**Supplementary Information**

**for**

**Shape-controllable synthesis of MnO2 nanostructures from manganese-contained wastewater for phenol degradation by activating peroxymonosulfate: Performance and mechanism**

Yaxiong Xiao, Yabo Wang, Yi Xie, Haixiang Ni, Xiang Li, Yongkui Zhang,

Tonghui Xie\*

*Department of Pharmaceutical & Biological Engineering, School of Chemical Engineering, Sichuan University, Chengdu 610065, P. R. China*

Corresponding author:

Tonghui Xie

Department of Pharmaceutical & Biological Engineering, School of Chemical Engineering, Sichuan University, Chengdu 610065, P. R. China

Tel.: +86-28-85405221; Fax: +86-28-85405222

Email: x[ietonghui@scu.edu.cn](mailto:ietonghui@scu.edu.cn)

1. **Electrochemical measurement method**

To prepare the working electrode, MnO2 material, acetylene black and PVDF binder were mixed in a mass ratio of 8:1:1. The mixed sample was loaded on Ni foam and then dried at 60°C overnight under vacuum. The linear sweep voltammetry (LSV) was performed on a CHI660E electrochemical workstation with a typical three-electrode configuration, which consisted of a counter electrode (graphite electrode), a working electrode and a saturated calomel electrode. LSV curves were tested in a 0.1 mol/L K2SO4 and 1.5 g/L PMS solution.

**Table. S1** Catalytic performance and activation energy of Mn-based catalysts with PMS for phenol removal

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Catalyst | Initial phenol concentration (mg/L) | PMS dosage (g/L) | Catalyst dosage  (g/L) | Time  (min) | Degradation efficiency  (%) | Activation energy (kJ/mol) | Reference |
| Mn2O3 | 25 | 2.0 | 0.4 | 60 | 100% | 61.2 | [25] |
| Corolla-like MnO2 | 20 | 2.0 | 0.2 | 30 | 100% | 25.3 | [26] |
| α-MnO2 -140 | 30 | 2.0 | 0.4 | 15 | 100% | 21.9 | [35] |
| Mn3O4 | 25 | 2.0 | 0.4 | 30 | 100% | 38.5 | [36] |
| α-Mn2O3@α-MnO2 | 25 | 2.0 | 0.4 | 20 | 100% | 32.1 | [37] |
| P-2 | 25 | 1.5 | 0.2 | 60 | 100% | / | This work |
| P-4 | 25 | 1.5 | 0.2 | 40 | 100% | / | This work |
| Mn-2 | 25 | 1.5 | 0.2 | 60 | 97% | / | This work |
| Mn-3 | 25 | 1.5 | 0.2 | 60 | 100% | / | This work |
| Mn-4 | 25 | 1.5 | 0.2 | 15 | 100% | 32.2 | This work |

C:\Users\Idea\Desktop\肖亚雄 1030 提交\1.tif

**Fig. S1** XRD patterns of the MnO2 materials prepared from manganese sulfate solution. P-2 and P-4 represent samples produced from commercial MnSO4 solution with the hydrothermal hours of 2 h and 4 h respectively.



**Fig. S2** EDS spectra of Mn-2 and Mn-4.



**Fig. S3** TOC removal rate of Mn-2 and Mn-4 at 15 min and 30 min. Reaction conditions: [phenol]0 = 25 mg/L, catalyst dosage = 0.2 g/L, PMS dosage = 1.5 g/L, initial pH = 3 and T = 25°C.



**Fig. S4** Phenol removal curves versus time over Mn-3, P-2 and P-4 samples. Reaction conditions: [phenol]0 = 25 mg/L, catalyst dosage = 0.2 g/L, PMS dosage = 1.5 g/L, initial pH = 3 and T = 25°C.

****

**Fig. S**5 Various pollutant removal curves versus time over Mn-4 samples. Reaction conditions: [phenol]0 = 25 mg/L, catalyst dosage = 0.2 g/L, PMS dosage = 1.5 g/L, initial pH = 3 and T = 25°C.

****

**Fig. S6** Leaching concentration of Mn2+ under various pH conditions.



**Fig. S7** Influence of free Mn2+ on phenol degradation of Mn-4. Degradation reaction conditions: [phenol]0 = 25 mg/L, catalyst dosage = 0.2 g/L, PMS dosage = 1.5 g/L, initial pH = 3 and T = 25°C.



**Fig. S8** XRD patterns of Mn-4 before and after catalytic phenol degradation reaction as well as after calcination regeneration. Reaction conditions: [phenol]0 = 25 mg/L, catalyst dosage = 0.2 g/L, PMS dosage = 1.5 g/L, initial pH = 3 and T = 25°C.

****

**Fig. S9** SEM images of Mn-4 before and after catalytic phenol degradation reaction. Reaction conditions: [phenol]0 = 25 mg/L, catalyst dosage = 0.2 g/L, PMS dosage = 1.5 g/L, initial pH = 3 and T = 25°C.



Fig. S10 N2 adsorption curves of Mn-4 after catalytic phenol degradation reaction and after calcination regeneration.

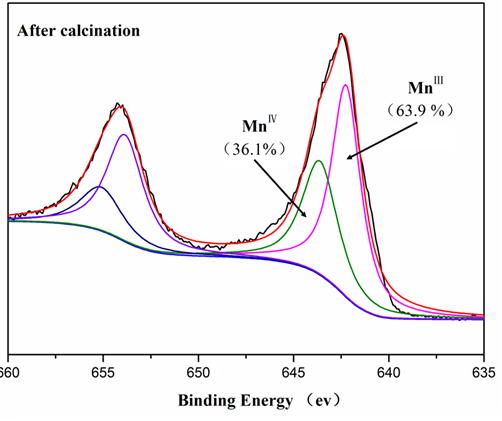


Fig. S11 XPS spectra of Mn 2p for Mn-4 after calcination regeneration.