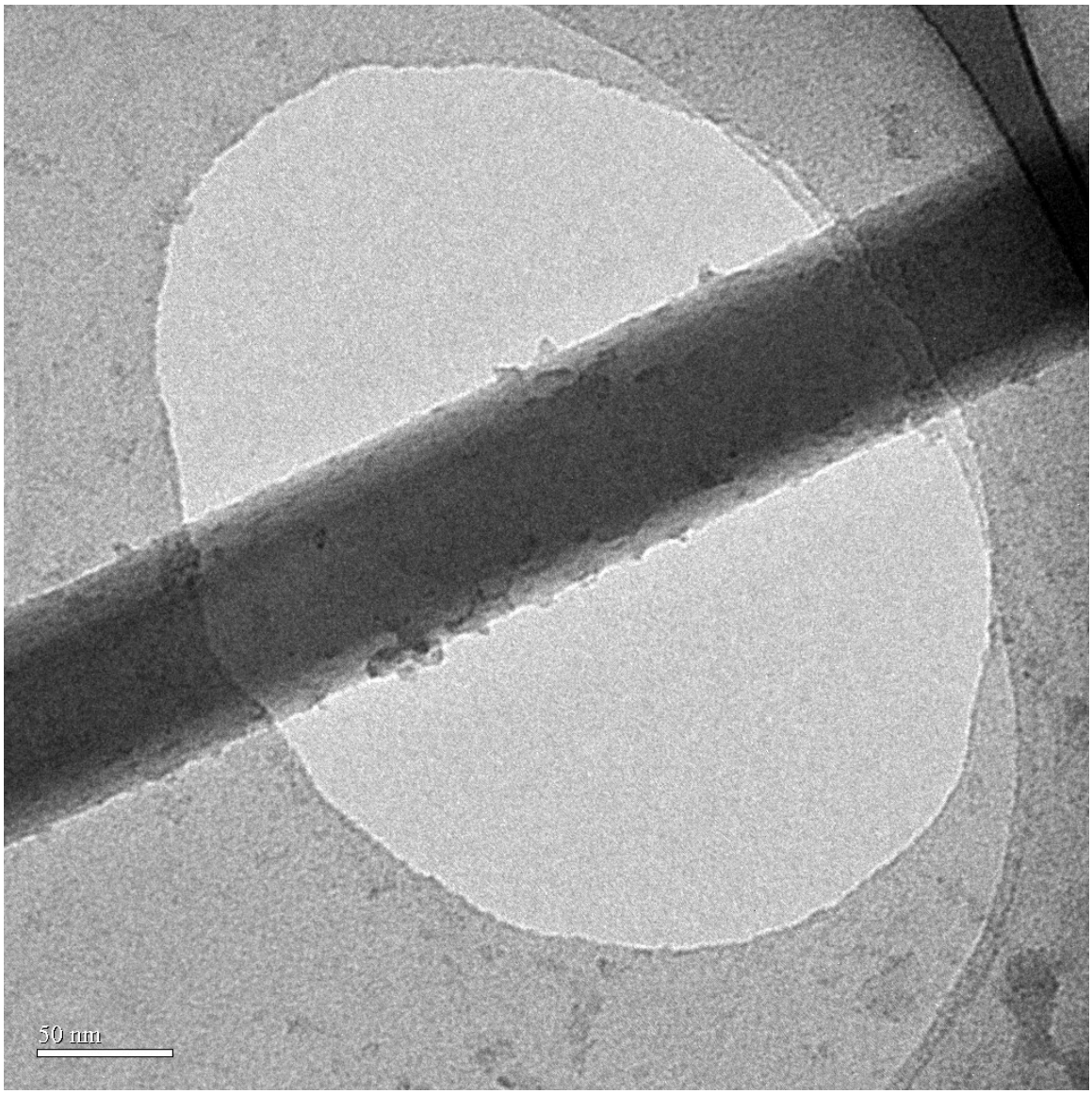

Figure S2 TEM image of $Co(OH)_2$@g-C_3N_4-2 NW.

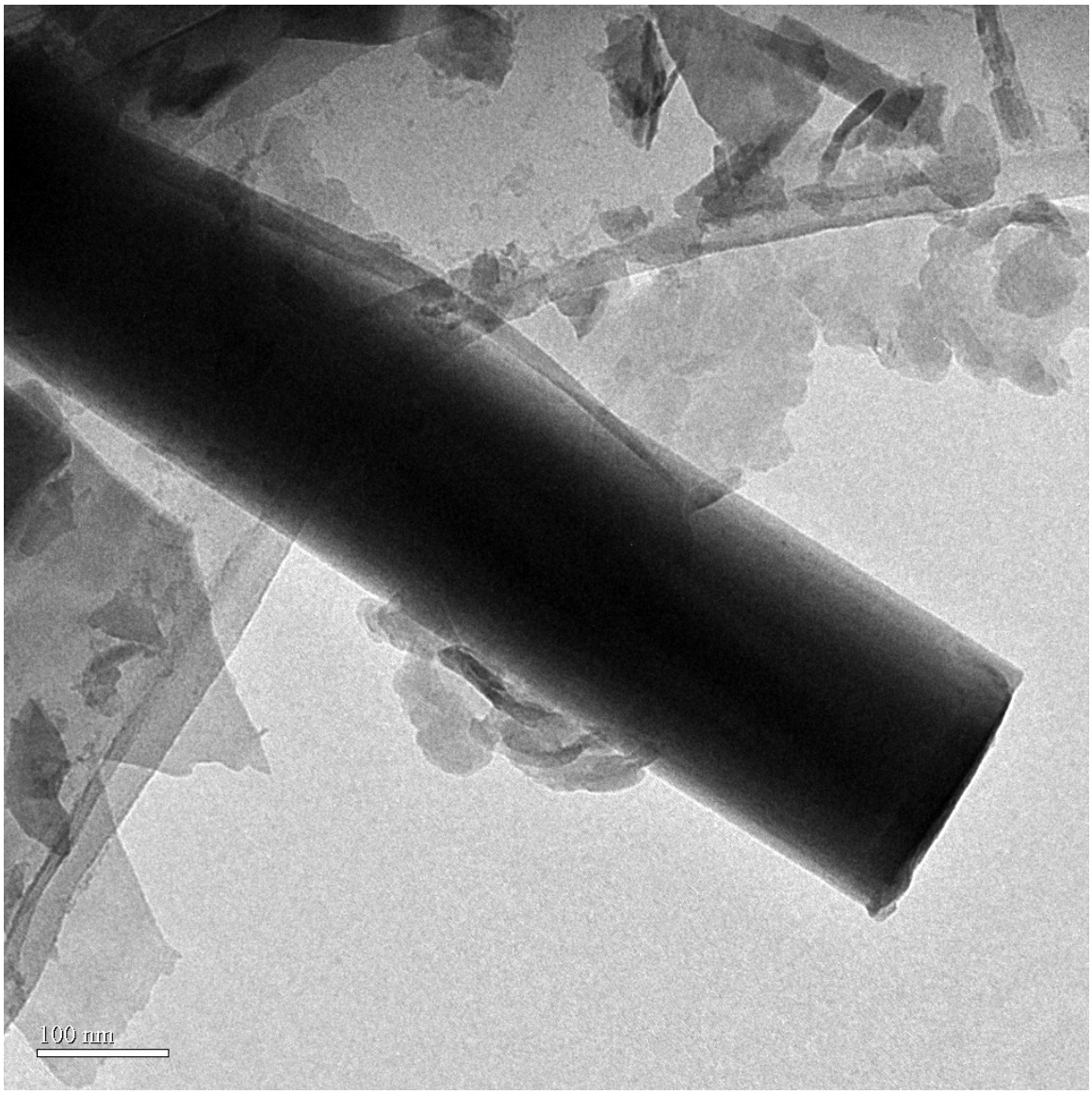

Figure S3 TEM image of $Co(OH)_2$/g-C_3N_4 NW.

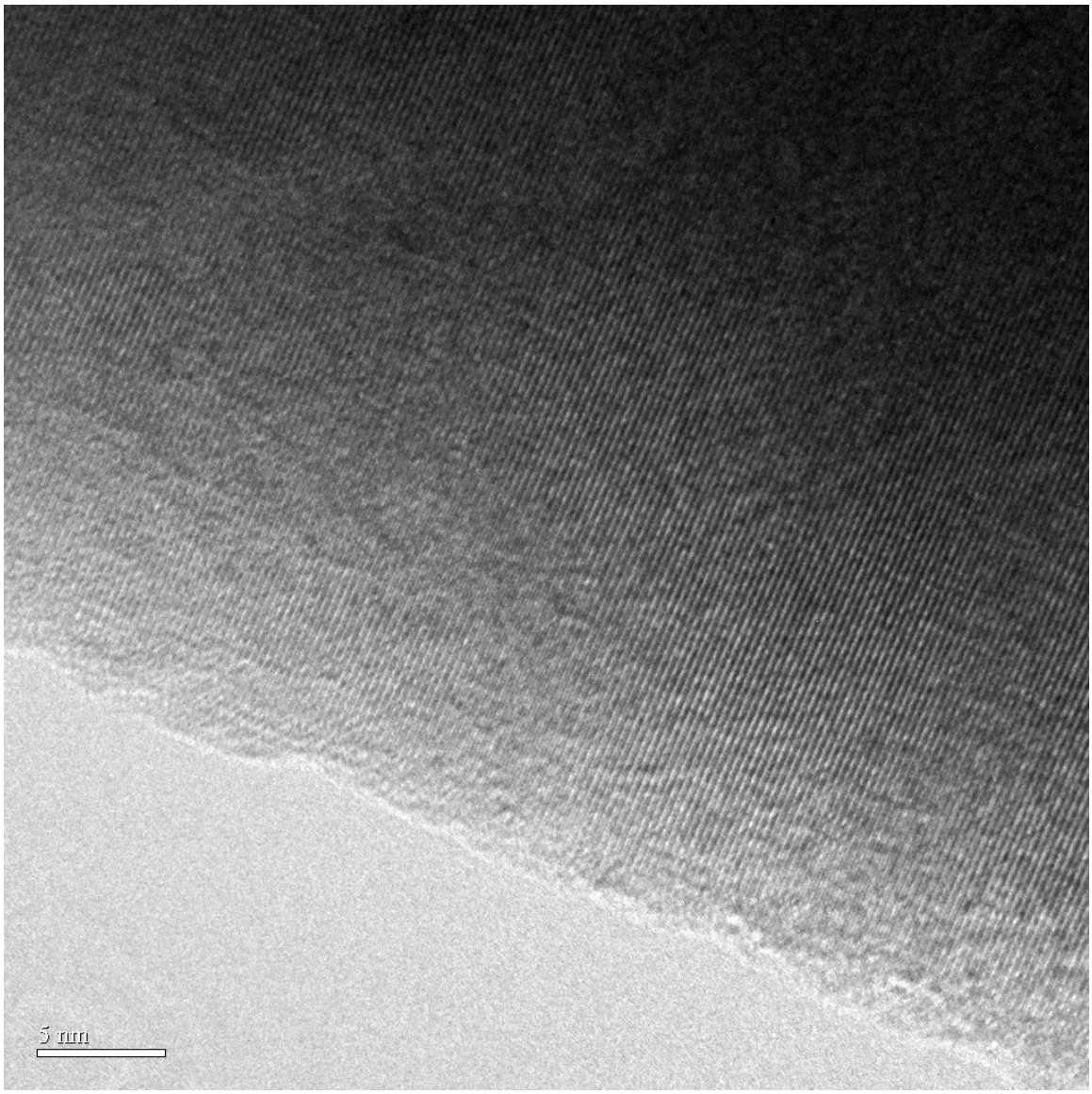

Figure S4 HRTEM image of $Co(OH)_2$/g-C_3N_4 NW.

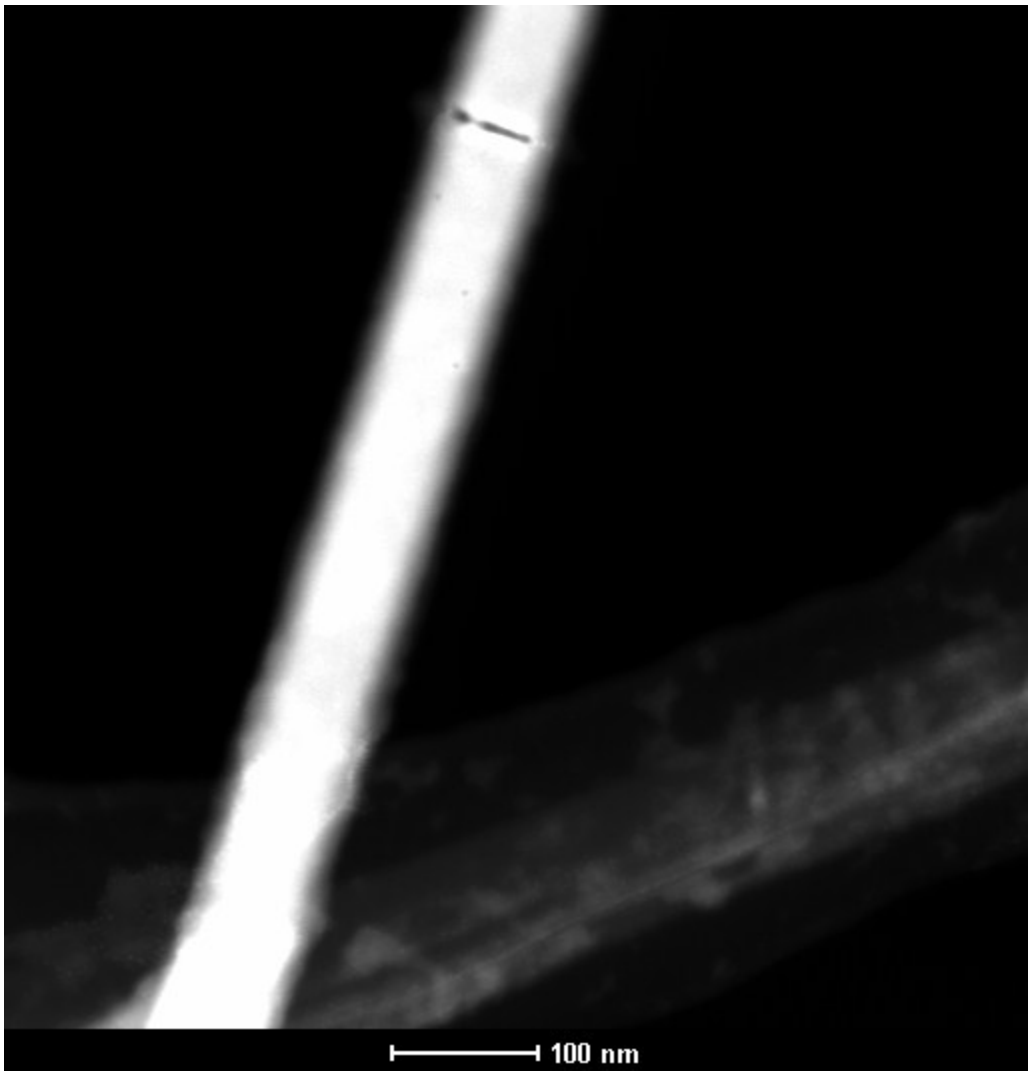

Figure S5 STEM image of $Co(OH)_2$@g-C_3N_4-5 NW.

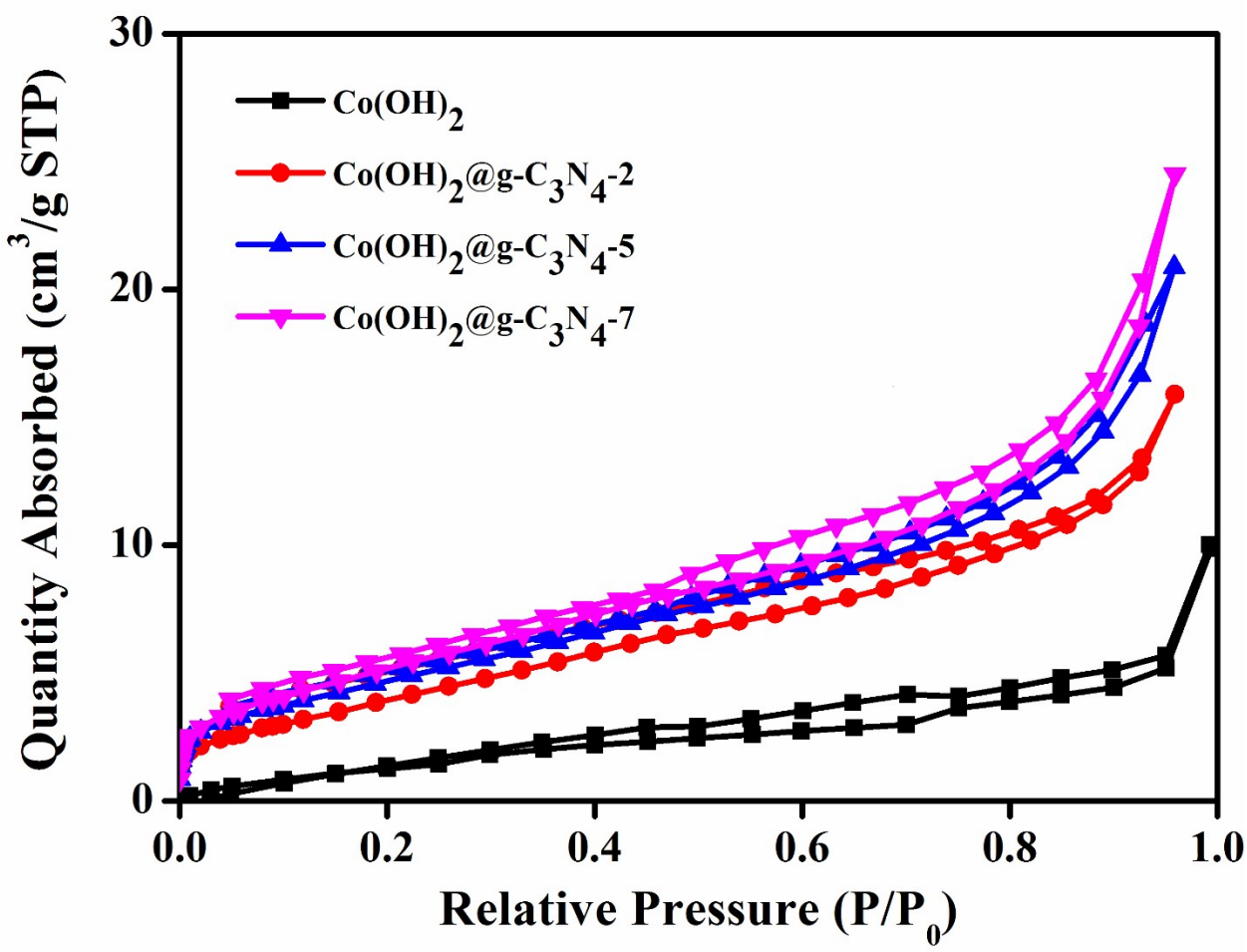

Figure S6 N_2 adsorption isotherms of $Co(OH)_2$, $Co(OH)_2$@g-C_3N_4-2, $Co(OH)_2$@g-C_3N_4-5 and $Co(OH)_2$@g-C_3N_4-7 NWs.

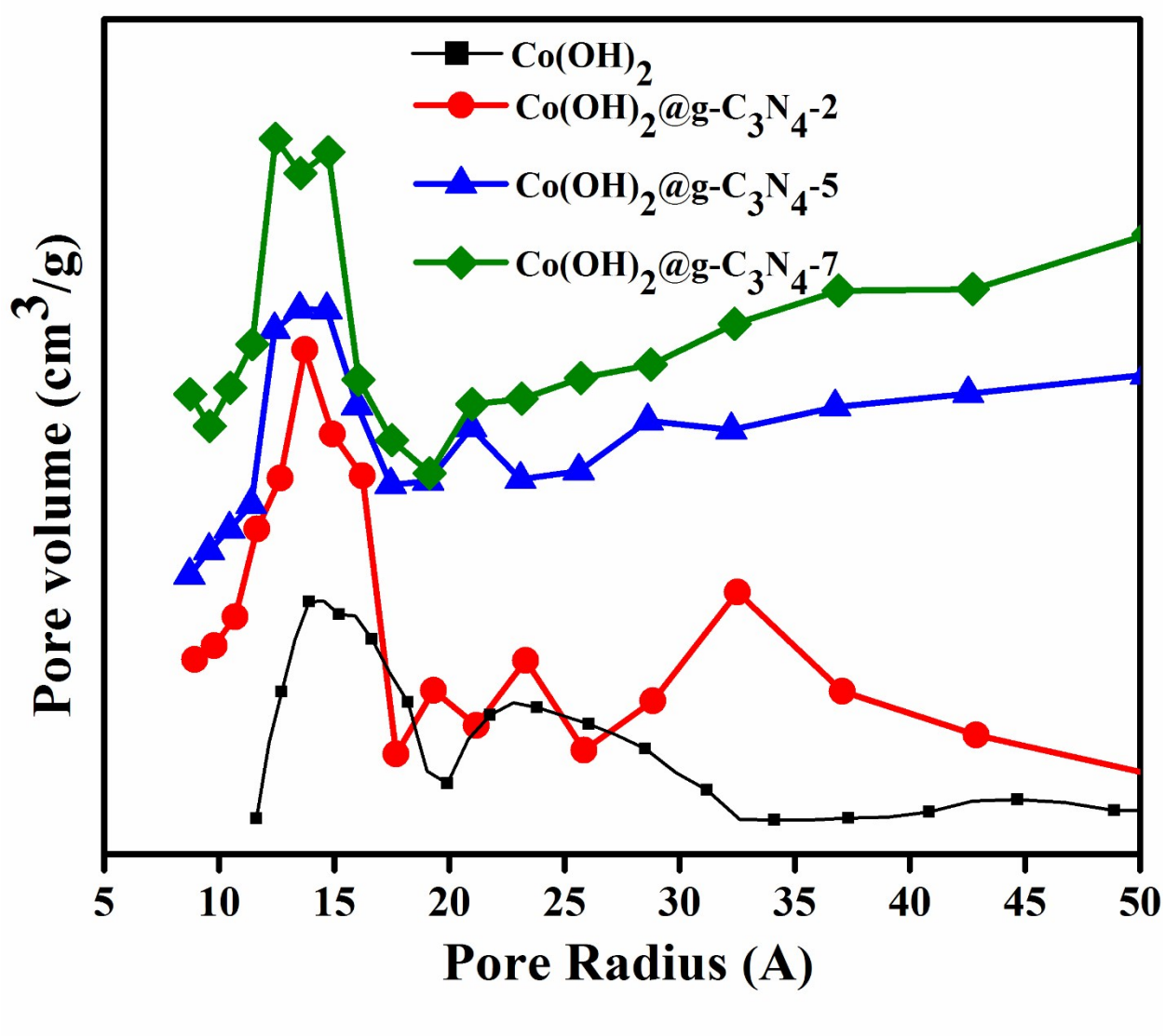

Figure S7 Pore Radius of $Co(OH)_2$, $Co(OH)_2$@g-C_3N_4-2, $Co(OH)_2$@g-C_3N_4-5 and $Co(OH)_2$@g-C_3N_4-7 NWs.

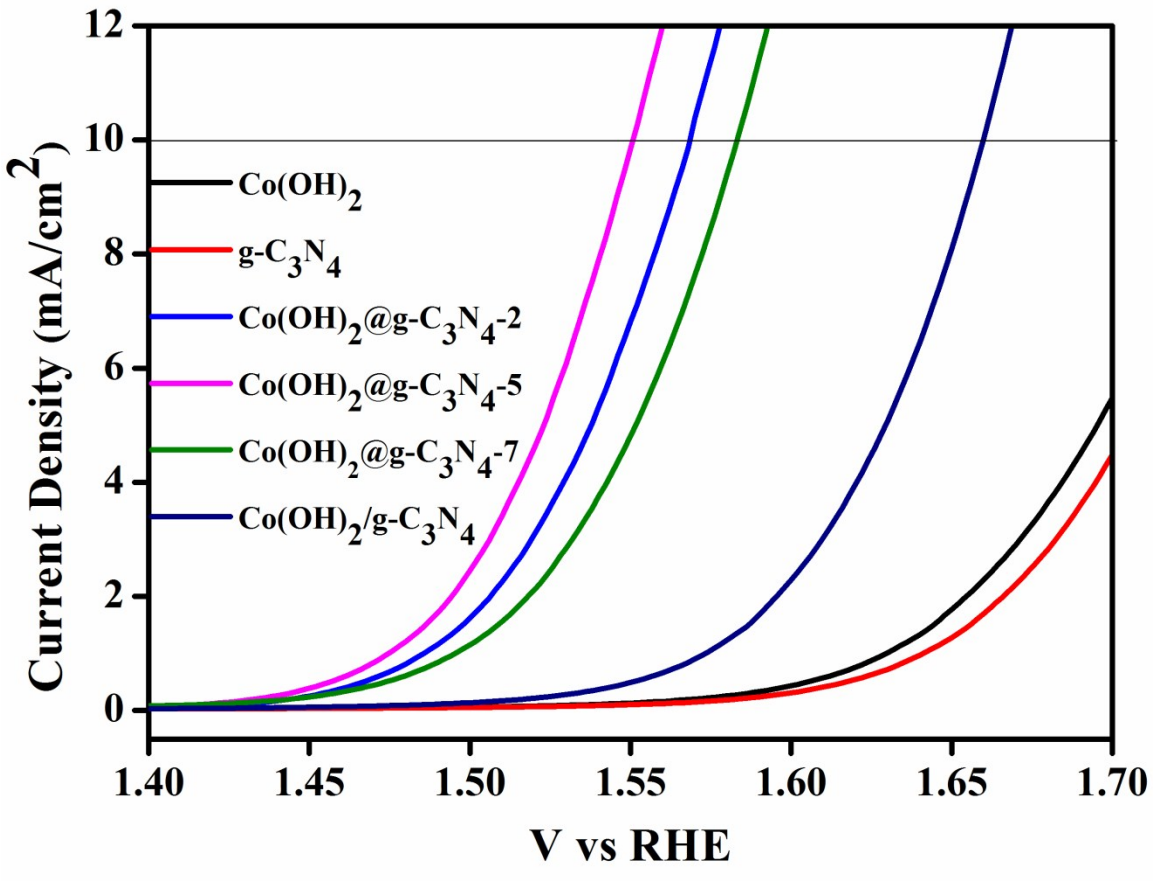

Figure S8 OER close view of the samples.

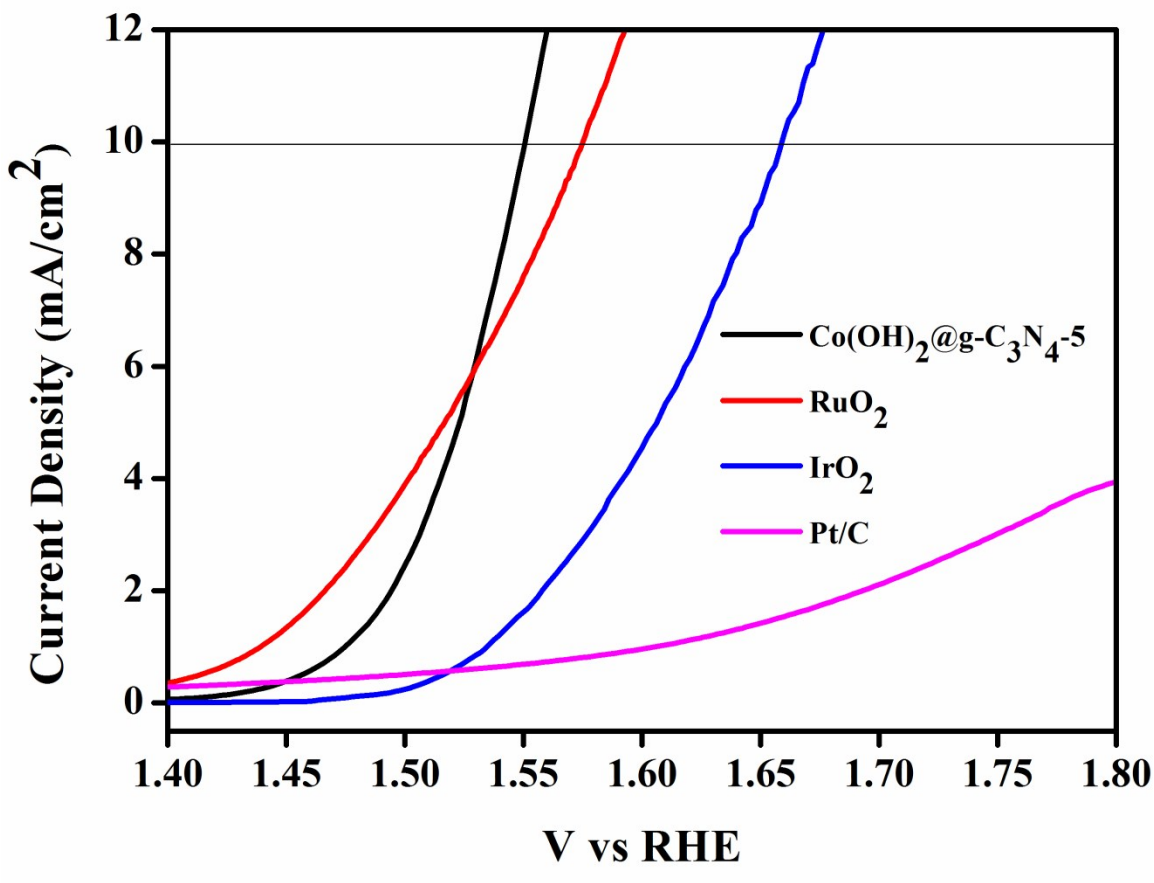

Figure S9 OER close view of the samples.

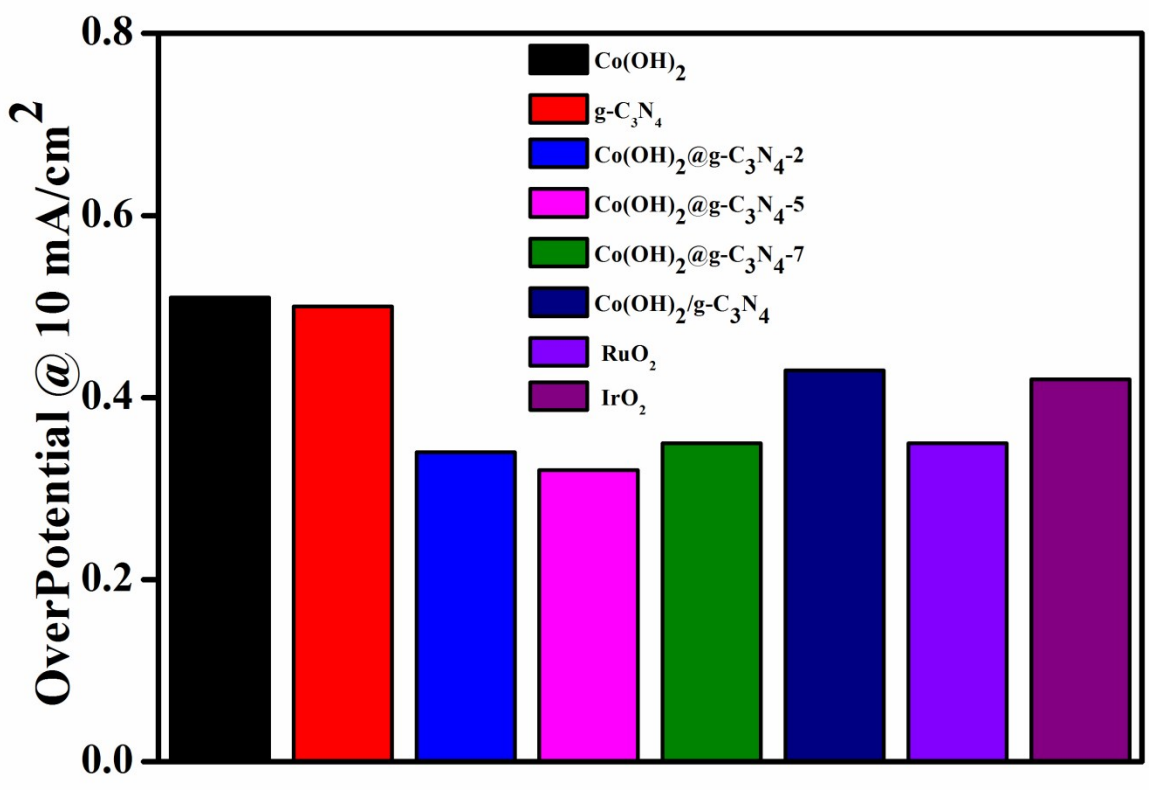

Figure S10 Over-potential of all the samples.

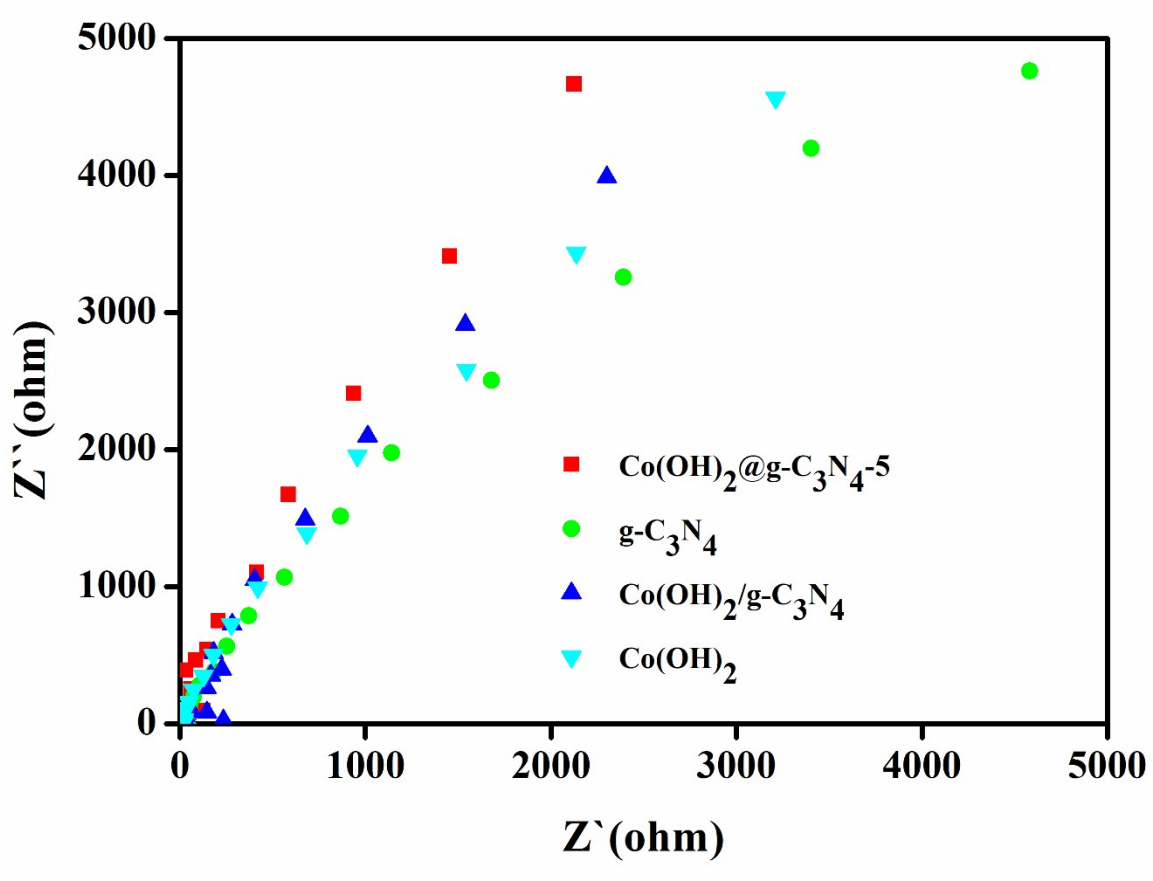

Figure S11 Nyquist plots of $Co(OH)_2$, g-C_3N_4, $Co(OH)_2$/g-C_3N_4 and $Co(OH)_2$@g-C_3N_4-5.

Table S1: Samples Names

Sample Name	g-C_3N_4 nanosheets (%)
$Co(OH)_2$@g-C_3N_4-2	2
$Co(OH)_2$@g-C_3N_4-5	5
$Co(OH)_2$@g-C_3N_4-7	7
$Co(OH)_2$/g-C_3N_4	5

Table S2: OER potentials of all catalyst along with IrO_2, RuO_2 and Pt.

Sample Name	Potentials (V) at 10 mA/cm^2	Over-potentials (V) at 10 mA/cm^2
g-C_3N_4	1.74	0.51
$Co(OH)_2$@g-C_3N_4	1.73	0.5
$Co(OH)_2$@g-C_3N_4-2	1.57	0.34
$Co(OH)_2$@g-C_3N_4-5	1.55	0.32
$Co(OH)_2$/g-C_3N_4-7	1.58	0.35
$Co(OH)_2$/g-C_3N_4	1.66	0.43
RuO_2	1.58	0.35
IrO_2	1.65	0.42
*Pt/C	2	0.77

*Pt/C did not reach at 10mA/cm^2, so we extrapolate.

Table S3: OER comparison with some best reported results in alkaline solution with similar mass loading.

Materials	Potential@10mA/cm^2 (RHE)	References
PCN-CFP	1.63	S[1]
N-dopedgraphene/CNT	1.63	S[2]
H-Pt/CaMnO$_3$	1.8	S[3]
Mn$_x$O$_y$/N-doped carbon	1.68	S[4]
Co_3O_4/N-doped-graphene	1.54	S[5]
$CaMn_4O_x$	1.77	S[6]
Co_3O_4	1.68	S[4]
Co_xO_y/ N-doped carbon	1.66	S[4]
Ni_xO_y/N-doped carbon	1.64	S[4]
NCNTFs	1.6	S[7]
Co@Co_3O_4/NC	1.64	S[8]
Co/NC	1.69	S[8]
NiO	1.66	S[9]
$Ni(OH)_2$	1.59	S[9]
α-$Ni(OH)_2$sphere	1.56	S[10]
β-$Ni(OH)_2$plate	1.67	S[10]
3D g-C_3N_4 NS–CNT	1.6	S[11]
$Co(OH)_2$@g-C_3N_4-5	1.55	This Work

References:

[1] T.Y. Ma, J. Ran, S. Dai, M. Jaroniec, S.Z. Qiao, Angewandte Chemie International Edition, 54 (2015) 4646-4650.
[2] G.-L. Tian, M.-Q. Zhao, D. Yu, X.-Y. Kong, J.-Q. Huang, Q. Zhang, F. Wei, Small, 10 (2014) 2251-2259.
[3] X. Han, F. Cheng, T. Zhang, J. Yang, Y. Hu, J. Chen, Advanced Materials, 26 (2014) 2047-2051.
[4] J. Masa, W. Xia, I. Sinev, A. Zhao, Z. Sun, S. Grützke, P. Weide, M. Muhler, W. Schuhmann, Angewandte Chemie International Edition, 53 (2014) 8508-8512.
[5] Y. Liang, Y. Li, H. Wang, J. Zhou, J. Wang, T. Regier, H. Dai, Nat Mater, 10 (2011) 780-786.
[6] Y. Gorlin, T.F. Jaramillo, Journal of the American Chemical Society, 132 (2010) 13612-13614.
[7] B.Y. Xia, Y. Yan, N. Li, H.B. Wu, X.W. Lou, X. Wang, Nature Energy, 1 (2016) 15006.
[8] B. Li, X. Ge, F.W. Goh, T.S. Hor, D. Geng, G. Du, Z. Liu, J. Zhang, X. Liu, Y. Zong, Nanoscale, 7 (2015) 1830-1838.
[9] X.-Y. Yu, Y. Feng, B. Guan, X.W. Lou, U. Paik, Energy Environ. Sci., (2016).
[10] M. Gao, W. Sheng, Z. Zhuang, Q. Fang, S. Gu, J. Jiang, Y. Yan, J Am Chem Soc, 136 (2014) 7077-7084.
[11] T.Y. Ma, S. Dai, M. Jaroniec, S.Z. Qiao, Angew Chem Int Ed Engl, 53 (2014) 7281-7285.