SUPPLEMENTARY INFORMATION

Nano ferrite (AFe_2O_4, A = Zn, Co, Mn, Cu) as efficient catalysts for catalytic ozonation of toluene

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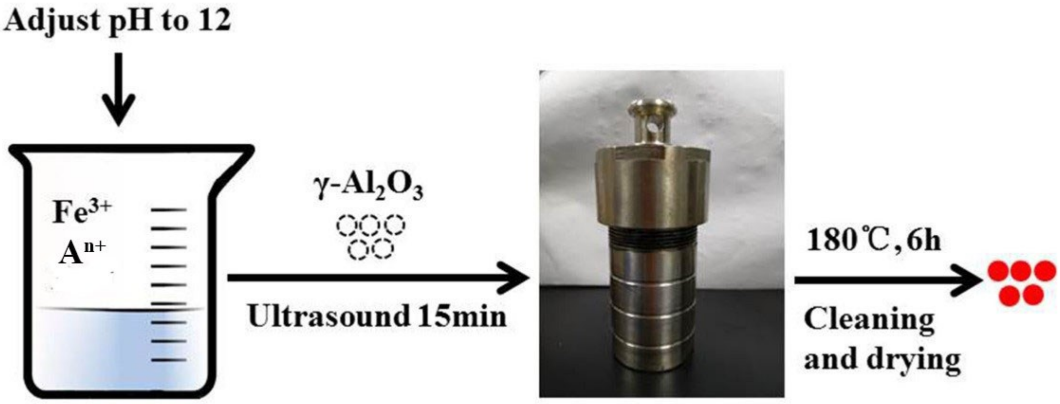


Fig. S1. Schematic illustration of the synthesis of AFe_2O_4 /γ-Al_2O_3 catalysts.

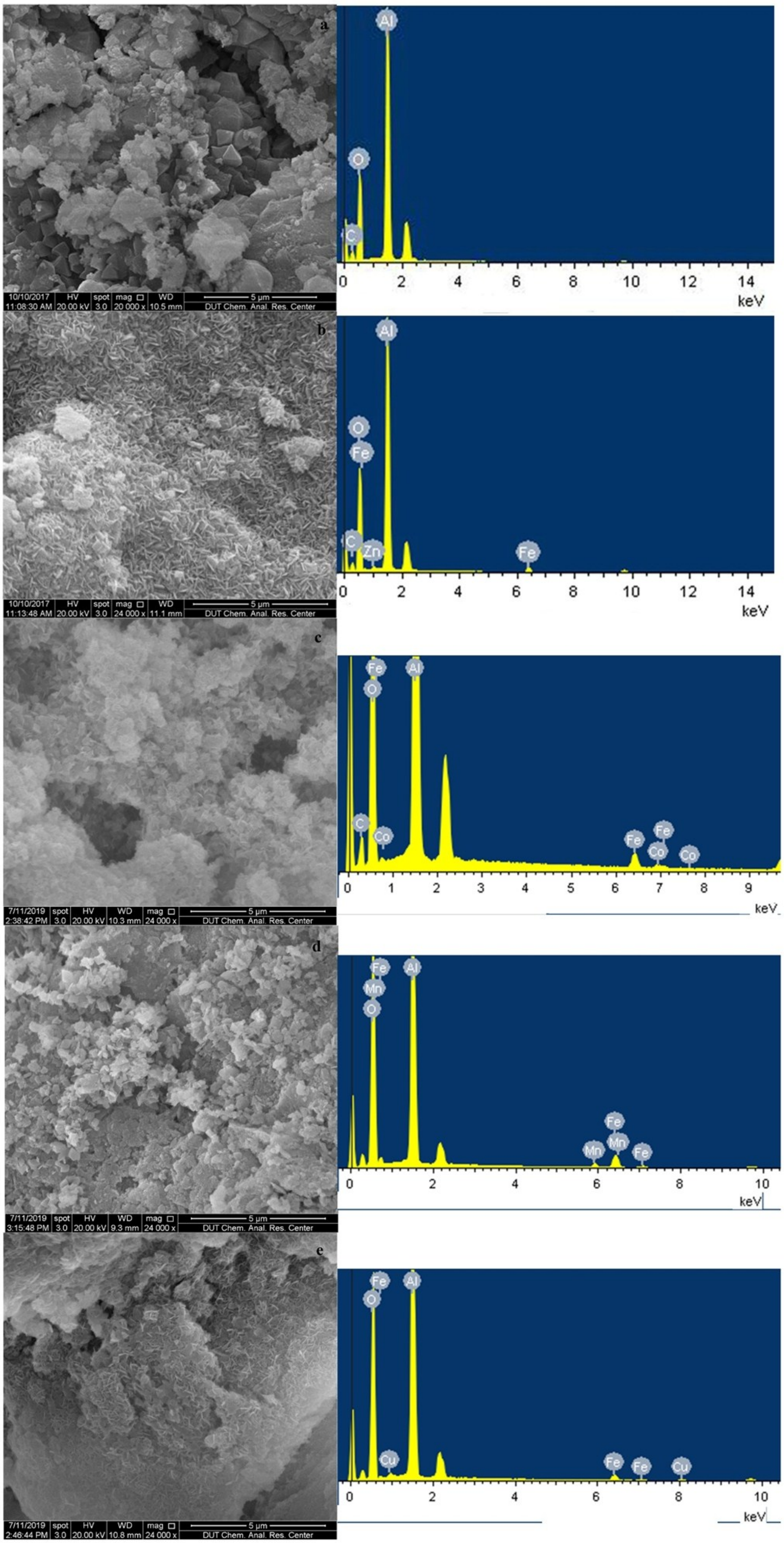


Fig. S2. SEM image and the corresponding EDS pattern of as-synthesized γ-Al_2O_3 supports and AFe_2O_4/γ-Al_2O_3 catalysts.

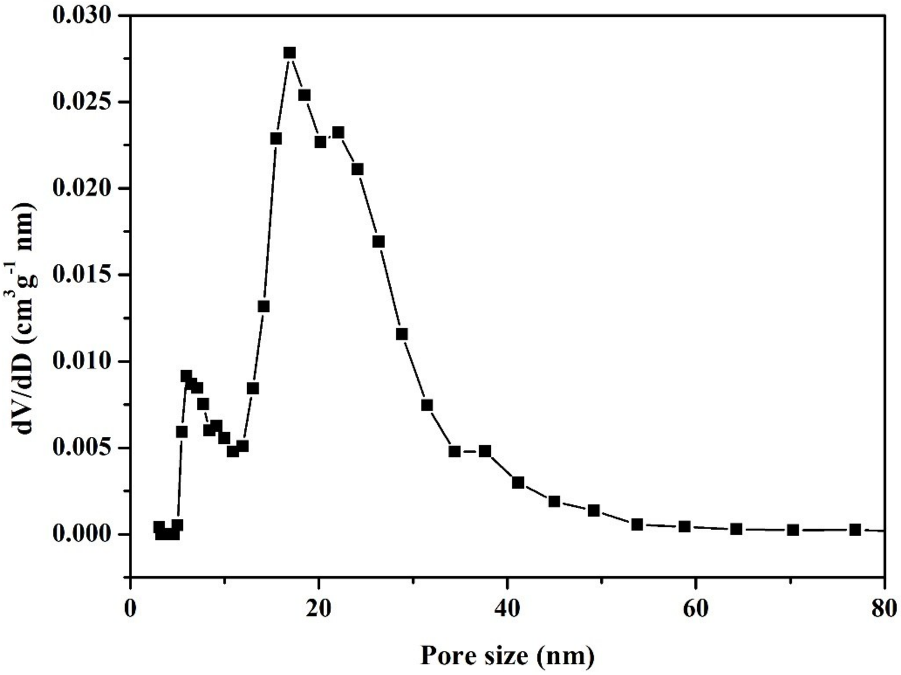


Fig. S3. Corresponding pore size distribution of γ-Al_2O_3 supports.

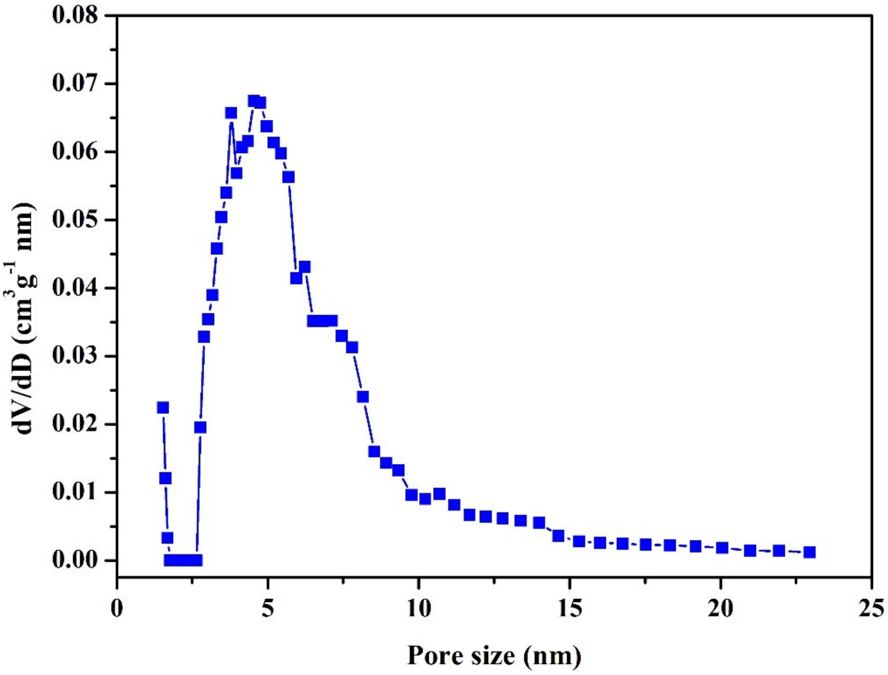


Fig. S4. Corresponding pore size distribution of $ZnFe_2O_4/\gamma\text{-}Al_2O_3$ catalysts.

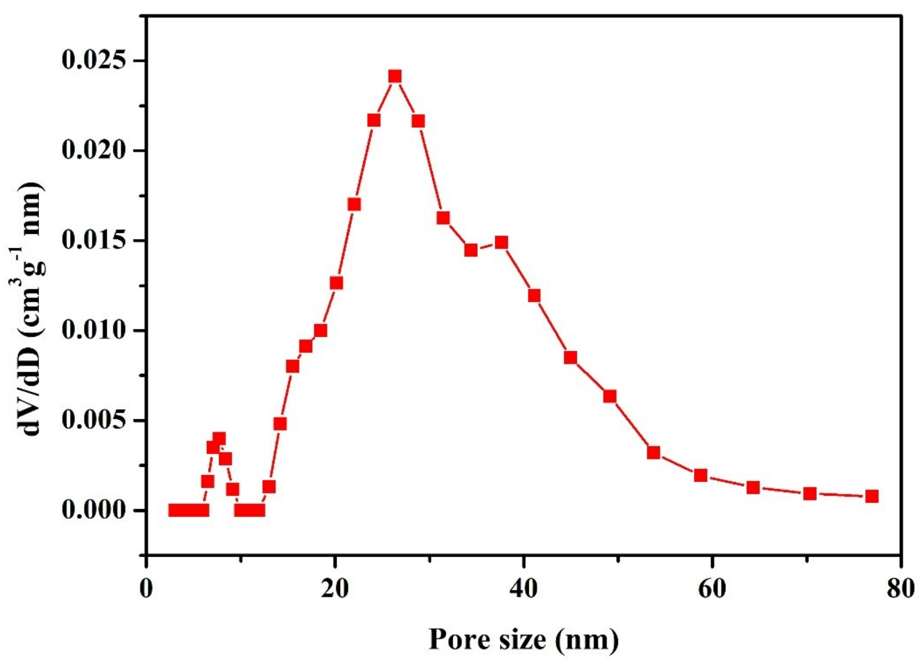


Fig. S5. Corresponding pore size distribution of $CoFe_2O_4/\gamma\text{-}Al_2O_3$ catalysts.

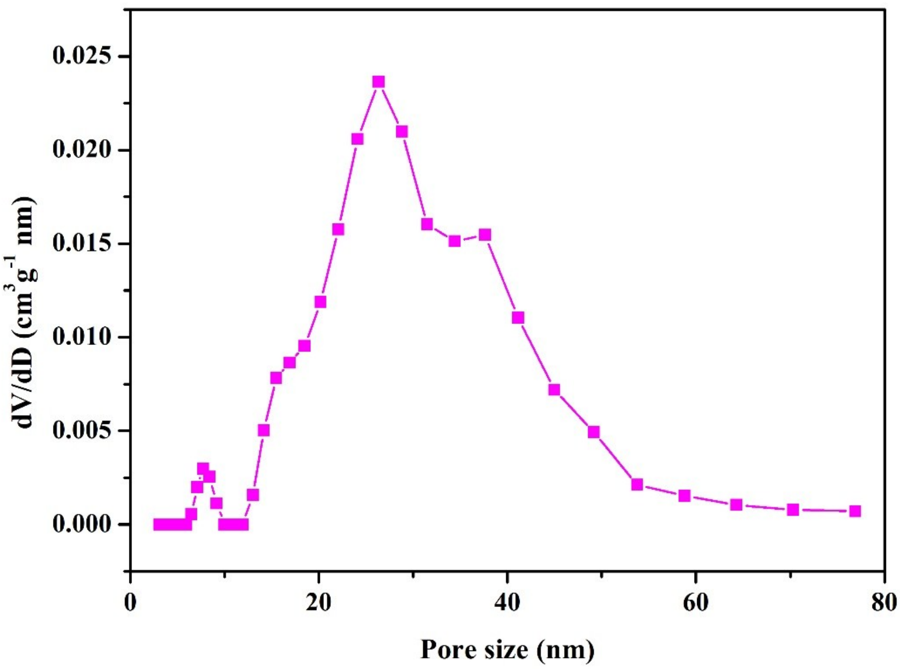


Fig. S6. Corresponding pore size distribution of $MnFe_2O_4/\gamma\text{-}Al_2O_3$ catalysts.

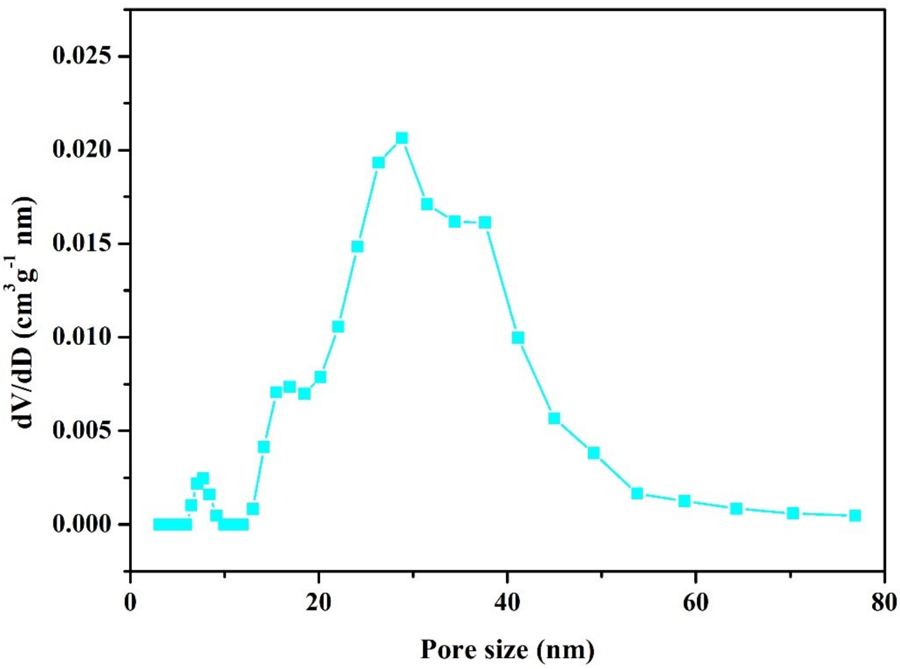


Fig. S7. Corresponding pore size distribution of $CuFe_2O_4/\gamma\text{-}Al_2O_3$ catalysts.

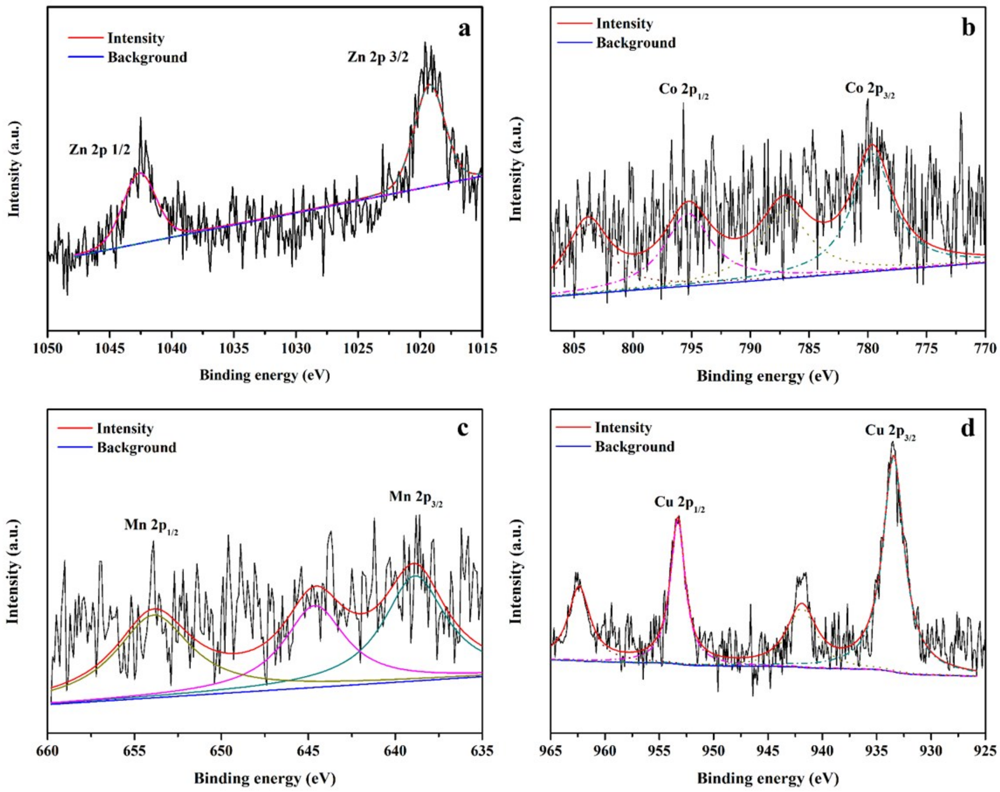


Fig. S8. XPS spectra of $AFe_2O_4/\gamma\text{-}Al_2O_3$ catalysts, **a)** Zn 2P; **b)** Co 2p; **c)** Mn 2P, **and d)** Cu 2p.

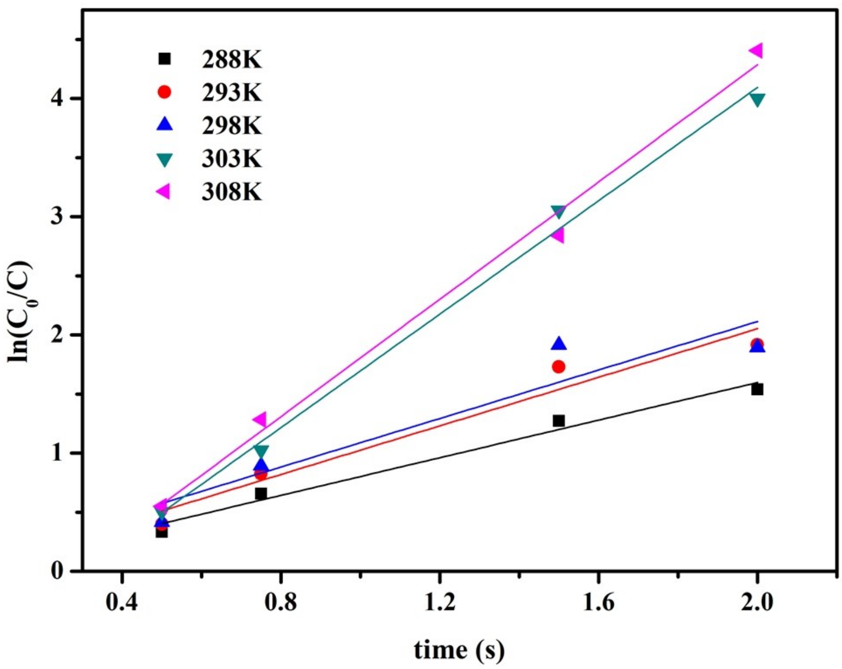


Fig. S9. Pseudo-first-order kinetics fitting at various temperatures.

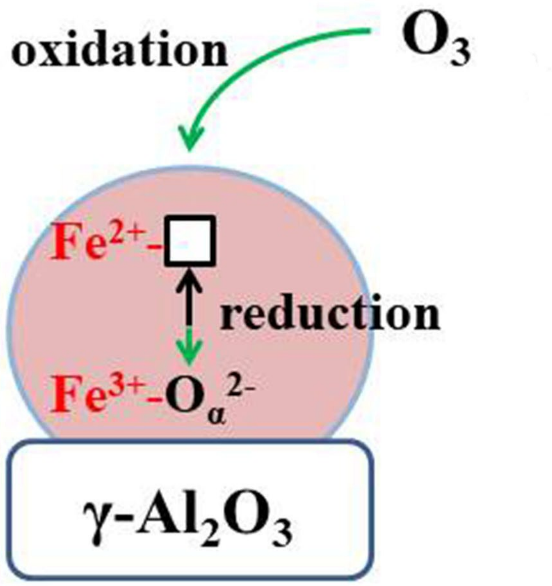


Fig. S10. $ZnFe_2O_4$/γ-Al_2O_3 catalyst surface reaction process

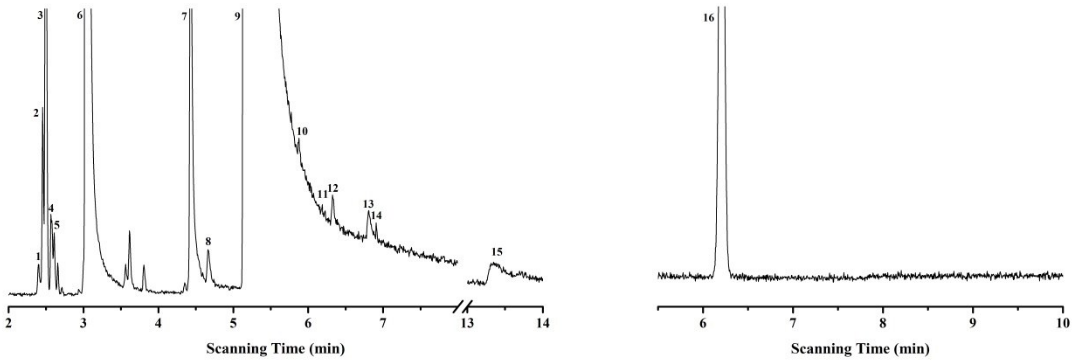


Fig. S11. a) GC/MS analysis of catalyst surface residues; **b)** GC/MS analysis of produced gas.

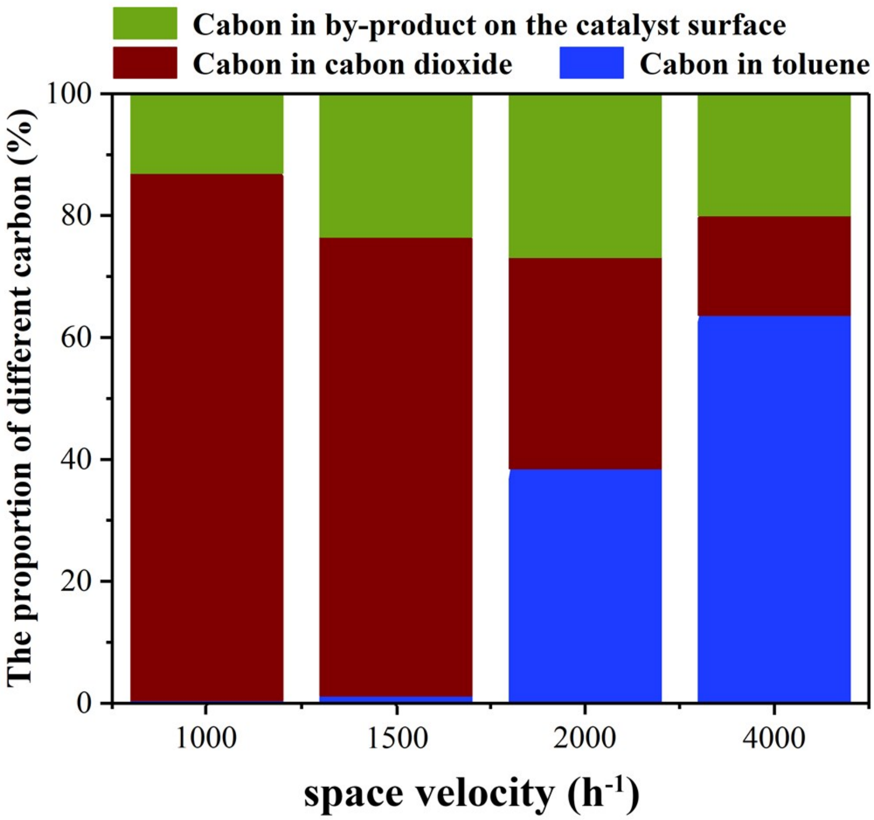


Fig. S12. Impact of space velocity on carbon balance.

Table S1. The comparison of BET surface area, pore structure for γ-Al_2O_3 and the AFe_2O_4/γ-Al_2O_3 catalysts.

Sample	S_{BET} (m^2/g)	Pore volume (cm^3/g)	Average pore diameter (nm)
γ-Al_2O_3	320	0.617	30.66
$ZnFe_2O_4$/γ-Al_2O_3 catalysts	300	0.615	32.66
$CoFe_2O_4$/γ-Al_2O_3 catalysts	286	0.589	32.96
$MnFe_2O_4$/γ-Al_2O_3 catalysts	245	0.513	32.99
$CuFe_2O_4$/γ-Al_2O_3 catalysts	154	0.294	34.56

Table S2. Amounts and proportional relationship of BAS and LAS.

Samples	150 ℃, μmol/g			Total
	LAS	BAS	B/L	
γ-Al_2O_3	61.8	1.2	0.019	63.0
$ZnFe_2O_4$/γ-Al_2O_3 catalyst	71.9	1.5	0.021	73.4
$CoFe_2O_4$/γ-Al_2O_3 catalyst	68.3	1.1	0.017	69.4
$MnFe_2O_4$/γ-Al_2O_3 catalyst	32.6	0.4	0.011	33.0
$CuFe_2O_4$/γ-Al_2O_3 catalyst	60.7	0.9	0.14	61.6

Table S3. Comparison of parameters of reaction kinetic equations for toluene-catalyzed ozonation in different systems under the same reaction conditions.

Kinetics equation	Zero order		pseudo-first order	
	Rate Constant/K	R^2	Rate Constant/K	R^2
Sole O_3	1584	0.2978	0.1171	0.9073
γ-Al_2O_3+O_3	9070	0.8917	0.3430	0.9875
$ZnFe_2O_4$/γ-Al_2O_3+O_3	27708	0.9171	0.6419	0.9184
$CoFe_2O_4$/γ-Al_2O_3+O_3	22574	0.9073	0.5951	0.9241
$MnFe_2O_4$/γ-Al_2O_3+O_3	8864	0.7152	0.3574	0.7736
$CuFe_2O_4$/γ-Al_2O_3+O_3	9483	0.8874	0.3748	0.8876

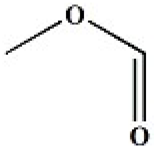
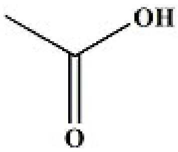
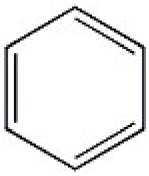
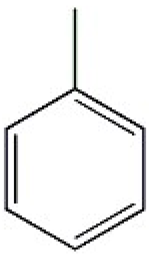
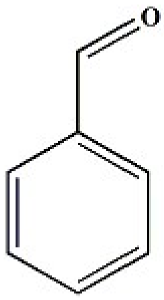
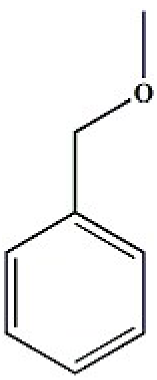
Table S4. Reaction rate constant value (***k***) at each temperature.

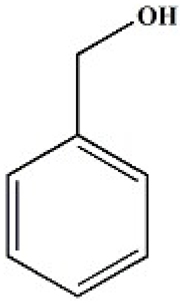
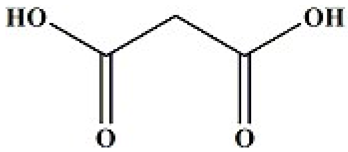
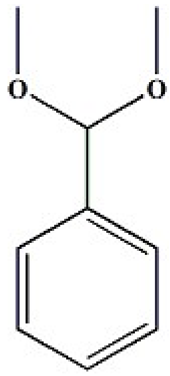
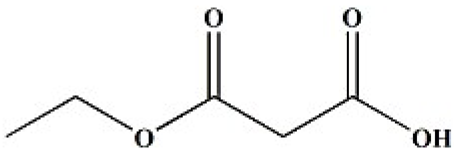
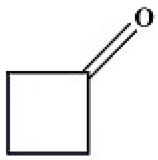
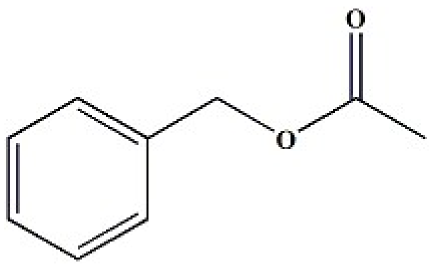
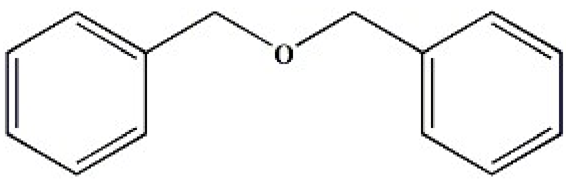
Temperature (K)	288	293	298	303	308
k	0.7961	1.0280	1.0261	2.3989	2.4812

Table S5. $[O_3]_w$(mg/m^3) in sole ozonation and catalytic ozonation process, respectively.

Initial ozone concentration (mg/L)	Sole O_3	γ-Al_2O_3+O_3	$ZnFe_2O_4$/γ-Al_2O_3+O_3
5	4.12	0	0
10	9.17	5.31	1.57
15	13.96	11.88	4.92
20	18.41	18.38	5.04

Table S6. Summary of GC/MS results.

Label	Molecular formula	Molecular structure	Name of Compound
1	CH_4O	CH_3OH	Methanol
2	$C_2H_4O_2$		Methyl formate
3	C_2H_6O		Ethanol
4	$C_2H_4O_2$		Acetic acid
5	C_6H_6		Benzene
6	C_7H_8		Toluene
7	C_7H_6O		Benzaldehyde
8	$C_8H_{10}O$		Benzyl methyl ether

9	C_7H_8O		Benzyl alcohol
10	$C_3H_4O_4$		Propanedioic acid
11	$C_9H_{12}O_2$		Benzaldehyde dimethyl acetal
12	$C_5H_8O_4$		Ethyl hydrogen malonate
13	C_4H_6O		Cyclobutanone
14	$C_9H_{10}O_2$		Acetic acid, phenylmethyl ester
15	$C_{14}H_{14}O$		Benzyl Ether
16	CO_2		Carbon dioxide