Supplementary information for

Nanocrystalline MnO_2 on Activated Carbon Fiber for Catalytic Formaldehyde Removal

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Table S1. Summary of catalytic oxidation for formaldehyde removal at ambient temperature in recent literature.

Catalyst	Concentration	Temperature	Test method	Performance	Ref.
Pt/TiO_2 hollow chains	260 ± 5 ppm	Room temperature	Organic glass box reactor(4.4 L) catalyst weight: 0.1 g	HCHO decreased to 17.2 ppm after 60 min with R0.5Pt/TiO_2	29
Eu/CeO_2	500 ppm	20-350 ^{o}C	Tests were performed in a fixed-bed reactor GHSV =30,000 $mL \cdot h^{-1} \cdot g^{-1}$	The complete HCHO oxidation of 4% Eu/CeO_2 nanosheets can be obtained at 120^{o}C	30
			Tests were	100% HCHO	

manganese oxides with different crystal structures	170 ppm	50-200 ^{o}C	performed in a fixed-bed quartz flow reactor (i.d. = 4 mm) catalyst: 60 mg GHSV =100 000 mL $(g_{cat}\ h)^{-1}$	conversion occurs at 80 °C for δ-MnO_2, 125 °C, 200 °C, and 150 °C for α-MnO_2, β-MnO_2 and γ-MnO_2	6
Pt/ceramics	140 ppm	Room temperature （25 °C）	Organic glass box reactor (6 L) catalyst weight: 21 g (300 mesh)	Best performance with 0.013 wt% Pt loaded at Pt/HC catalysts.	31
Pt/MnO_2	460 ppm	20-200 ^{o}C	Test in fixed-bed reactor; catalyst: 0.1 g; GHSV: 20 000 h^{-1}	~30% conversion of HCHO over 0.5-1 wt% Pt/MnO_2 20 °C	27
$Au_{0.5}Pt_{0.5}$/MnO_2/ cotton	460 ppm;	20-200 °C	Fixed-bed reactor; (length = 500 mm, diameter = 4 mm) GHSV:20 000 h^{-1}	~30% HCHO conversion over ($Au_{0.5}Pt_{0.5}$/ MnO_2)(20 wt%)/cotton at 40 °C 100% conversion at 120 ^{o}C	32
MnO_2/cellulose	100 ppm	60-180 ^{o}C	Tests were performed in a fixed-bed quartz flow reactor (length = 300 mm,	100 % conversion with 8.86% loading amount in MnO_2/cellulose at 140 ^{o}C	

			diameter = 4 mm) GHSV =50 000^{-1}	~16.7% conversion at 60 ^{o}C	13
Pt/TiO_2	100 ppm	Room temperature （25 °C）	Performed with a fixed-bed quartz flow reactor (length = 300 mm, diameter = 4 mm) GHSV: 50,000, 100,000, 200,000 h^{-1} by changing the used catalyst volume	100% HCHO conversion was attained in the space velocity of GHSV = 50,000 h^{-1}, and about 97% and 58% HCHO conversion in the space velocity of GHSV = 100,000 and 200,000 h^{-1},	33

Content of δ-MnO_2.

Table S2. **Preparation of MnO_2/ACF.**

Sample	Conc. of $KMnO_4$ solution (mol L^{-1})	Conc. of $MnSO_4$ solution (mol L^{-1})	MnO_2 content in MnO_2/ACF (wt.%)
0.01-MnO_2/ACF	0.013	0.010	5.62
0.02-MnO_2/ACF	0.026	0.020	11.74
0.03-MnO_2/ACF	0.040	0.030	16.12
0.04-MnO_2/ACF	0.052	0.040	22.42
0.05-MnO_2/ACF	0.066	0.050	29.33

Results illustrated that the amount of δ-MnO_2 NPs attached in MnO_2/ACF was determined by the initial concentration of $MnSO_4$ and $KMnO_4$ solution. By altering the concentration of $MnSO_4$ and $KMnO_4$ solution, different MnO_2 contents of MnO_2/ACF could be obtained. With the increasing of the concentration of $MnSO_4$ and $KMnO_4$ solution, the content of δ-MnO_2 was increasing.

Calculation of formaldehyde removal amount

The removal capacity of formaldehyde was calculated according to the following equation (equation [1]):

where W is the removal amount of formaldehyde per unit weight of adsorbent (mol/g), P is atmospheric pressure (1 atm), V is volume of removal formaldehyde at 80% breakthrough time which was calculated from the integrated area over breakthrough curve × 10^{-6} × 0.2 L/min, R is universal gas constant (0.08204 atm × mol^{-1} × K^{-1}), T is operating temperature (298.15 K), and m is mass of adsorbent.

Finally, W was converted to weight percentage of removed formaldehyde per unit weight of adsorbent and labelled as W_0 (mg/g).

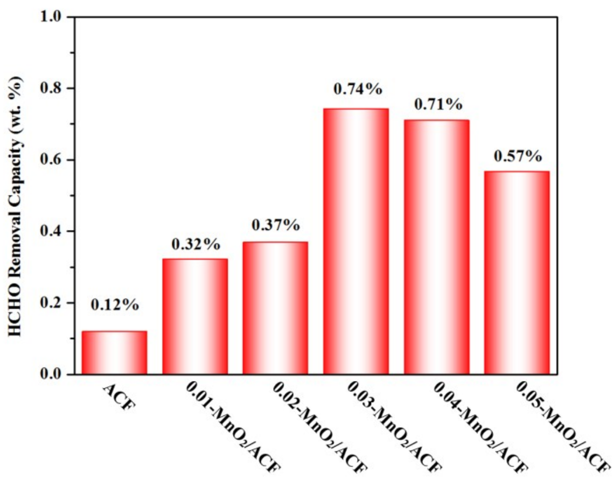

Fig. S1 HCHO removal capacities of ACF and MnO_2/ACF samples.

References

[S1] Song Y, Qiao W, Yoon S-H, Mochida I, Guo Q, Liu L. Removal of formaldehyde at low concentration using various activated carbon fibers. J Appl Polym Sci 2007;106(4);2151-2157.