

Supplementary material

Revealing the unexpected promotion effect of diverse potassium-precursors on α -MnO₂ for toluene catalytic destruction

Qing Zhu^{1,†}, Zeyu Jiang^{1,†}, Mudi Ma^{1,†}, Chi He^{1,2,*}, Yanke Yu³, Xiaohe Liu^{1,*}, Reem Albilali⁴

¹State Key Laboratory of Multiphase Flow in Power Engineering, School of Energy and Power Engineering, Xi'an Jiaotong University, Xi'an 710049, Shaanxi, P.R. China

²National Engineering Laboratory for VOCs Pollution Control Material & Technology, University of Chinese Academy of Sciences, Beijing 101408, P.R. China

³Department of Chemical Engineering, Columbia University, New York 10027, United States

⁴Department of Chemistry, College of Science, Imam Abdulrahman Bin Faisal University, P.O. Box 1982, Dammam 31441, Saudi Arabia

†These authors contributed equally to this work.

*To whom correspondence should be addressed:

Tel./Fax: +86 29 82663857; E-mail: chi_he@xjtu.edu.cn (C. He)

Tel./Fax: +86 29 82668169; E-mail: xiaohe-liu@outlook.com (X.H. Liu)

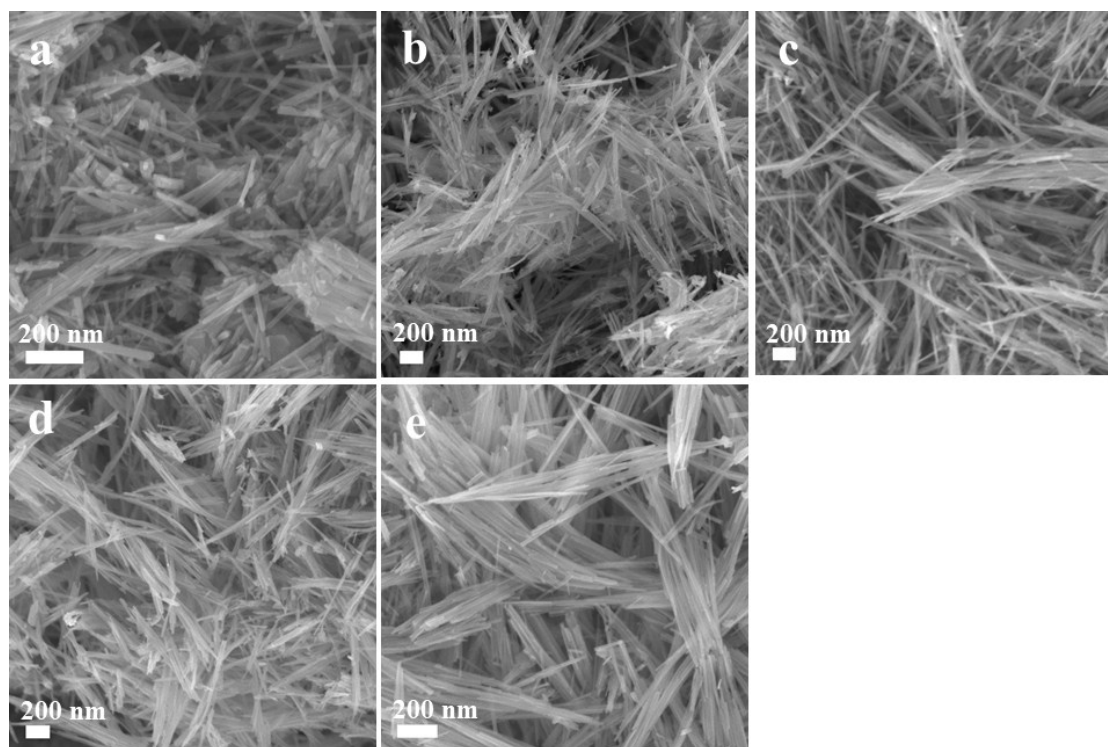


Fig. S1 SEM images of synthesized catalysts: (a) MnO₂; (b) KOH/MnO₂; (c) KCl/MnO₂; (d) K₂SO₄/MnO₂ and (e) KNO₃/MnO₂.

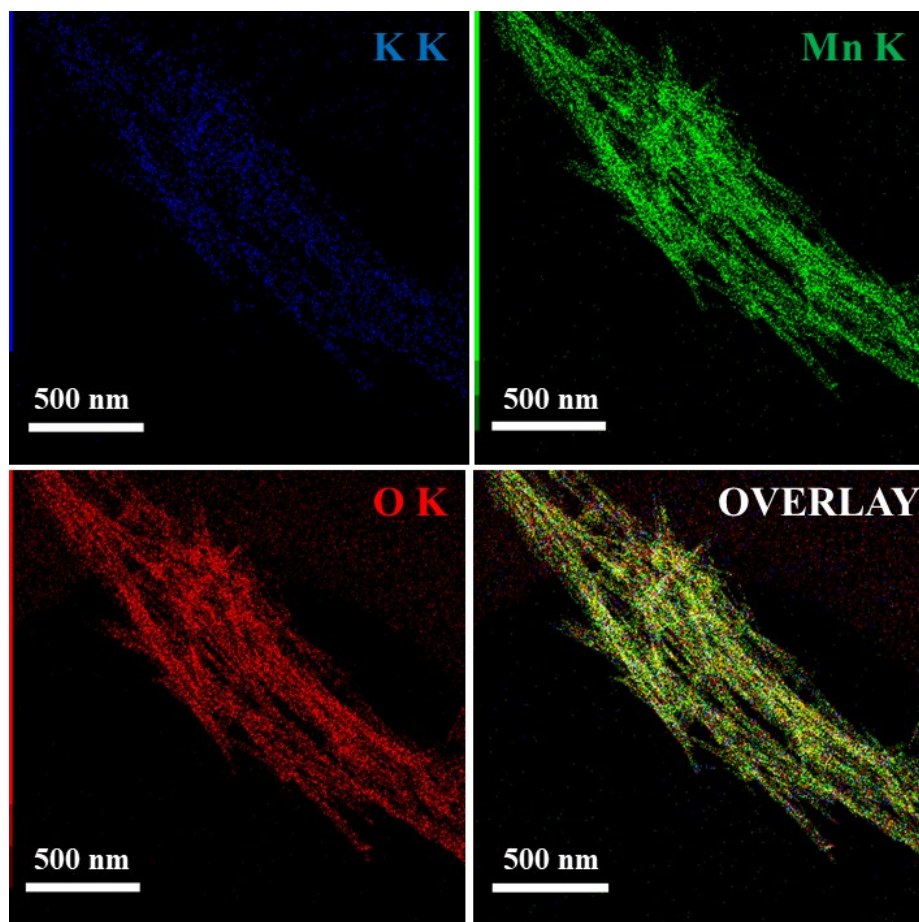


Fig. S2 SEM-EDX mapping of KOH/MnO₂ catalyst.

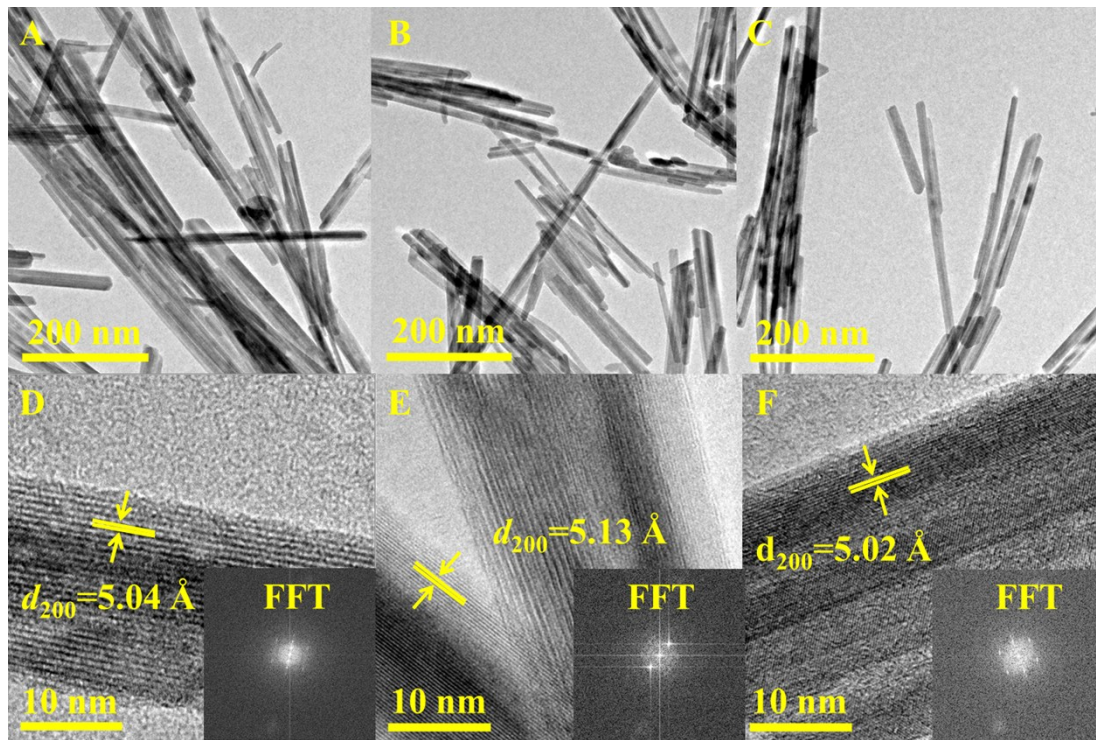


Fig. S3 (A, D) HR-TEM images of KCl/MnO_2 ; (B, E) HR-TEM images of $\text{K}_2\text{SO}_4/\text{MnO}_2$; (C, F) HR-TEM images of $\text{KNO}_3/\text{MnO}_2$.

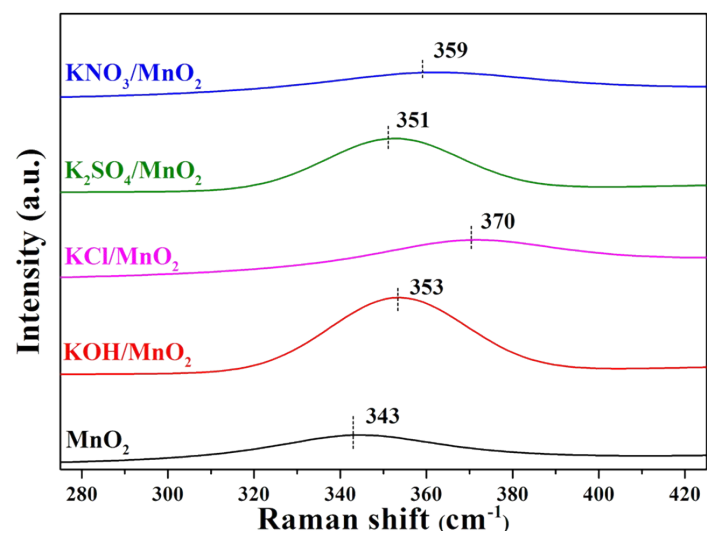


Fig. S4 Laser Raman spectra of prepared materials

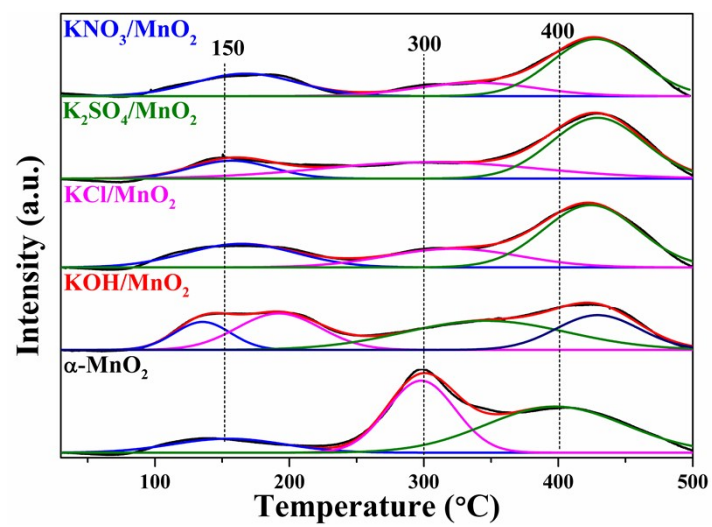


Fig. S5 NH₃-TPD spectra of prepared materials

Table S1 XRF results of all synthesized catalysts.

Samples	K content wt.%	Mn content wt.%	O content wt.%
MnO ₂	0	56.9	43.1
KOH/MnO ₂	4.7	56.2	39.1
KCl/MnO ₂	2.4	57.6	40.0
K ₂ SO ₄ /MnO ₂	3.0	57.1	39.9
KNO ₃ /MnO ₂	3.1	54.4	42.5

Table S2 Reducibility of all synthesized samples.

Sample	Reduction temperature (°C)		H ₂ consumption (mmol/g)		
	Peak 1	Peak 2	Peak 1	Peak 2	Total
MnO ₂	397	573	4.01	2.21	6.22
KOH/MnO ₂	346	403	6.51	1.34	7.85
KCl/MnO ₂	385	437	7.14	1.39	8.54
K ₂ SO ₄ /MnO ₂	401	460	7.30	1.08	8.38
KNO ₃ /MnO ₂	373	426	6.89	1.37	8.26

Table S3 Summarized percentage of mass lost from thermos-gravimetry analysis.

Sample	Temperature (°C)			
	30-200	200-300	300-700	200-700
MnO ₂	2.5	0.4	7.2	7.6
KOH/MnO ₂	1.6	1.0	9.5	10.5
KCl/MnO ₂	1.9	0.7	10.5	11.2
K ₂ SO ₄ /MnO ₂	2.2	0.8	10.0	10.8
KNO ₃ /MnO ₂	3.3	1.6	8.2	9.8

Table S4 The assigned peaks obtained from NH₃-TPD results.

Sample	Temperature (°C)			Peak area			
	Peak 1	Peak 2	Peak3	Peak 1	Peak 2	Peak 3	Total
MnO ₂	155	298	398	57	180	236	473
KOH/MnO ₂	172	349	430	181	172	105	458
KCl/MnO ₂	164	322	424	96	91	217	404
K ₂ SO ₄ /MnO ₂	157	304	429	53	131	206	390
KNO ₃ /MnO ₂	168	339	428	85	58	187	330