# Electronic Supplementary Information

Three-dimensional flower-like Mn-Ni-Co-O microstructure as a high-performance electrocatalyst for methanol oxidation reaction

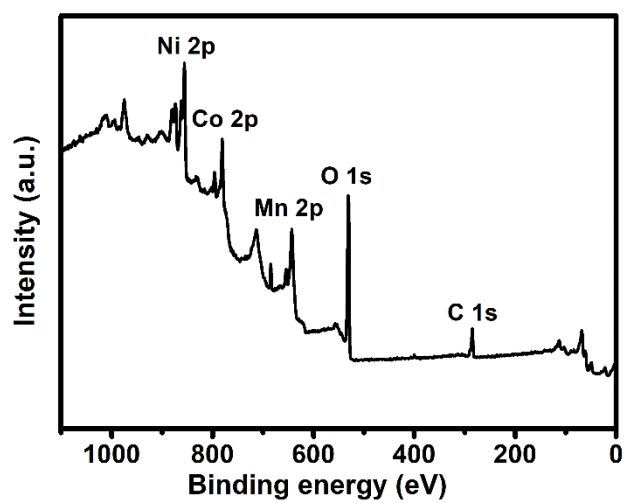Dan Jin,[a,b] Zhen Li,[a] Tingting Ma[a] and Zhenghua Wang [a,*]

[a] Key Laboratory of Functional Molecular Solids, Ministry of Education, College of Chemistry and Materials Science, Anhui Normal University, Wuhu 241000, People's Republic of China
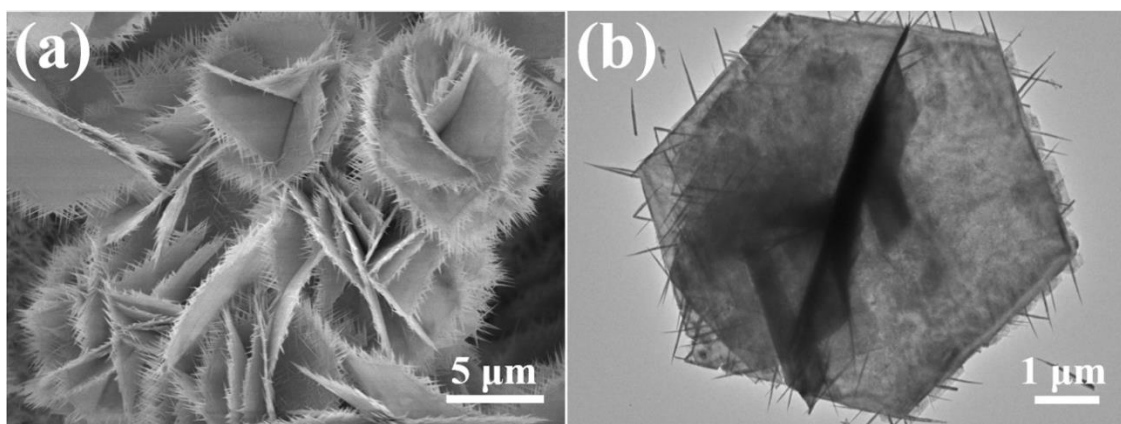
[b] School of Pharmacy, Wannan Medical College, Wuhu 241002, People's Republic of China
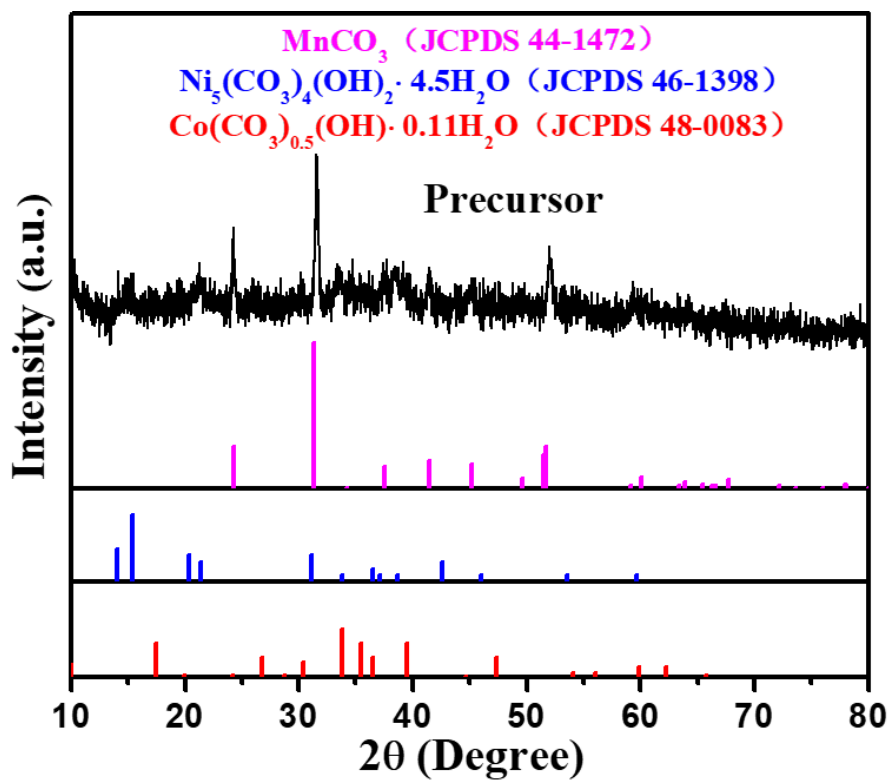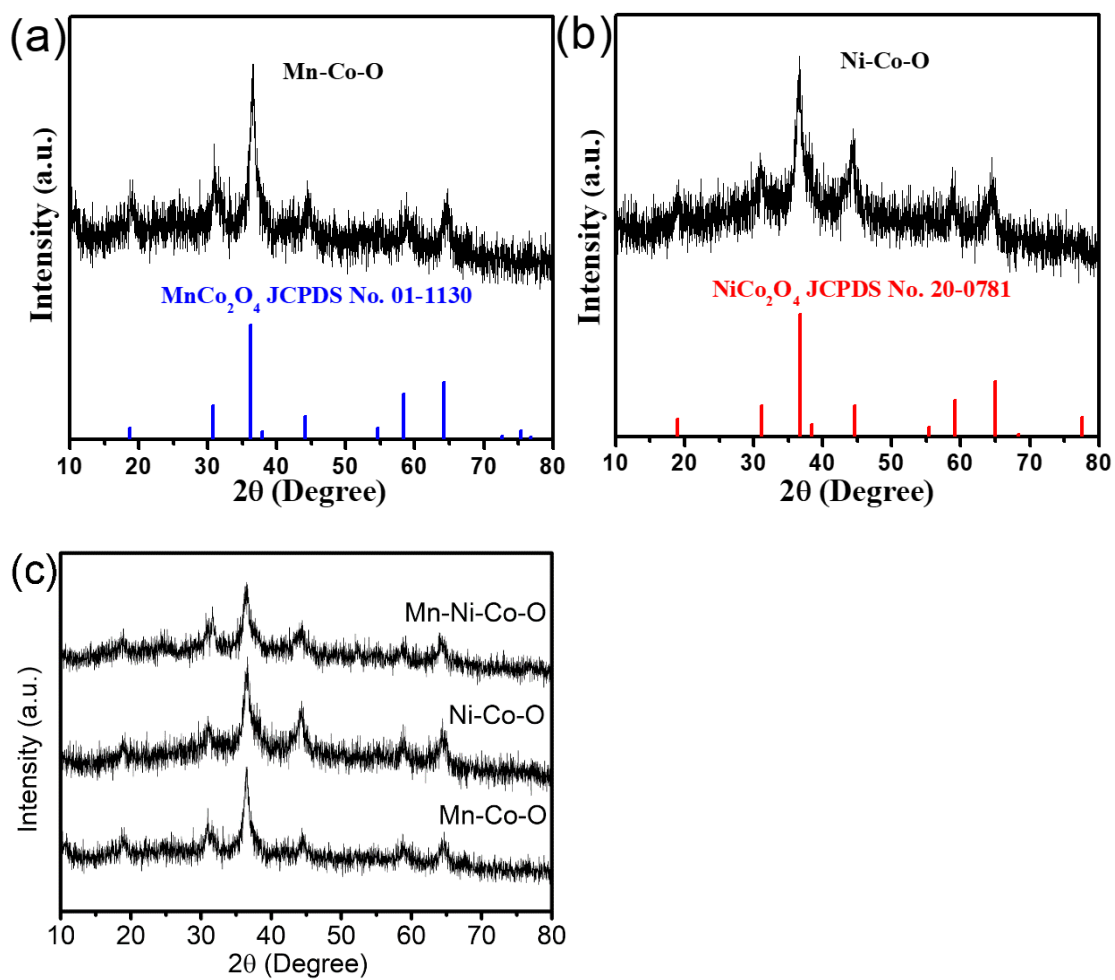
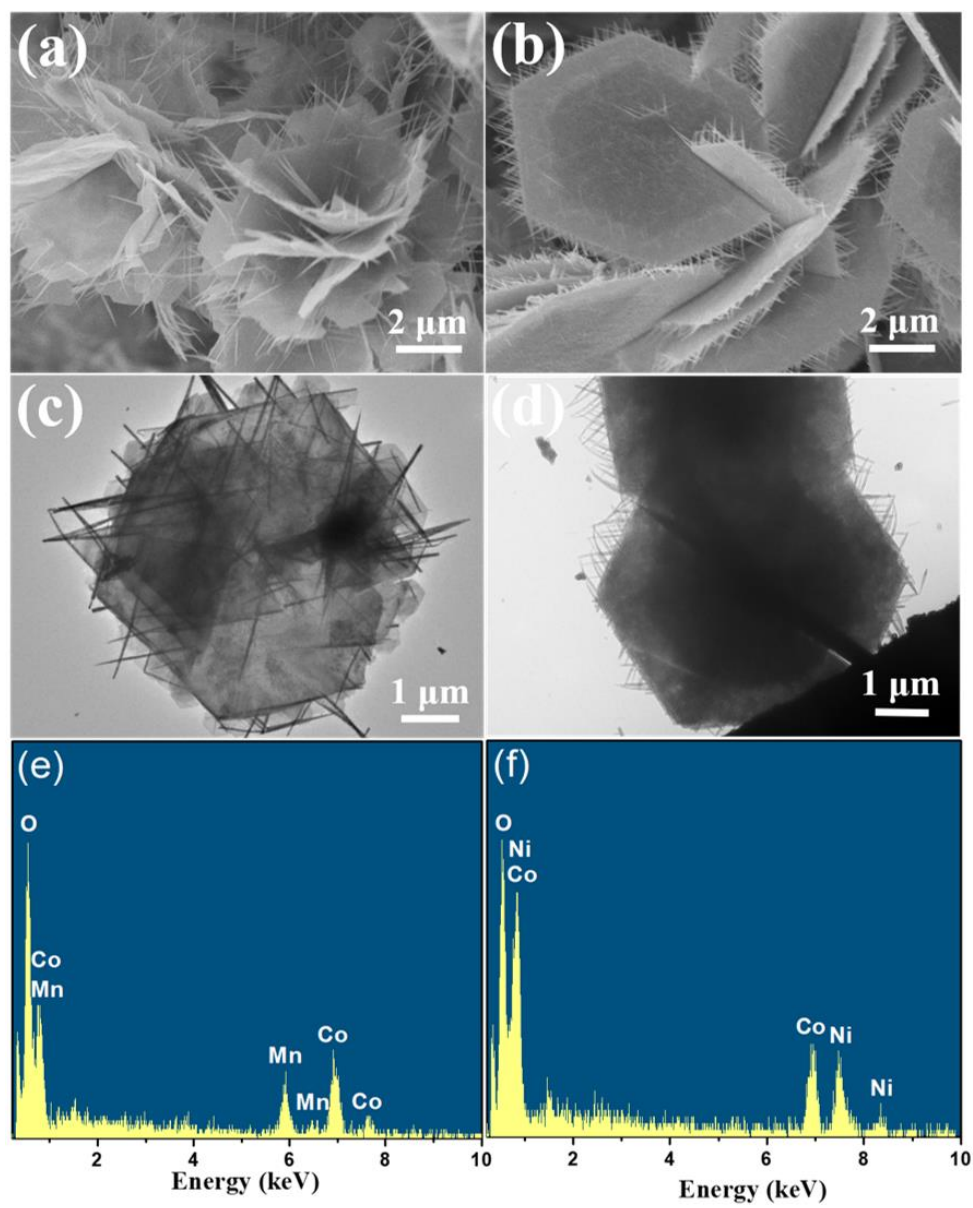**Fig. S1** XRD pattern of the Mn-Ni-Co precursor.

Fig. S2 XPS survey spectrum of the Mn-Ni-Co-O sample.

Fig. S3 (a) SEM image and (b) TEM image of the Mn-Ni-Co precursor.

Fig. S4 (a) XRD pattern of the Mn-Co-O sample; (b) XRD pattern of the Ni-Co-O sample; (c) a comparison of the XRD patterns of Mn-Ni-Co-O, Ni-Co-O and Mn-Co-O samples.

Fig. S5 (a, b) SEM images; (c, d) TEM images and (e, f) EDX spectra of Mn-Co-O and Ni-Co-O samples.

Table S1 Comparison of the electrocatalysts in this work with other reports in literature.

Catalyst	Potential window (V)	Current density	Scan rate (mV s^{-1})	Ref.
Mn-Co-O	0–0.6 (vs. Ag/AgCl)	33 mA mg^{-1}	10	This work
Ni-Co-O	0–0.6 (vs. Ag/AgCl)	73 mA mg^{-1}	10	This work
Mn-Ni-Co-O	0–0.6 (vs. Ag/AgCl)	113 mA mg^{-1}	10	This work
$MnCo_2O_4$	0–0.7 (vs. Ag/AgCl)	79.9 A g^{-1}	10	[1]
$MnCo_2O_4$	1.0–1.62 (vs. RHE)	96 A g^{-1}	10	[2]
$NiCo_2O_4$	0–0.6 (vs. Hg/HgO)	50 A g^{-1}	10	[3]
$Co_3O_4/NiCo_2O_4$	0–0.6 (vs. Hg/HgO)	140 mA cm^{-2}	10	[4]
$NiCo_2O_4/Ni(OH)_2$	0–0.6 (vs. Ag/AgCl)	92.3 A g^{-1}	10	[5]

References:

[1] G. M. Thorat, H. S. Jadhav, J. G. Seo, *Ceram. Int.*, 2017, **43**, 2670-2679.

[2] H. S. Jadhav, A. Roy, W. J. Chung, J. G. Seo, *New J. Chem.*, 2017, **41**, 15058-15063.

[3] L. Qian, L. Gu, L. Yang, H. Yuan, D. Xiao, Nanoscale, 2013, **5**, 7388-7396.

[4] L. Qian, S. Luo, L. Wu, X. Hu, W. Chen, W. Chen, X. Wang, *Appl. Surf. Sci.*, 2020, **503**, 144306.

[5] B. Wang, Y. Cao, Y. Chen, R. Wang, X. Wang, X. Lai, C. Xiao, J. Tu, S. Ding, *Inorg. Chem. Front.*, 2018, **5**, 172-182.