Electronic Supplementary Material (ESI) for RSC Advances.

Supporting Information

Highly dispersed MnO*x* nanoparticles supported on three-dimensionally ordered macroporous carbon: a novel nanocomposite for catalytic reduction of NO*x* with NH_3 at low temperature

Xin Gao [a, b], Ling Li [b], Lihong Song [a, b], Ting Lu [b], Jiaxin Zhao [b], Zhi Liu [a, b, *]

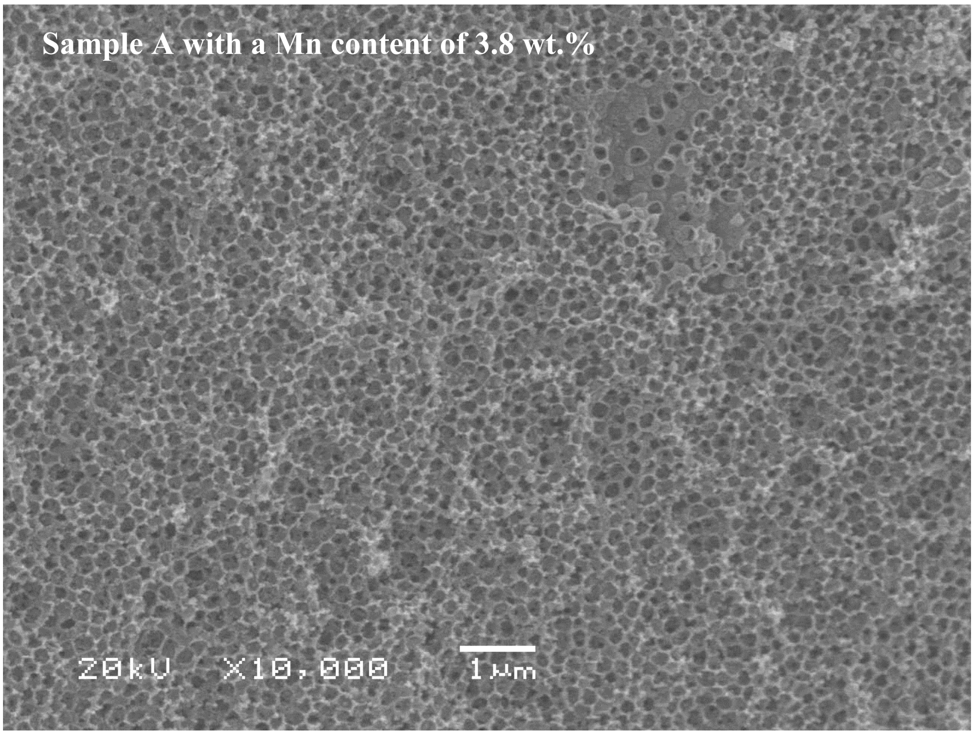
[a]*Institute of Chemistry for Functionalized Materials, Faculty of Chemistry and Chemical Engineering, Liaoning Normal University, Dalian 116029, China*

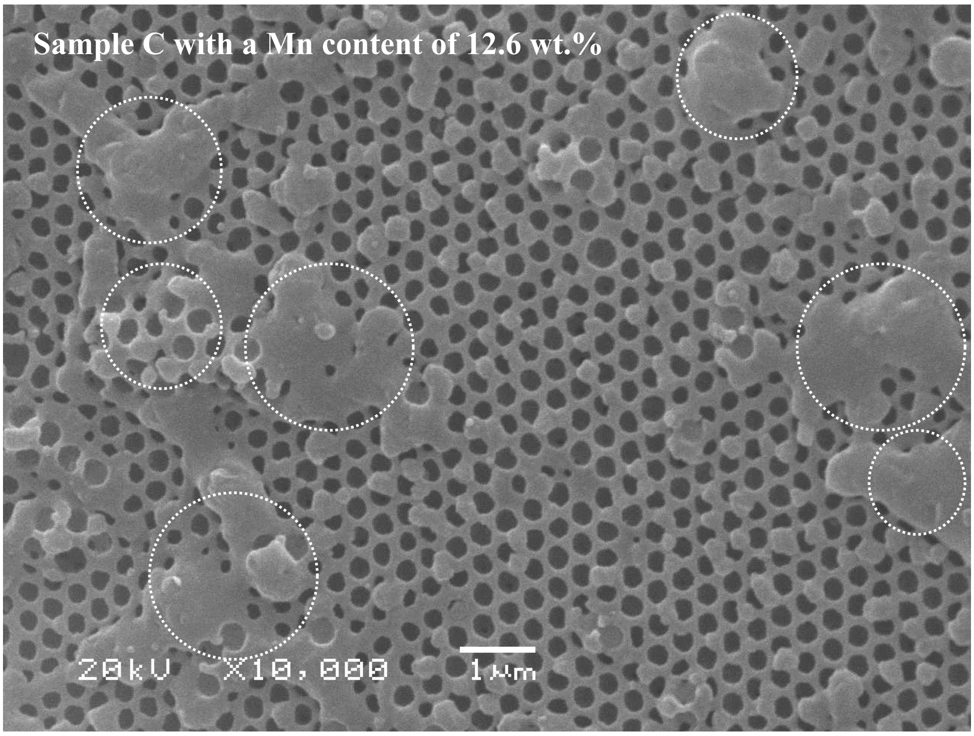
[b]*Faculty of Chemistry and Chemical Engineering, Liaoning Normal University, Dalian, Liaoning 116029, China*

*Corresponding author. Tel.: +86 411 82156989; fax: +86 411 82156858.

E-mail address: zhiliu@lnnu.edu.cn

Supporting figures





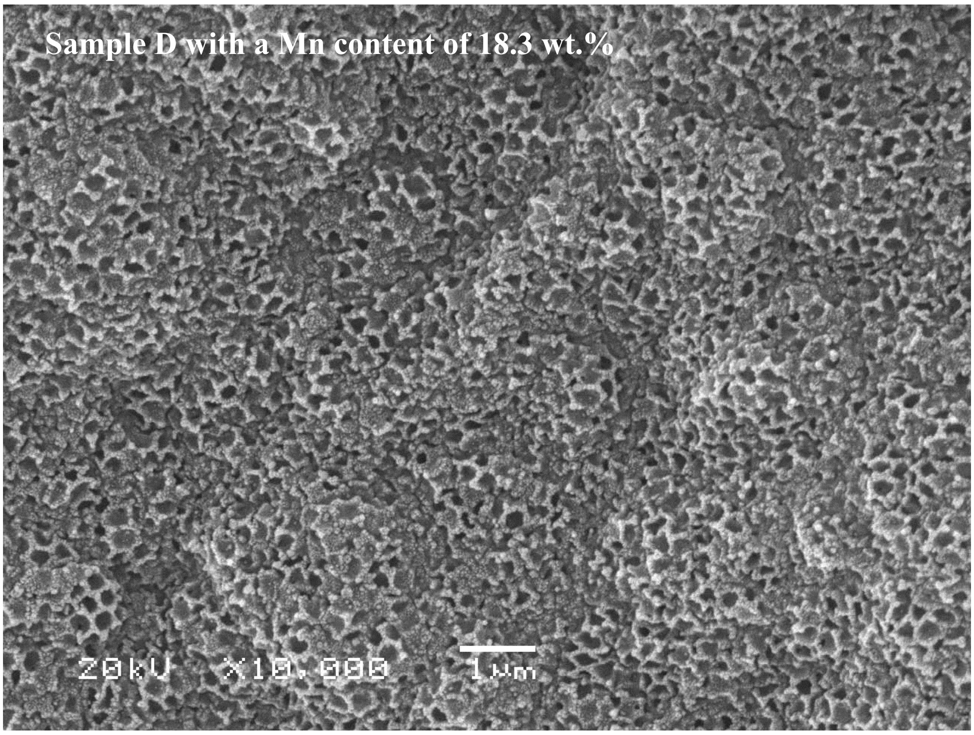


Fig. S1. SEM images of the preliminary testing for the preparation of MnO*x*/3DOMCs with different amount of $Mn(NO_3)_2$ in MP

As shown in Fig.S1, for the sample A obtained with 0.11 g of $Mn(NO_3)_2$, the three-dimensionally ordered macroporous structure was frail and fractured. The sizes of the macropores were irregular as well. The sample B was just the MnO*x*/3DOMC catalyst with a Mn content of 7.1 wt.% (0.23 g of $Mn(NO_3)_2$) mentioned in the Experimental section. After the content of $Mn(NO_3)_2$ was elevated to 0.35 g, the sample C still kept a uniform 3DOM alignment, however, distinct pores blockage could be found as the circular rings shown. As the content of $Mn(NO_3)_2$ was further elevated to 0.43 g, the sample D presented a completely indiscernible 3DOM structure with large-scale pores blockage. The great discrepancy in morphology for these samples was probably due to the difference in polymerizing rate of P-F resol caused by addition different amount of $Mn(NO_3)_2$ with a varied pH (generally less than 7.0). It was reported that the polymerization of phenol with formaldehyde could be catalyzed by both acid and base. The polymerizing rate under acidic conditions was much more than that under basic conditions [S1]. Although the increase in amount of $Mn(NO_3)_2$ was beneficial to improve the polymerizing rate of P-F resol to form uniform 3DOM structure and accordingly increase the content of Mn in corresponding products, addition of too much $Mn(NO_3)_2$ led to the lowest pH of the precursor solution, which gave rise to the fastest P-F polymerization rate accompanying with the overwhelming growth of the cross-linked phenol-formaldehyde monomer. As a result, a part of PMMA microspheres were covered and pores blockage appeared after the following thermal treatment, thus leading to the damage of 3DOM structure and decreasing the NH_3-SCR activity (Fig. S2). Therefore, the introduction of the appropriate amount of $Mn(NO_3)_2$ into the MP is crucial to prepare the MnO_x/3DOMC catalyst.

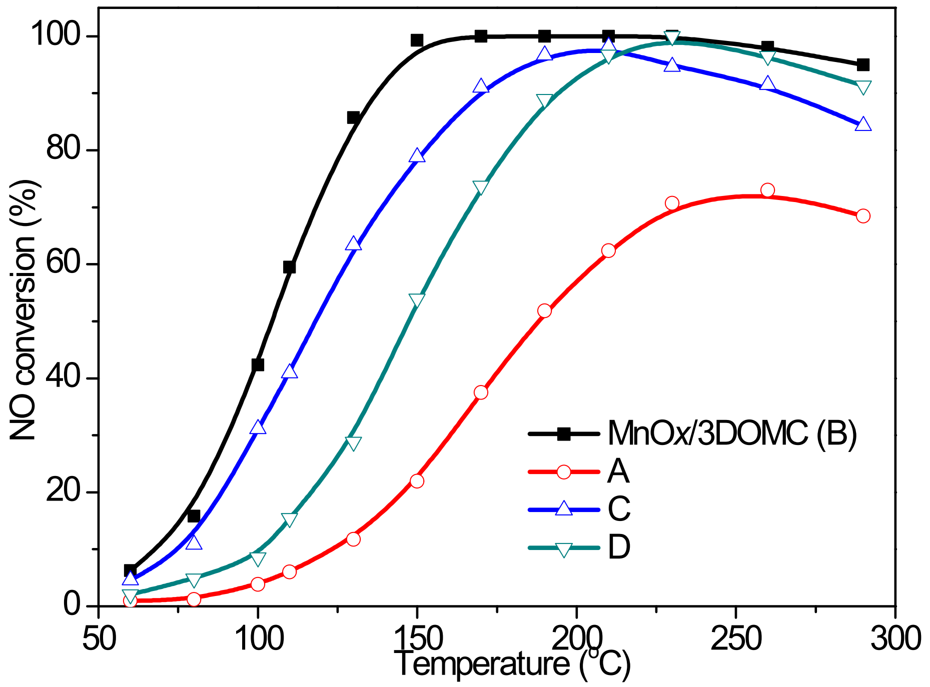


Fig. S2. NO conversions over the sample A, sample B (MnO*x*/3DOMC), sample C and sample D catalysts. Reaction conditions: 1000 ppm of NO, 1000 ppm of NH_3, 5% of O_2, He balance.

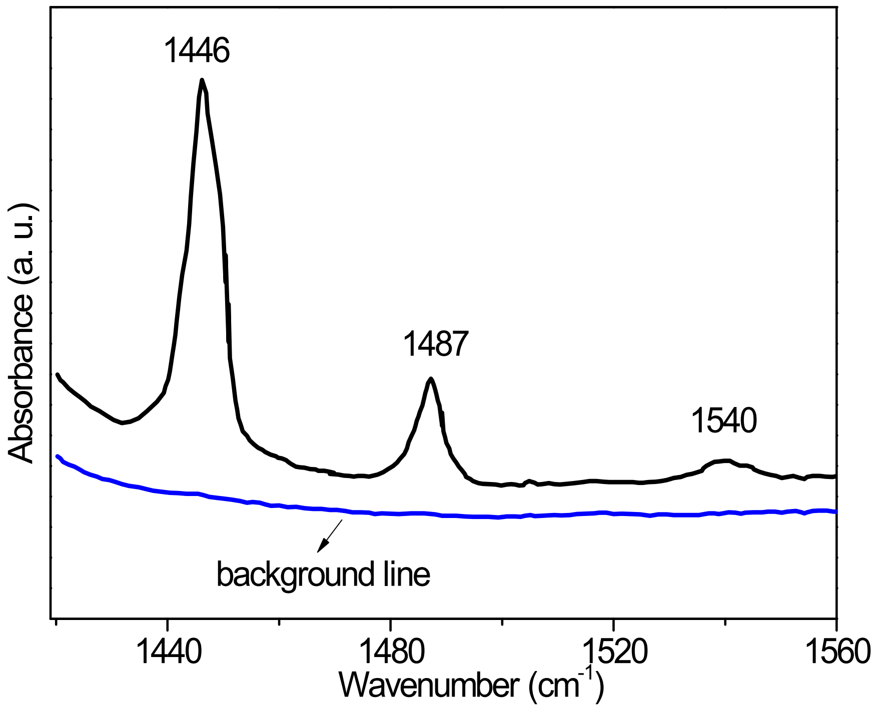


Fig. S3. Pyridine-DRIFTS of the MnO*x*/3DOMC catalyst at room temperature.

.

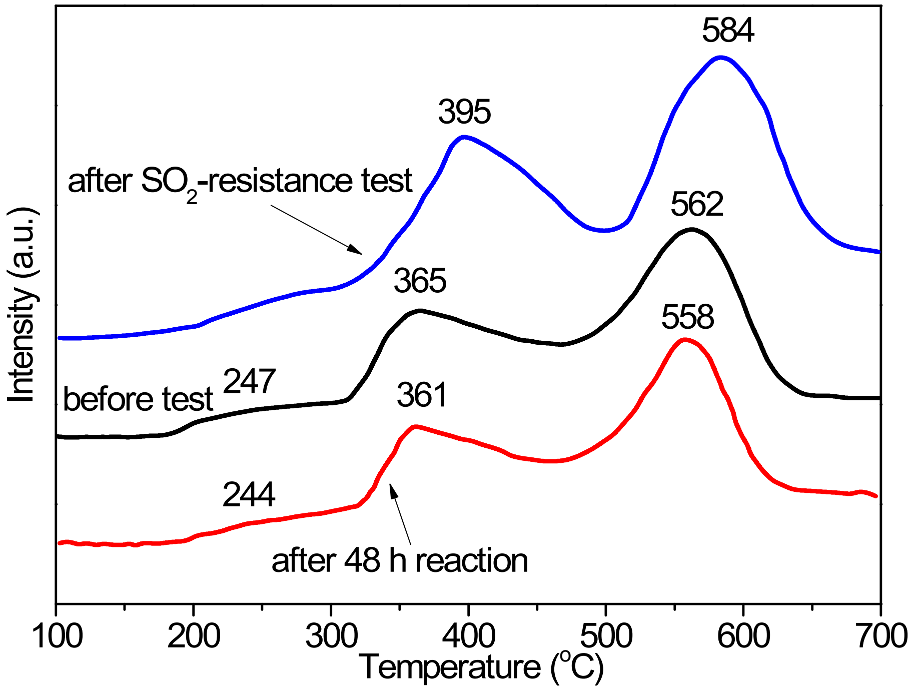


Fig. S4. NH_3-TPD profiles of the MnO*x*/3DOMC catalyst before and after the long-term and SO_2-resistance tests.

Reference

[S1] M. J. Xie, H. H. Dong, D. D. Zhang, X. F. Guo, W. P. Ding, *Carbon*, 2011, **49**, 2459-2464.