*Supporting Information for*

# Ceria regulated surface properties of Mn/SAPO-34 for improved $NH_3$-SCR at low temperature

**Qizhi Chen[a,c], Yong Yang[b], Hang Luo[b], Zuohua Liu[b], Zhangfa Tong[c], Changyuan Tao[b], Jun Du[b]***

*(a. School of Chemistry and Chemical Engineering, Guangxi University, Nanning 530004, China*

*(b. College of Chemistry and Chemical Engineering, Chongqing University, Chongqing 401331, China)*

*c. Guangxi Huiyuan Manganese Industry Co., Ltd.*

**Corresponding authors: College of Chemistry and Chemical Engineering, Chongqing University, Chongqing 401331, China.*

*E-mail addresses: dujune@cqu.edu.cn (Jun Du),*

**Mailing address for correspondence:**

Dr. Du, Jun (Prof.)

College of Chemistry and Chemical Engineering, Chongqing University

No.55 Daxuecheng South Rd., Shapingba

Chongqing 401331, China

Tel: +86-23-65678923

Fax: +86-23-65678923

E-mail: dujune@cqu.edu.cn

## 1. Nitrogen adsorption and desorption for Texture analysis

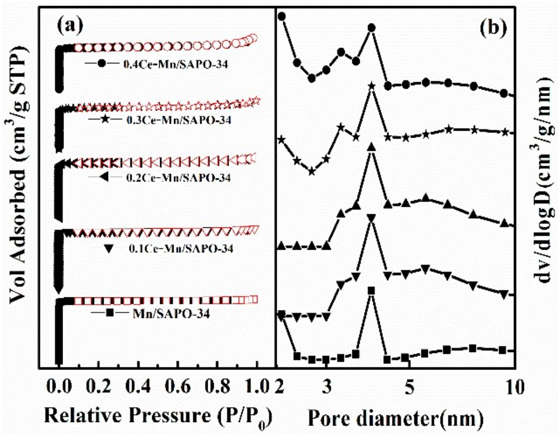


**Fig. S1** $N_2$ adsorption-desorption isotherms (a) and pore distribution (b) of Mn/SAPO-34 and Ce-Mn/SAPO-34.

**Table S1** BET surface area and pore structures of Mn/SAPO-34 and Ce-Mn/SAPO-34 catalysts.

| Samples | $S_{BET}$ ($m^2$ $g^{-1}$)[a] | Pore volume ($cm^3$ $g^{-1}$)[b] | Pore diameter (nm)[c] |
|---|---|---|---|
| Mn/SAPO-34 | 416.57 | 0.2117 | 3.66 |
| 0.1Ce-Mn/SAPO-34 | 408.50 | 0.1975 | 3.46 |
| 0.2Ce-Mn/SAPO-34 | 394.78 | 0.1880 | 3.45 |
| 0.3Ce-Mn/SAPO-34 | 375.75 | 0.1692 | 3.35 |
| 0.4Ce-Mn/SAPO-34 | 370.07 | 0.1634 | 3.32 |

[a] BET Specific surface area

[b] T-Plot desorption pore volume

[c] The most probable pore diamete

## 2. BET analysis of aged 0.3Ce-Mn/SAPO-34 catalyst

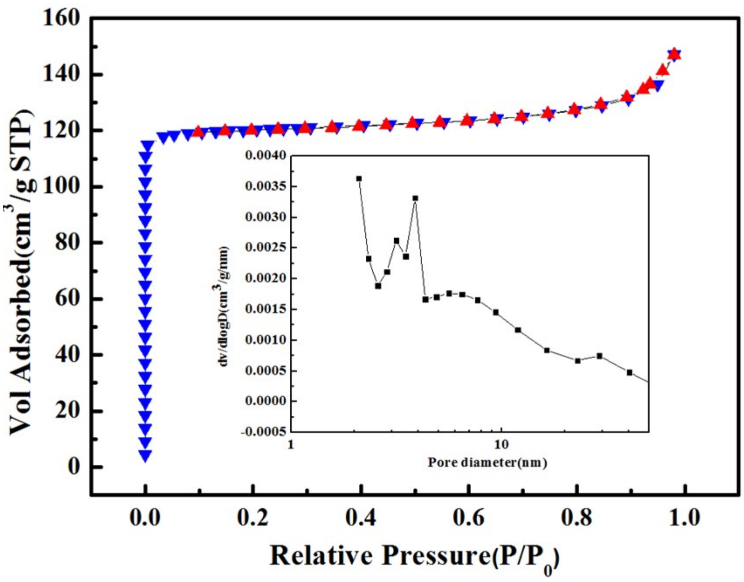


**Fig. S2** $N_2$ adsorption-desorption isotherms and pore distribution of aged 0.3Ce-Mn/SAPO-34 catalyst.

**Table S2** BET surface area and pore structures of aged Ce-Mn/SAPO-34 catalyst

| Samples | $S_{BET}$ ($m^2$ $g^{-1}$)[a] | Pore volume ($cm^3$ $g^{-1}$)[b] | Pore diameter (nm)[c] |
|---|---|---|---|
| 0.3Ce-Mn/SAPO-34 aged | 359.21 | 0.0514 | 1.97 |

[a] BET Specific surface area
[b] T-Plot desorption pore volume
[c] The most probable pore diameter

## 3. **Surface acid amount of Mn/SAPO-34 and Ce-Mn/SAPO-34 catalysts based $NH_3$-TPD**

**Table S3** Surface acidity of Mn/SAPO-34 and Ce-Mn/SAPO-34 catalysts

| Samples | Weak acid amount (mmol $g^{-1}$) | Strong acid amount (mmol $g^{-1}$) | The total acid amount (mmol $g^{-1}$) |
|---|---|---|---|
| Mn/SAPO-34 | 0.203 | 0.104 | 0.307 |
| 0.1Ce-Mn/SAPO-34 | 0.195 | 0.09 | 0.285 |
| 0.2Ce-Mn/SAPO-34 | 0.148 | 0.079 | 0.227 |
| 0.3Ce-Mn/SAPO-34 | 0.143 | 0.078 | 0.221 |
| 0.4Ce-Mn/SAPO-34 | 0.100 | 0.035 | 0.135 |

**Table.S4** the relationship between the ratio of Ce/Mn and the catalytic activity or selectivity

| The atomic concentration ratio of Ce/Mn (%) | The NO conversion in 200$^{o}$C (%) | The $N_2$ selectivity in 200$^{o}$C (%) |
|---|---|---|
| 0.00 | 77.5 | 93.4 |
| 9.32 | 80.4 | 94.8 |
| 27.30 | 85.7 | 96.1 |
| 49.05 | 90.3 | 98.5 |
| 73.16 | 86.2 | 96.4 |

Table. S5 the SCR performance on the catalysts about Ce and Mn in the literatures.

| | Catalyst | NO conversion (%) | $N_2$ selectivity (%) | $N_2O$ concentration (ppm) | reference |
|---|---|---|---|---|---|
| 1 | Ce-Mn/SAPO-34 | 90.3 | 98.5 | 0.2 | This work |
| 2 | $MnCeO_x$@Z5 | 80.2 | 89.4 | 23 | [S.1] |
| 3 | $Mn_4Co_1O_x$-HS | 100 | 66.5 | 41.5 | [S.2] |
| 4 | CeCu-SSZ-39-750 | 55 | 46.8 | -- | [S.3] |
| 5 | 6% Cu/SSZ-13 | 99.4 | -- | 2.8 | [S.4] |
| 6 | $MnCoCeO_x$ | 98.5 | 98.8 | -- | [S.5] |
| 7 | Mn-Ce nanorods | 70.5 | 89.5 | -- | [S.6] |
| 8 | $CeO_2$-N | 73.4 | 98.5 | -- | [S.7] |
| 9 | 11.2Fe11Mn/SBA-15 | 90 | -- | -- | [S.8] |
| 10 | Mn-W/Ce-Cl-C | 98 | 90 | -- | [S.9] |
| 11 | Mn10/W5Ti | 97 | 86 | -- | [S.10] |
| 12 | 5W-5Nb/CZ | 90.8 | -- | 0.5 | [S.11] |
| 13 | $Ce_{0.2}W_{0.1}TiO_x$ | 79.5 | -- | 2 | [S.12] |
| 14 | Mn-$VO_x$/$CeO_2$ | 92 | 68 | -- | [S.13] |
| 15 | $MnO_x$/$TiO_2$ | 90 | -- | -- | [S.14] |
| 16 | Hollw $MnO_x$@$PrO_x$ | 92 | 95 | -- | [S.15] |
| 17 | Cu/SAPO-34 | 60.5 | -- | 4 | [S.16] |
| 18 | H-Sn/$CeO_2$ | 61 | 98 | -- | [S.17] |
| 19 | Mn(25%)Ce(28%)/CNTs-S | 89.2 | -- | -- | [S.18] |
| 20 | $MnCo_2Nb_{0.9}O_x$ | 98.2 | 80.5 | 24.8 | [S.19] |


[S.1] R.Yan, S Lin, Y Li et al. J Hazard Mater, 2020, 396, 122592

[S.2] C. Yang, X. Tang, H. Yi. ChemiStrySelect 2020, 5, 9409

[S.3] Y. Wang, G. Li, S. Zhang. Chem Eng J, 2020, 393, 124782

[S.4] L. Jiang, Y. Cai, M. Jin. Journal of ChemiStry, 2020, 2020, 1

[S.5] X. Wang, R. Duanc, W. Liu. Appl Surf Sci. 2020, 510, 145517

[S.6] C. Yang, J. Yang, Q. Jiao. Ceram Int, 2020,46, 4394

[S.7] X. Sun, R. Guo, S. Liu. Appl Surf Sci, 2018, 462, 187

[S.8] G. Lia, B. Wang, H. Wang. Catal Commun, 2018, 108, 82

[S.9] X. Wang, K. Zhang, W. Zhao. Ind. Eng. Chem. ReS. 2017, 56, 14980

[S.10] J. Shia, Z. Zhang, M. Chen. Fuel, 2017,210, 783

[S.11] H. Xu, Q. Lin, Y. Wang. RSC Adv, 2017, 7, 47570

[S.12] Y. Geng, H. Huang, X. Chen. RSC Adv, 2016, 6, 64803

[S.13] Z. Lian, F. Li, H. He. RSC Adv., 2015,5, 37675

[S.14] X. Gao, L. Li, L. Song. RSC Adv., 2015, 5, 29577

[S.15] S. Cheng, J. Shao, B. Huang. RSC Adv., 2020, 10, 13855

[S.16] Y. Duan, J. Wang, T. Yu. RSC Adv., 2015, 5, 14103

[S.17] C. Fang, L. Shi, H. Li. RSC Adv, 2016,6, 78727

[S.18] D. Zhang, L. Zhang, C. Fang. RSC Adv, 2013, 3, 882
[S.19] T. Xu, C. Wang, X. Wu. RSC Adv., 2016,6, 97004