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## Supporting information

### Facet Engineered $\alpha$ -MnO<sub>2</sub> for Efficient Catalytic Ozonation of Odor CH<sub>3</sub>SH: Oxygen Vacancy-Induced Active Centers and Catalytic Mechanism

Chun He <sup>a, b</sup>, Yunchen Wang <sup>a</sup>, Zhiyao Li <sup>a</sup>, Yajing Huang <sup>a</sup>, Yuhong Liao <sup>a</sup>, Dehua Xia <sup>a</sup>,  
<sup>b, \*</sup>, Shuncheng Lee <sup>c</sup>

<sup>a</sup> *School of Environmental Science and Engineering, Sun Yat-sen University,  
Guangzhou, 510275, CHINA*

<sup>b</sup> *Guangdong Provincial Key Laboratory of Environmental Pollution Control and  
Remediation Technology, Guangzhou, 510275, CHINA*

<sup>c</sup> *Department of Civil and Structural Engineering, Hong Kong Polytechnic University,  
Hong Kong, China*

\* Corresponding author: School of Environmental Science and Engineering, Sun Yat-sen University, Guangzhou, 510275, China. Tel.: +86 20 39332690. Email address: xiadehua3@mail.sysu.edu.cn (D.H. Xia).

Supporting information contains 10 pages, 4 Tables, 4 Figures.

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Table S1. H<sub>2</sub>-TPR, Raman and degradation rate constant of three facet engineered MnO<sub>2</sub>

Table S2. XPS analysis of facet engineered MnO<sub>2</sub> before and after catalytic ozonation

Table S3. EDS analysis of 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>

Table S4. BET analysis of 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>

Figure S1. Schematic diagram of setup

Figure S2. N<sub>2</sub> adsorption-desorption isotherm and pore-size distribution of 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>

Figure S3. XRD, SEM, EDS spectra and elemental mapping of 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>

Figure S4. Performances in catalytic ozonation of CH<sub>3</sub>SH with 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>

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**Table S1.** H<sub>2</sub>-TPR, Raman results and degradation rate constant of catalysts.

Sample	Reduction temperature (°C)		Raman shift (cm <sup>-1</sup> )			Rate constant <i>k</i> (s <sup>-1</sup> )
	Peak 1	Peak 2	<i>v</i> <sub>2</sub> (Mn-O)	<i>v</i> <sub>3</sub> (Mn-O)	Intensity ratio of <i>v</i> <sub>2</sub> / <i>v</i> <sub>3</sub>	
310-MnO <sub>2</sub>	354	-	621	577	0.963	0.00416
110-MnO <sub>2</sub>	364	390	626	580	1.046	0.00297
100-MnO <sub>2</sub>	371	438	630	584	0.998	0.00239

**Table S2.** Chemical and surface compositions of facet engineered MnO<sub>2</sub> before, after adsorption and catalytic ozonation.

	Mn <sup>2+</sup> (%)	Mn <sup>3+</sup> (%)	Mn <sup>4+</sup> (%)	O <sub>latt</sub> (%)	O <sub>ads</sub> (%)	O <sub>surf</sub> (%)	Mn <sup>2+</sup> +Mn <sup>3+</sup> /M n <sup>4+</sup>	O <sub>ads</sub> /O <sub>latt</sub>	Mn/O
310-MnO <sub>2</sub>	10.2	43.2	46.6	70.9	29.1	0	1.15	0.41	0.53
110-MnO <sub>2</sub>	10.5	38.1	51.4	79.4	20.6	0	0.95	0.26	0.53
100-MnO <sub>2</sub>	10.6	37.7	51.7	79.2	20.8	0	0.94	0.25	0.51
310-MnO <sub>2</sub> (Adsorption)	8.5	44.0	47.5	76.5	23.5	0	1.11	0.31	0.53
310-MnO <sub>2</sub> (Catalytic ozonation)	8.1	37.6	54.3	80.6	12.9	6.5	0.84	0.26	0.52

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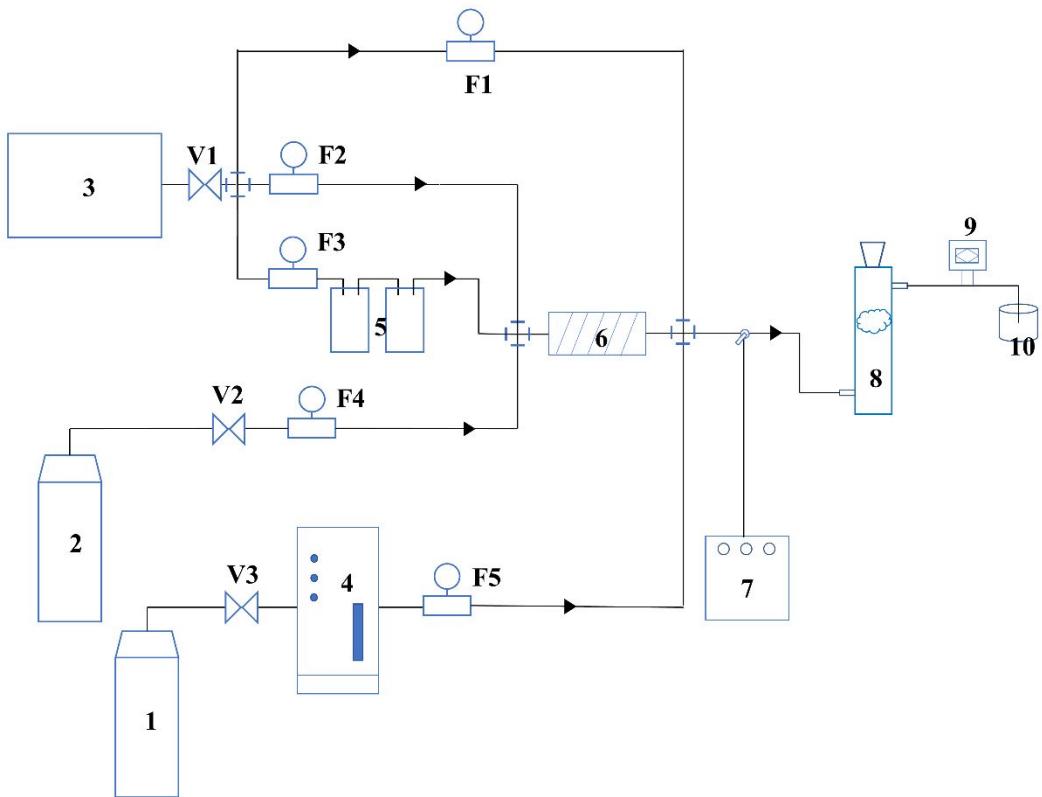
**Table S3.** Mass and atomic fraction of elements in 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub> by EDS.

Element	Weight%	Atomic%
O K	52.95	66.19
Al K	44.22	32.78
Mn K	2.83	1.03
Totals	100.00	

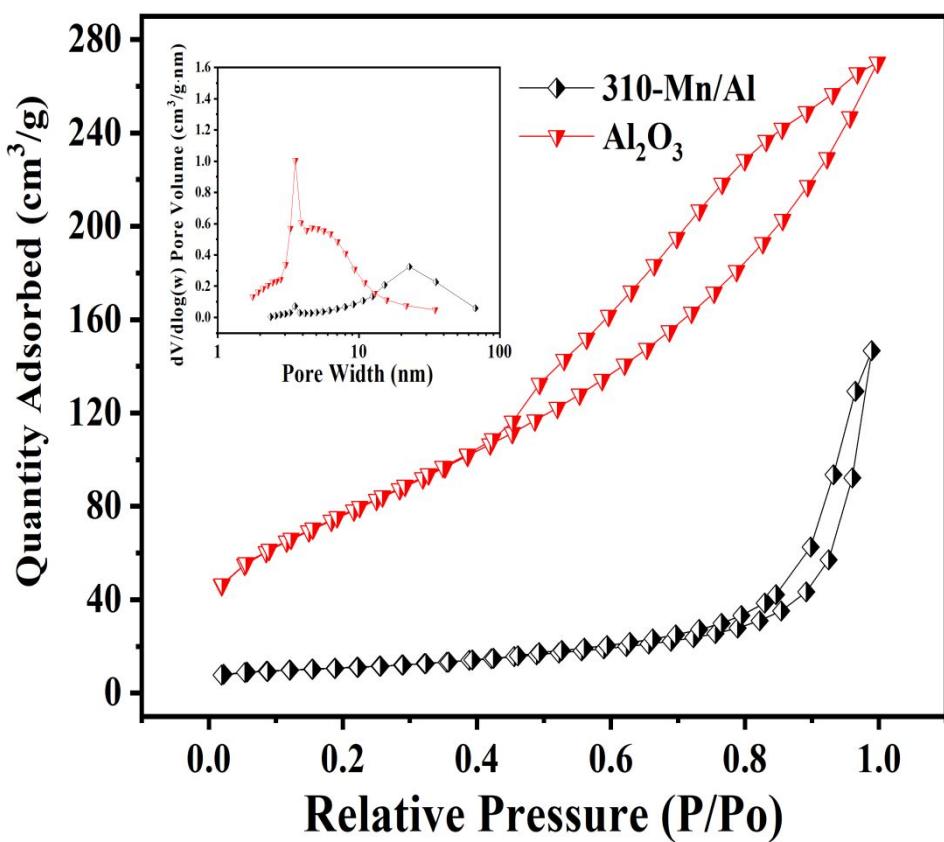
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**Table S4.** BET surface area, pore volume and pore size of catalysts.

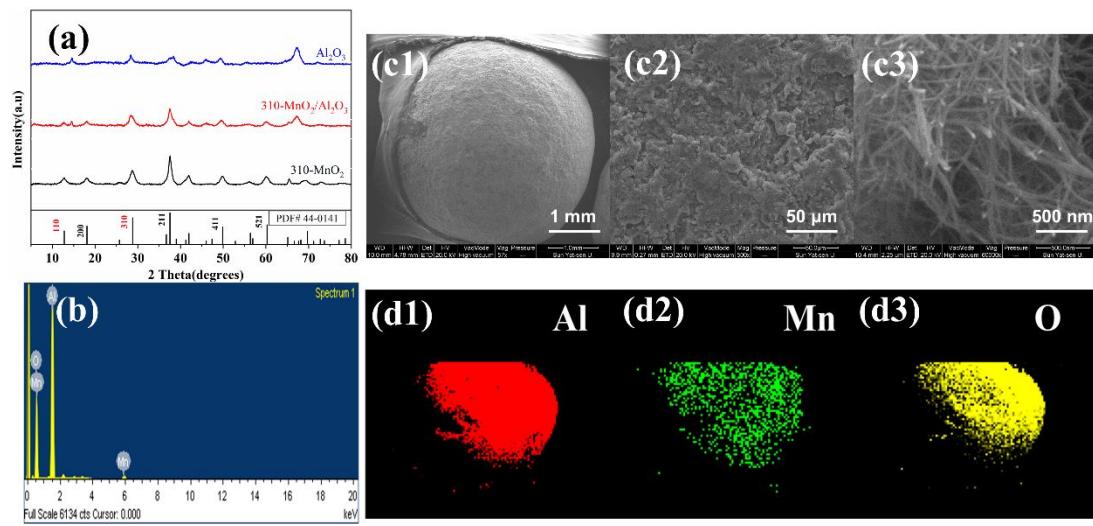
<b>Sample</b>	<b>S<sub>BET</sub> (m<sup>2</sup>/g)</b>	<b>Pore volume (cm<sup>3</sup>/g)</b>	<b>Pore size (nm)</b>
310-Mn/Al <sub>2</sub> O <sub>3</sub>	238.2	0.3311	4.1
Al <sub>2</sub> O <sub>3</sub>	277.7	0.3858	4.8



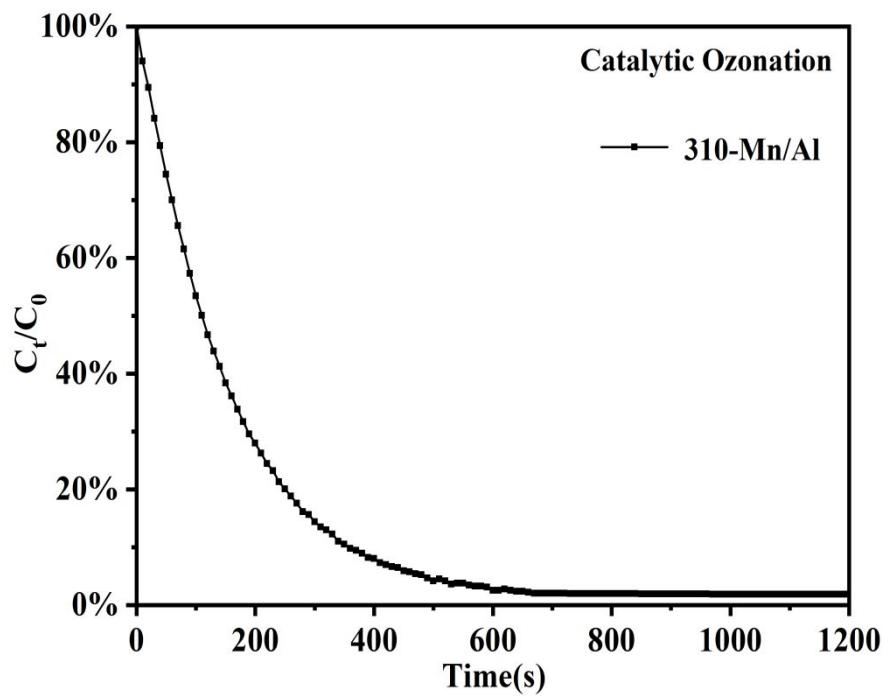
**Figure S1.** Schematic diagram of system for removal of  $\text{CH}_3\text{SH}$ . 1. O<sub>2</sub> gas source; 2.  $\text{CH}_3\text{SH}$  gas source; 3. N<sub>2</sub> gas source; 4. ozone generator; 5. buffer bottles; 6. mixing container; 7. FTIR; 8. tube reactor; 9. gas sensor of  $\text{CH}_3\text{SH}$ ; 10. exhausted gas absorption bottle; V1-V3. Valves; F1-F5. gas flow meters.



**Figure S2.**  $N_2$  adsorption-desorption isotherm and pore-size distribution (inset) of different 310-MnO<sub>2</sub>/Al<sub>2</sub>O<sub>3</sub>.



**Figure S3.** (a) XRD pattern of pure  $\alpha$ - $\text{MnO}_2$  with different exposed facets; (b) EDS spectra, (c1, c2) SEM images and (d1-d3) elemental mapping images of 310- $\text{MnO}_2/\text{Al}_2\text{O}_3$  sample.



**Figure S4.** Performances in catalytic ozonation of  $\text{CH}_3\text{SH}$  with  $310-\text{MnO}_2/\text{Al}_2\text{O}_3$ .