

*Supporting Information*

**Mechanism of catalytic ozonation in different surface acid sites of oxides aqueous suspension**

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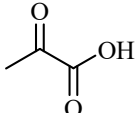
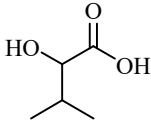
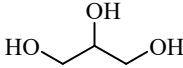
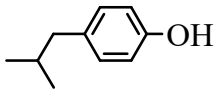
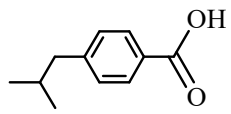
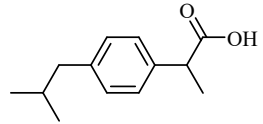
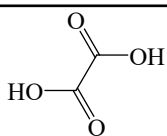
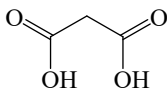
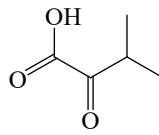
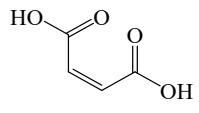
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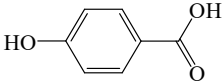
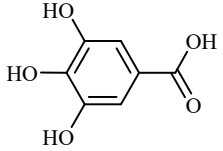
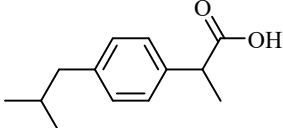
e. BaoXianLe Supply Chain Co., Ltd.

The Supporting Information contains 13 pages, 9 Figures and 1 Table.

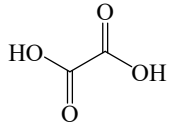
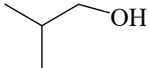
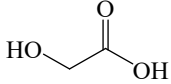
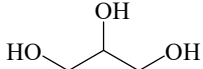
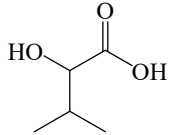
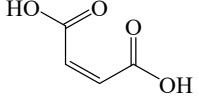
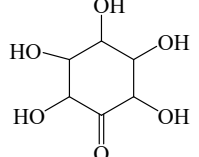
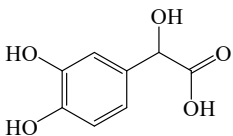
**Table S1** Main products in  $\gamma$ -Al<sub>2</sub>O<sub>3</sub> catalytic ozonation of ibuprofen at 5 min and 20 min of reaction time.

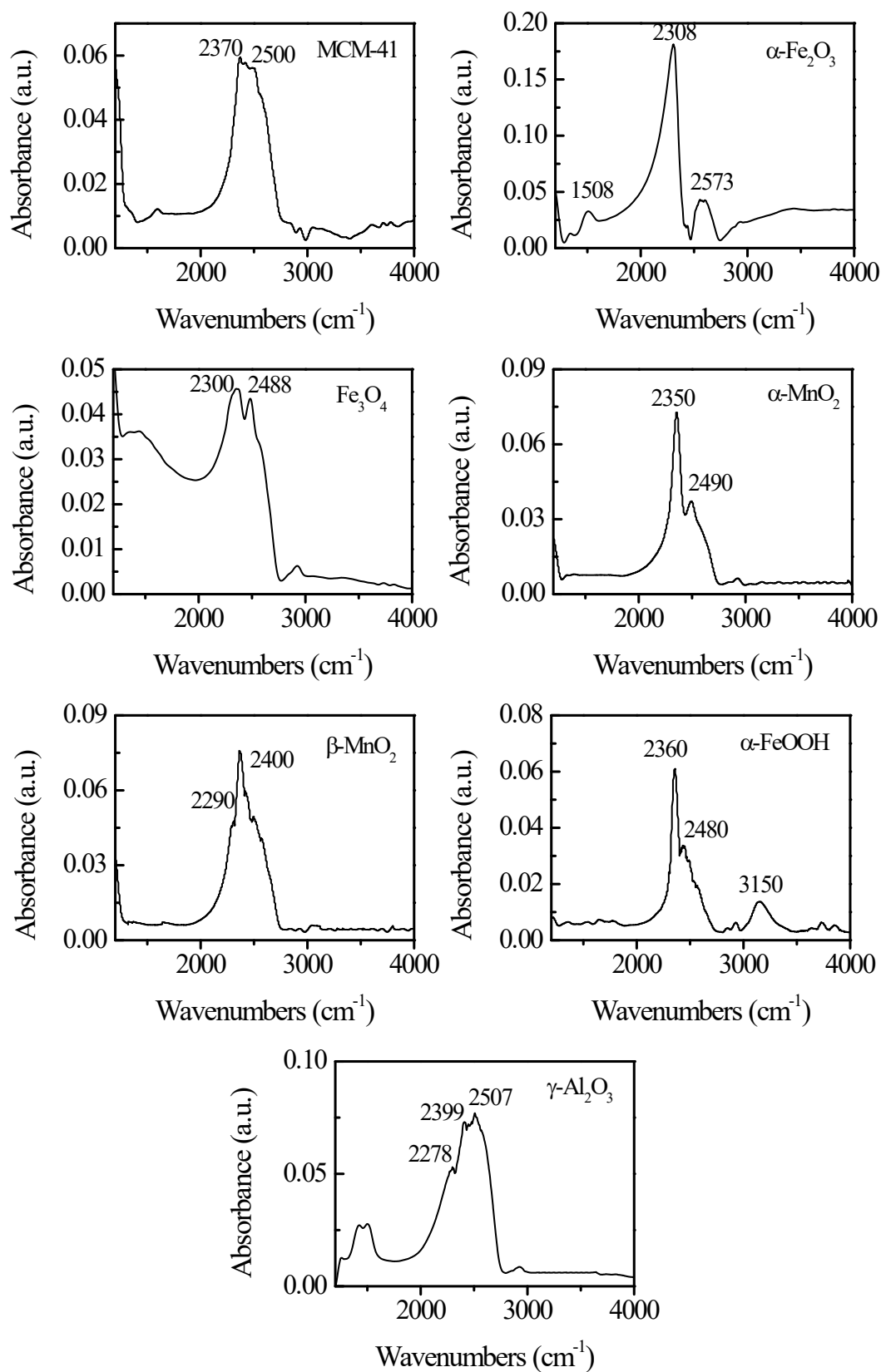
**Ibuprofen (Reaction 5 min)**

Retention time/min	Products	Molecular structure
Main products in the aqueous solution		
9.71	2-oxopropanoic acid	
11.53	2-hydroxy-3-methylbutanoic acid	
26.67	propane-1,2,3-triol	
33.51	4-isobutylphenol	
36.93	4-isobutylbenzoic acid	
42.09	ibuprofen	
Main products on the surface of $\gamma$ -Al <sub>2</sub> O <sub>3</sub>		
7.77	oxalic acid	
13.84	malonic acid	
17.86	3-methyl-2-oxobutanoic acid	
28.92	maleic acid	

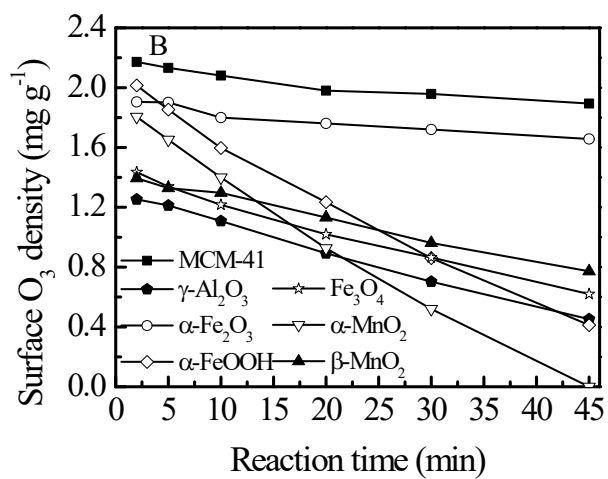
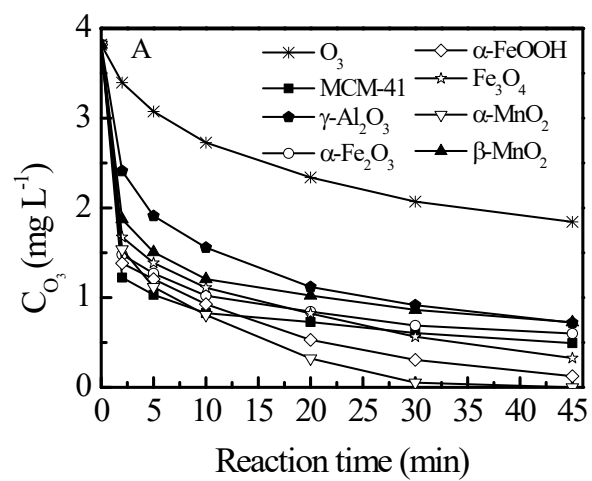
32.29	4-hydroxybenzoic acid	
35.46	3,4,5-trihydroxybenzoic acid	
42.09	ibuprofen	

### Ibuprofen (Reaction 20 min)

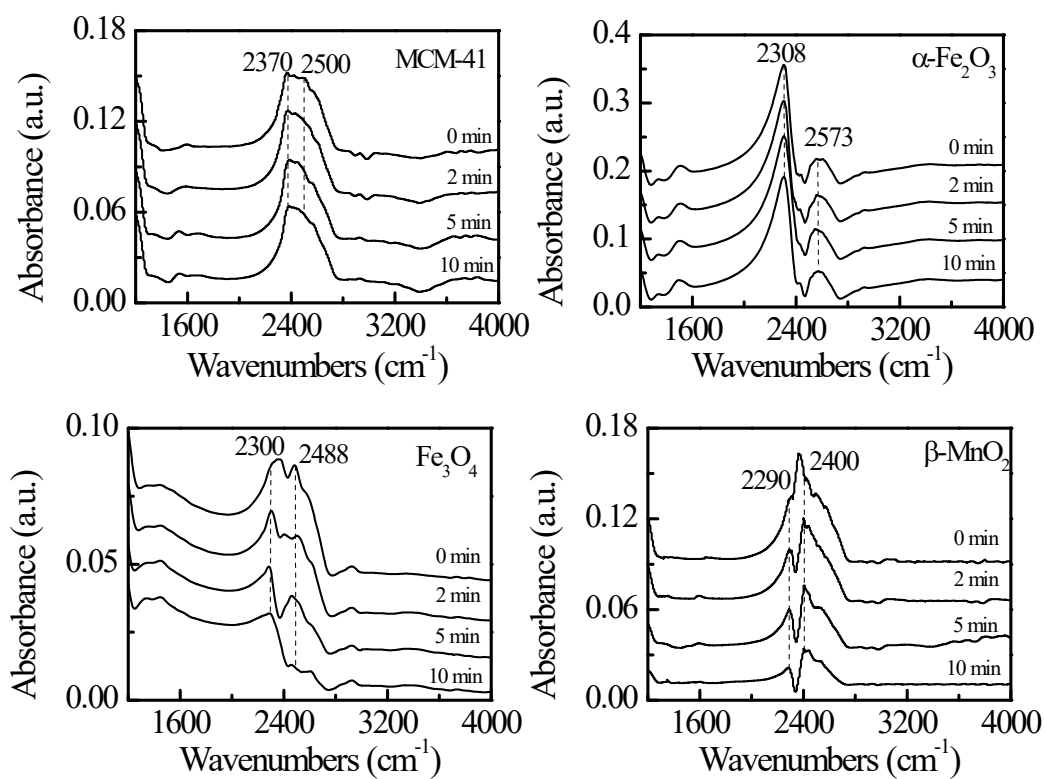
Retention time/min	Products	Molecular structure
Main products in the aqueous solution		
7.77	oxalic acid	
15.18	2-methylpropan-1-ol	
16.86	2-hydroxyacetic acid	
26.68	propane-1,2,3-triol	
Main products on the surface of $\gamma$ -Al <sub>2</sub> O <sub>3</sub>		
11.53	2-hydroxy-3-methylbutanoic acid	
28.92	maleic acid	
29.68	2,3,4,5,6-pentahydroxycyclohexanone	
38.95	2-(3,4-dihydroxyphenyl)-2-hydroxyacetic acid	



**Fig. S1** ATR-FTIR spectra of different catalyst suspensions in D<sub>2</sub>O. (Catalyst concentration: 100 g L<sup>-1</sup>, pD: 7.0).

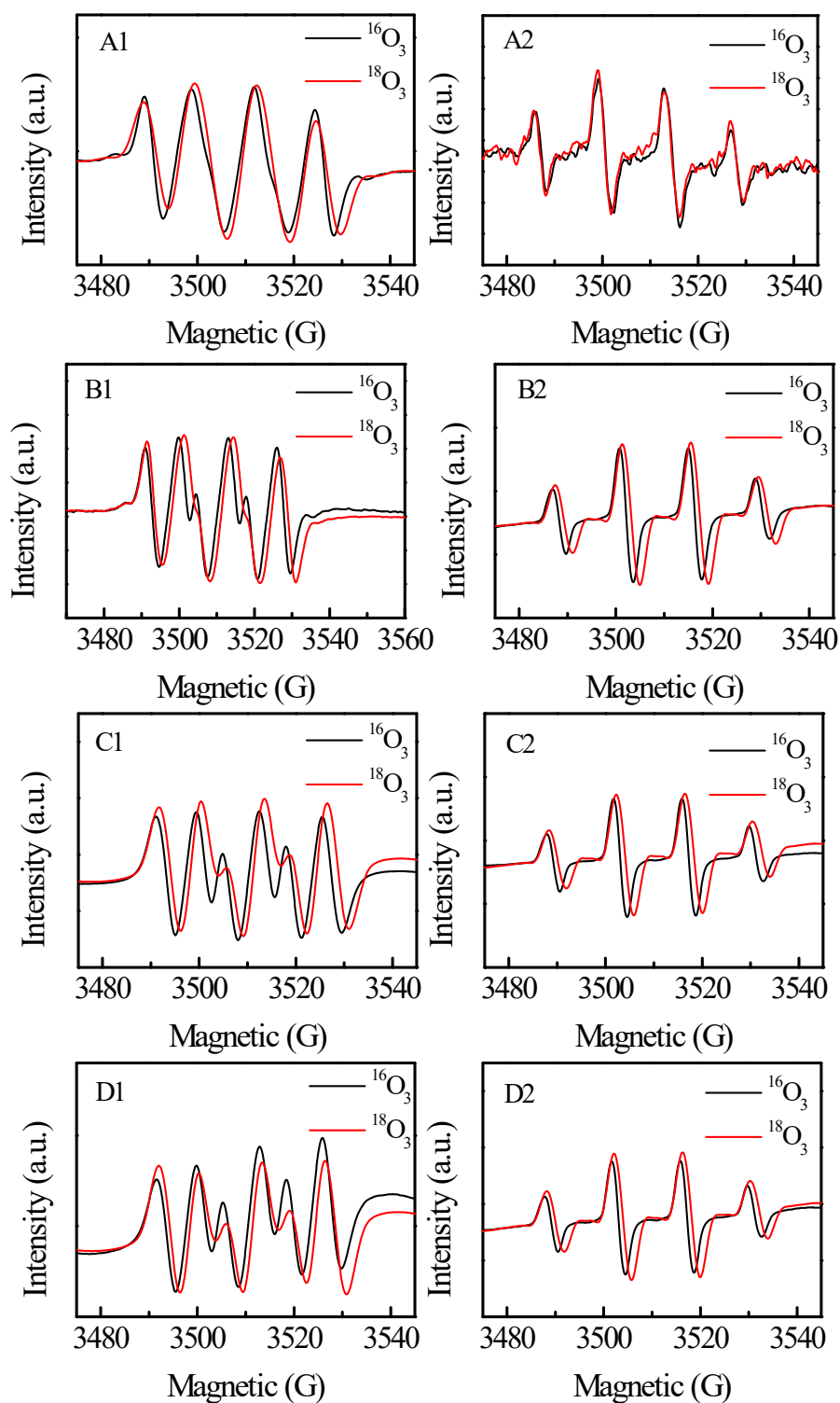


**Fig. S2** The changes of ozone concentration in bulk water (A) and the adsorbed ozone onto catalysts (B) during the decomposition of ozone in aqueous dispersions of various catalysts. (Catalyst dose: 1.5 g L<sup>-1</sup>, initial ozone concentration in water: 3.82 mg L<sup>-1</sup>, initial pH: 7.0).

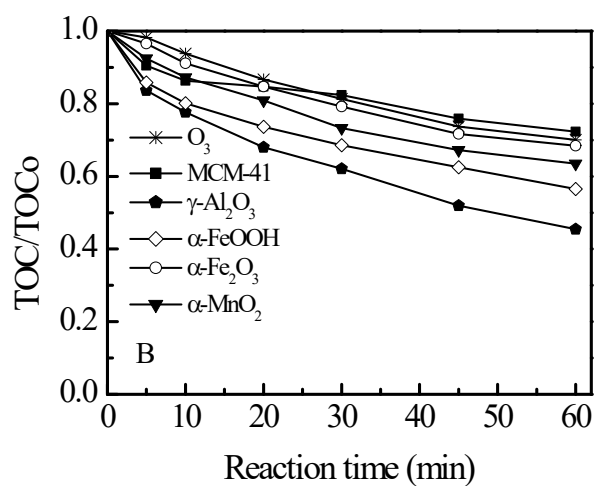
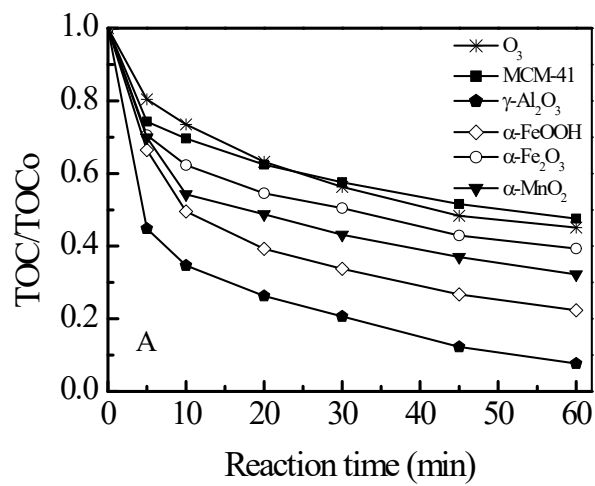


**Fig. S3** ATR-FTIR spectra of different catalysts suspended in D<sub>2</sub>O bubbling ozone for different time.

(Gaseous ozone concentration: 30 mg L<sup>-1</sup>, catalyst dose: 100 g L<sup>-1</sup>, pD: 7.0).

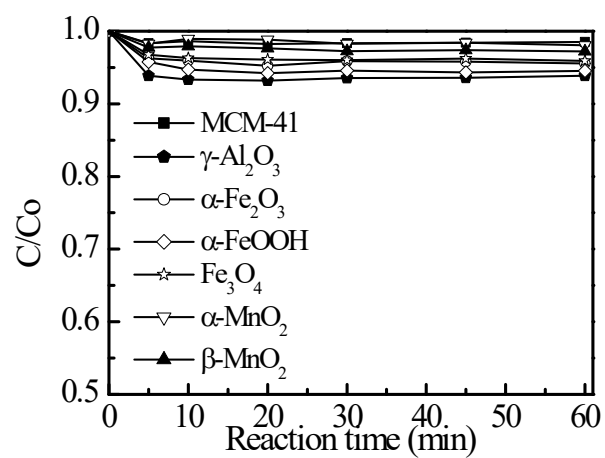


**Fig. S4** BMPO spin-trapping ESR spectra of  $O_3$  alone (A),  $Fe_3O_4$  (B),  $\alpha$ - $MnO_2$  (C) and  $\beta$ - $MnO_2$  (D) recorded in methanol dispersion for  $BMPO\text{-}HO_2^*/O_2^*$  (A1, B1, C1 and D1) and aqueous dispersion for  $BMPO\text{-}^*OH$  (A2, B2, C2 and D2) with  $^{16}O_3$  or  $^{18}O_3$ . (Initial pH: 7.0, catalyst concentration: 10 g  $L^{-1}$ , initial ozone concentration in water: 3.82 mg  $L^{-1}$ , initial BMPO concentration: 25 mM).

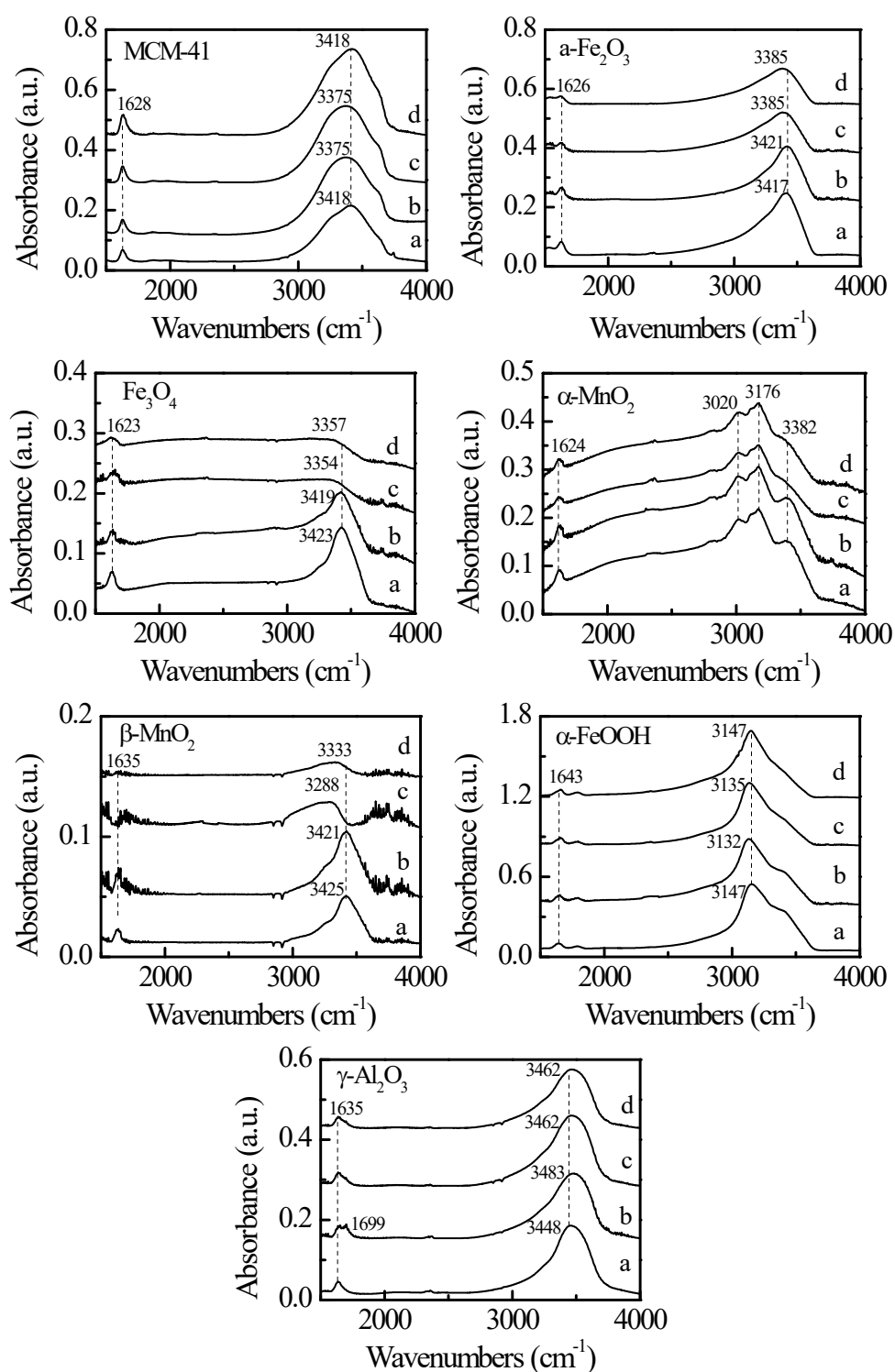


**Fig. S5** Catalytic ozonation of humic acid (A) and acyclovir (B) in various suspensions. (Initial pH: 7.0, initial acyclovir or humic acid concentration: 10 mg L<sup>-1</sup>, catalyst concentration: 1.5 g L<sup>-1</sup>, gaseous ozone concentration: 30 mg L<sup>-1</sup>).

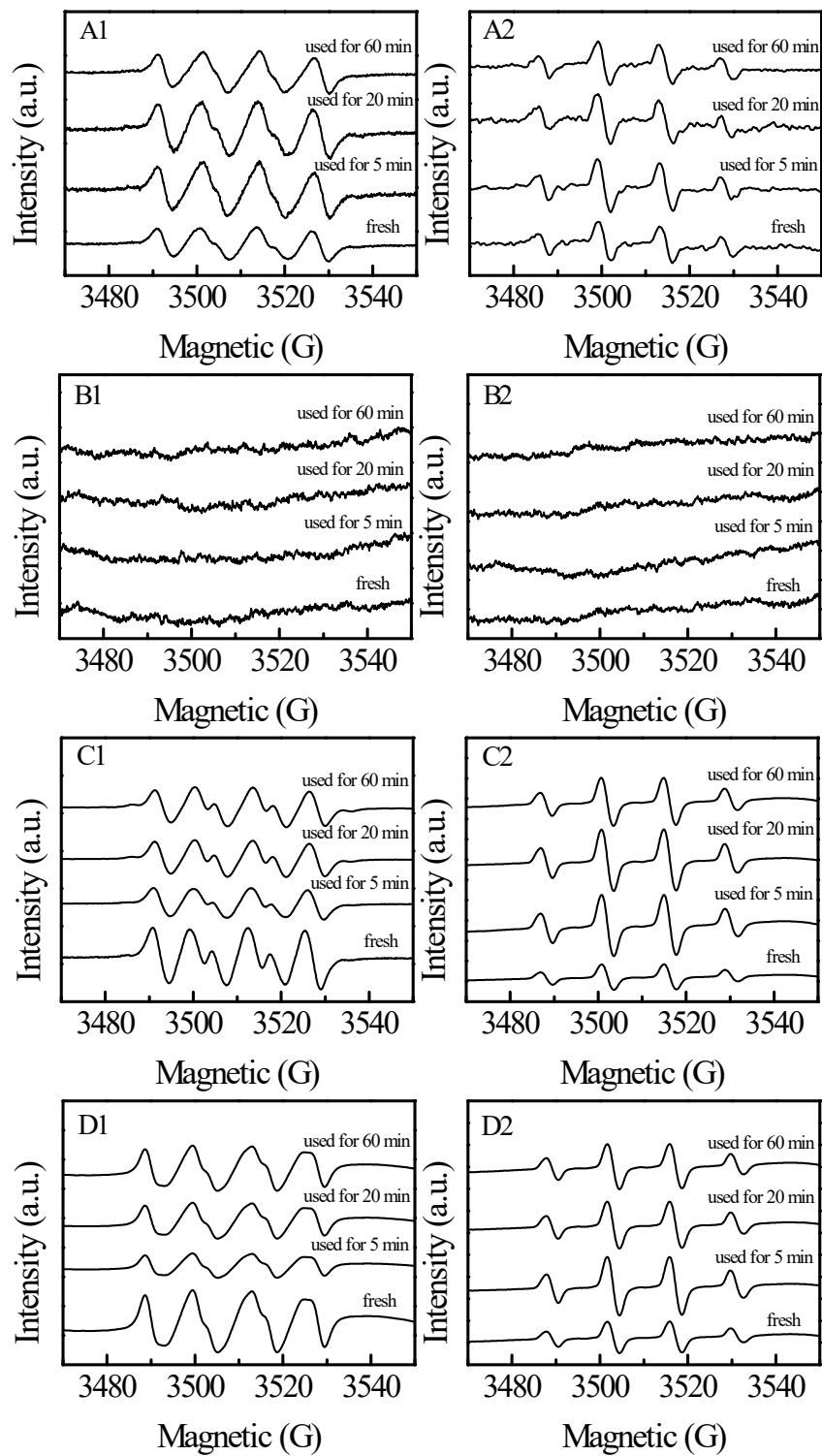


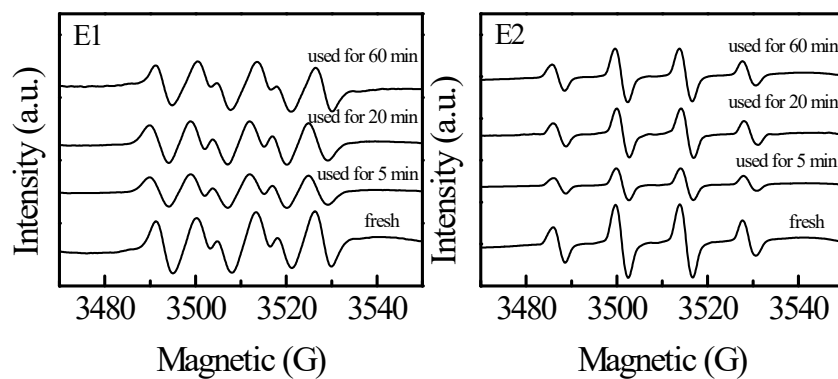


**Fig. S6** Comparison of IBU removal by adsorption processes in various suspensions. (Initial pH: 7.0, initial IBU concentration: 10 mg L<sup>-1</sup>, catalyst concentration: 1.5 g L<sup>-1</sup>).

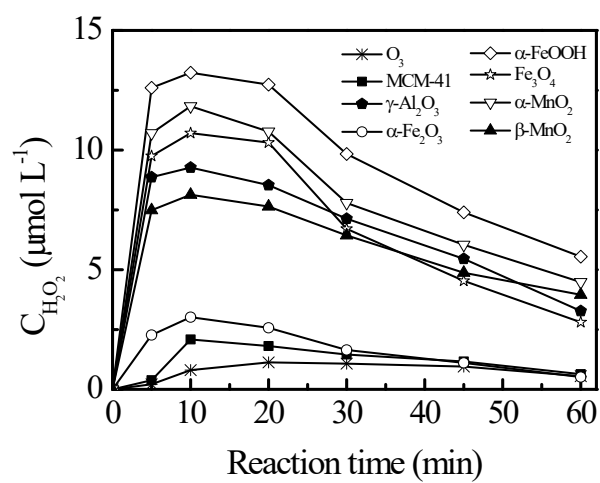


**Fig. S7** FTIR spectra for various samples: (a) fresh catalyst, (b) catalyst adsorbed IBU, (c) catalyst used for 20 min and (d) catalyst used for 60 min in the catalytic ozonation reaction with IBU. (Initial pH: 7.0, initial IBU concentration: 10 mg L<sup>-1</sup>, catalyst concentration: 1.5 g L<sup>-1</sup>, gaseous ozone concentration: 30 mg L<sup>-1</sup>).





**Fig. S8** BMPO spin trapping EPR spectra for various MCM-41 (A),  $\alpha$ - $\text{Fe}_2\text{O}_3$  (B),  $\text{Fe}_3\text{O}_4$  (C),  $\alpha$ - $\text{MnO}_2$  (D) and  $\beta$ - $\text{MnO}_2$  (E) samples with  $\text{O}_3$  recorded in methanol dispersion for  $\text{BMPO}\text{-HO}_2^\bullet/\text{O}_2^{\bullet-}$  (A1, B1, C1, D1 and E1) and aqueous dispersion for  $\text{BMPO}\text{-}\bullet\text{OH}$  (A2, B2, C2, D2 and E2). (Initial pH: 7.0, catalyst concentration:  $10 \text{ g L}^{-1}$ , initial BMPO concentration: 25 mM, recording time: 3 min).



**Fig. S9** The formation of H<sub>2</sub>O<sub>2</sub> during catalytic ozonation of IBU in aqueous dispersions of different catalysts. (Initial pH: 7.0, initial IBU concentration: 10 mg L<sup>-1</sup>, catalyst concentration (if use): 1.5 g L<sup>-1</sup>, gaseous ozone concentration: 30 mg L<sup>-1</sup>).