Supporting information

Adsorption and oxidative desorption of acetaldehyde over mesoporous $Fe_xO_yH_z/Al_2O_3$

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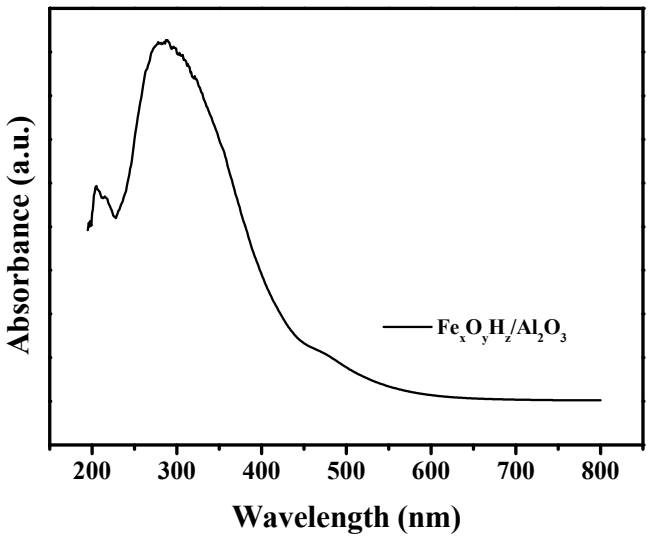
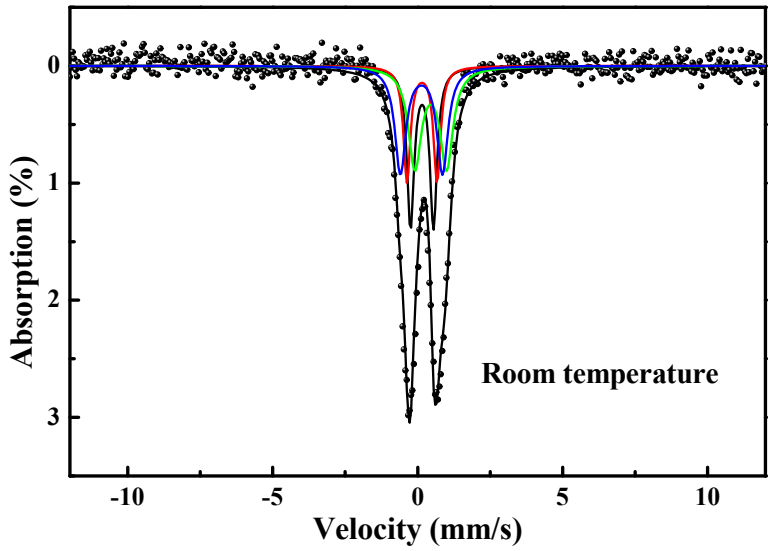
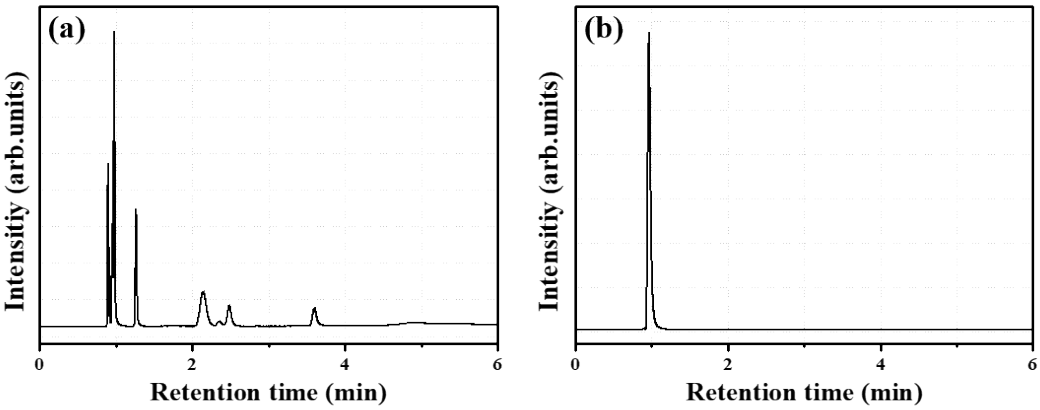


Figure S1. UV-VIS DRS spectra of $Fe_xO_yH_z/Al_2O$



Compound	E_Q (mm/s)	δ (mm/s)	A (%)
α-Fe_2O_3	0.79	0.15 (Fe^{3+})	25.60
Fe_3O_4_A-site	1.03	0.15 (Fe^{3+})	18.33
Fe_3O_4_B-site	1.09	0.45 (Fe^{2+})	29.22
Ferrihydrite	1.45	0.12 (Fe^{3+})	26.86

Figure S2. Mossbauer spectrum of $Fe_xO_yH_z/Al_2O_3$ taken at the room temperature



Retention time of unknown product (min)	Anticipated compounds	Temperature range (°C)
0.9	CO	300 ~ 450
1.4	CH_4	200 ~ 450
2.3	C_3	200 ~ 450
2.5	C_3	200 ~ 450
3.6	C_3	200 ~ 450
5	C_6	300 ~ 450

Figure S3. Chromatogram of gases passed through (a) bulk Al_2O_3 and (b) $Fe_xO_yH_z/Al_2O_3$ at 350 °C during TPD.

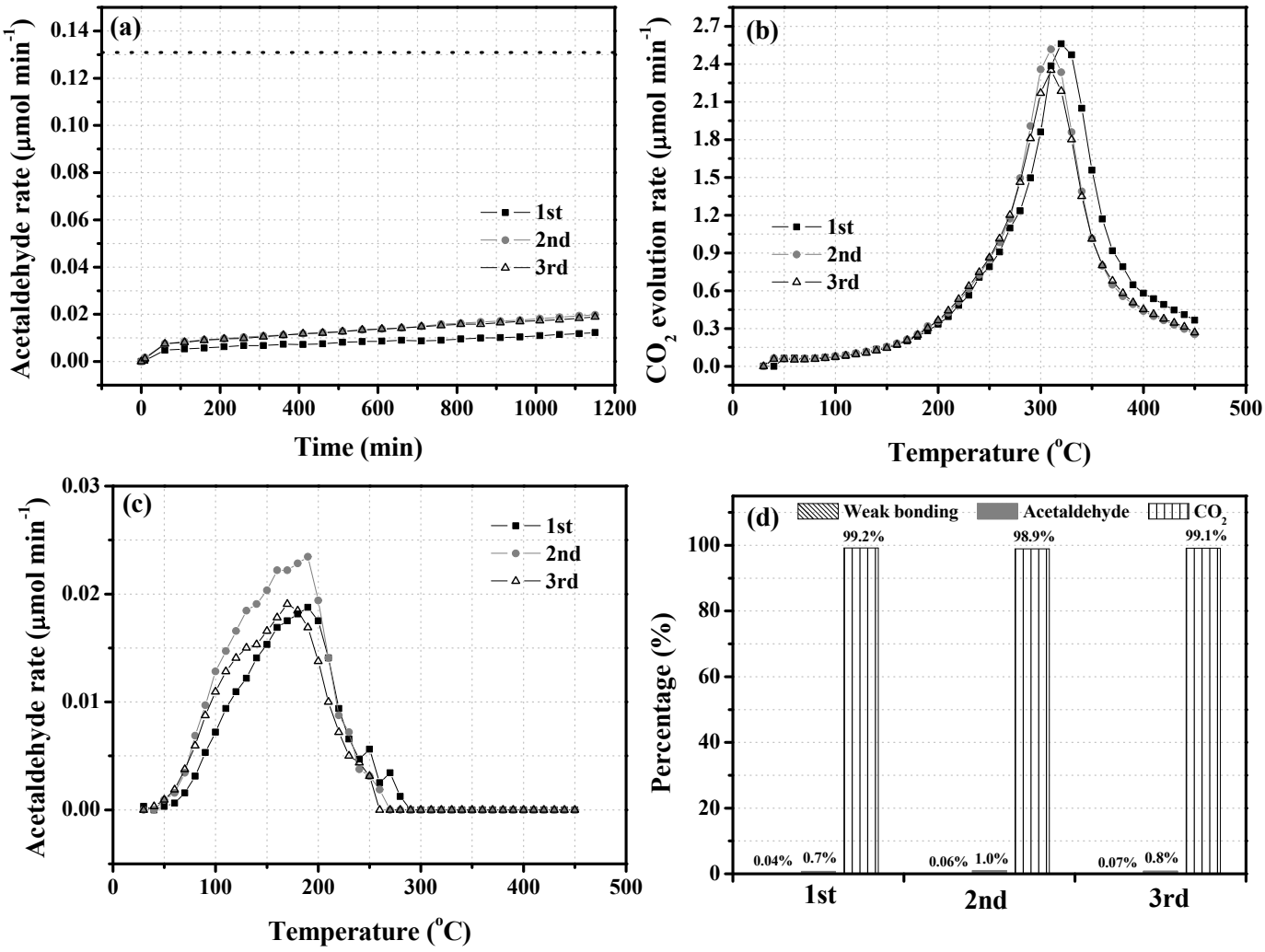


Figure S4. (a) Acetaldehyde flow rate at the outlet of the reactor with $Fe_xO_yH_z/Al_2O_3$ during acetaldehyde adsorption experiment as a function of time. The blank level without $Fe_xO_yH_z/Al_2O_3$ is also indicated. (b) CO_2 evolution rate and (c) acetaldehyde desorption rate during TPO of $Fe_xO_yH_z/Al_2O_3$ after acetaldehyde adsorption for 1150 min. (d) Percentages of the amount of weakly bound acetaldehyde desorbed at 30 °C during purging, and molecularly desorbed acetaldehyde and emitted CO_2 during TPO from $Fe_xO_yH_z/Al_2O_3$ after acetaldehyde adsorption for 1150 min. These experiments were all conducted under dry conditions and the samples were put in a quartz boat which was located in the middle of a quartz reactor.

Desorbed acetaldehyde and evolved CO_2 on the sample surface by heating and subsequently were injected into a sampling loop of the gas chromatograph with a carrier gas. Here, one can calculate the Acetaldehyde desorption rate and CO_2 evolution rate with the equation shown below.

$$Acetaldehyde\ and\ CO_2\ desorption\ rate = \frac{C}{C_0} \times \frac{sampling\ loop\ volume}{sampling\ time} \times \frac{P}{RT}$$

-C_0: Acetaldehyde or CO_2 peak area in GC analysis when acetaldehyde or CO_2 gas fully occupies a sampling loop

-C: Acetaldehyde or CO_2 peak area in GC analysis when the TPO is carried out after adsorbing acetaldehyde on the sample surface.

The percentage of desorbed acetaldehyde and evolved CO_2 were calculated with the equation shown below.

$$Percentage\ of\ Acetaldehyde\ and\ CO_2$$

$$= \frac{\int(Acetaldheyde\ desorption\ rate\ or\ CO_2}{\int(Acetaldheyde\ desorption\ rate)dt + \int(C}$$

In the calculations of the percentage of acetaldehyde desorption and CO_2 evolution, the amount of acetaldehyde and CO_2 gas were calculated by using TPO data.

Figure S5. Detailed description about the calculations of the desorption rates and percentage of acetaldehyde and CO_2 in Figure 9.

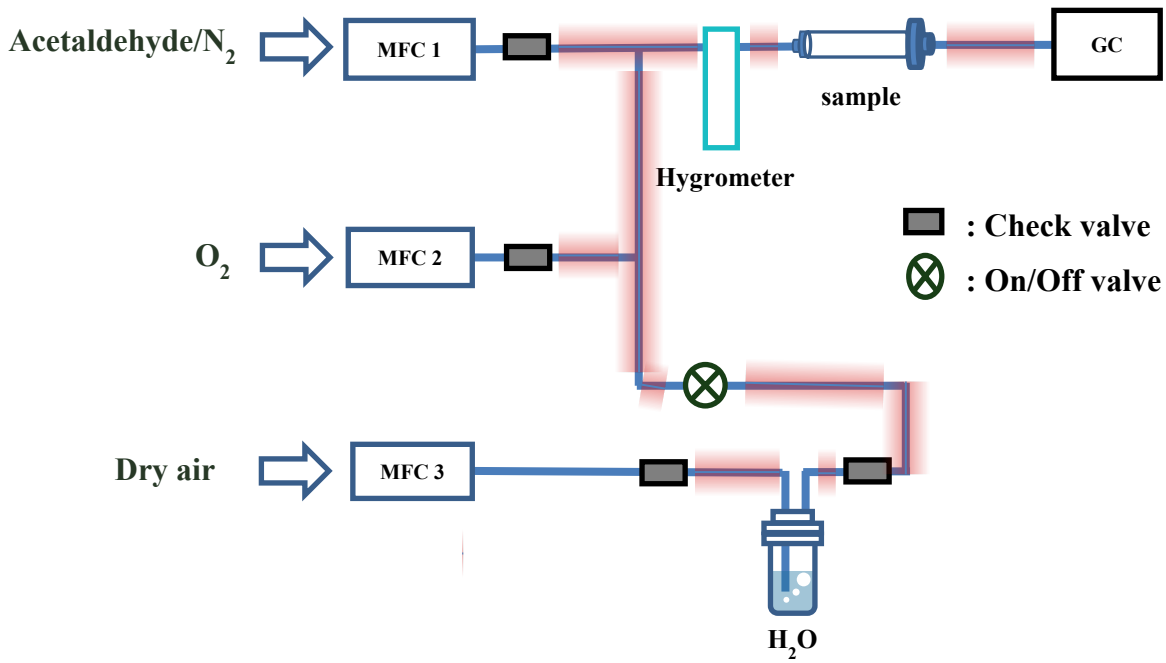


Figure S6. Experiment set-up for acetaldehyde adsorption and oxidative desorption at humidity conditions