

Supporting Information

Text S1 The content of CNTs in C@M was calculated based on the TGA results

The percentages of MIL-88B-Fe and CNTs in the composites were calculated by the following equation.

$$1 = \omega_{\text{MIL-88B-Fe}} + \omega_{\text{CNTs}}, \quad \text{S(1)}$$

$$\omega_{\text{Residue}} = 0.305 \omega_{\text{MIL-88B-Fe}} + 0 \omega_{\text{CNTs}}, \quad \text{S(2)}$$

where $\omega_{\text{MIL-88B-Fe}}$ and ω_{CNTs} are the actual weight percentage of MIL-88B-Fe and CNTs in the composites respectively. ω_{Residue} is the actual weight percentage of residue in composites. The 0.305 and 0 are the weight fraction of residue in pure MIL-88B-Fe and functionalized CNTs.

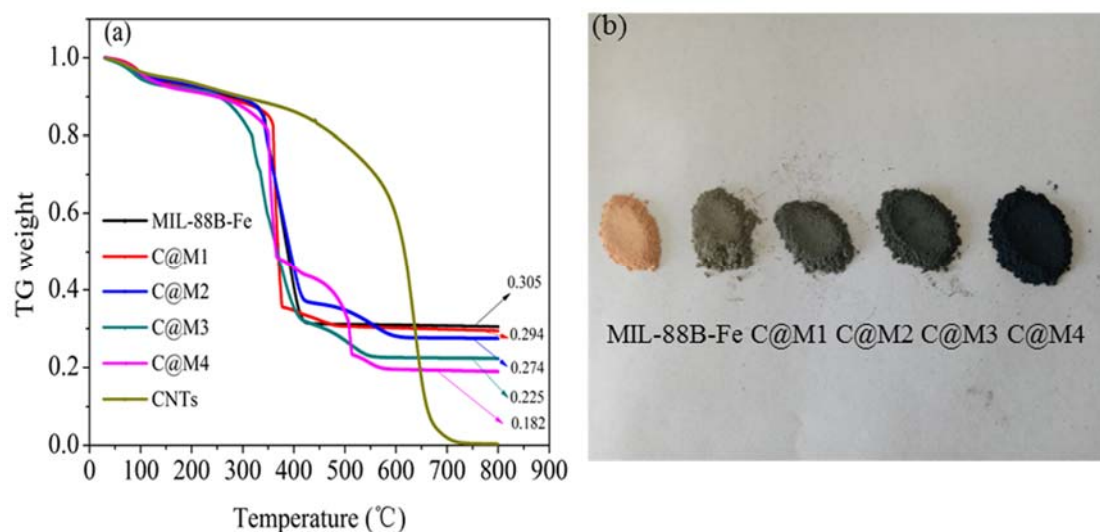


Fig. S1 (a) TGA results of CNTs, MIL-88B-Fe and C@M composites; (b) powder images of MIL-88B-Fe and C@M composites

Table S1 The CNT percentage in composites calculated by TGA

Samples	TG result
C@M1	3.61%
C@M2	10.16%
C@M3	26.23%
C@M4	40.33%

Table S2 Detection methods of organic compounds by HPLC

Compound	Mobile phase (v/v)	Flow rate (mL/min)	Wavelength (nm)
BPA	methanol/water: 0.7/0.3	1.0	280
2,4-DCP	methanol/water: 0.6/0.4	1.0	280
SMX	acetonitrile/water: 0.4/0.6	1.0	270

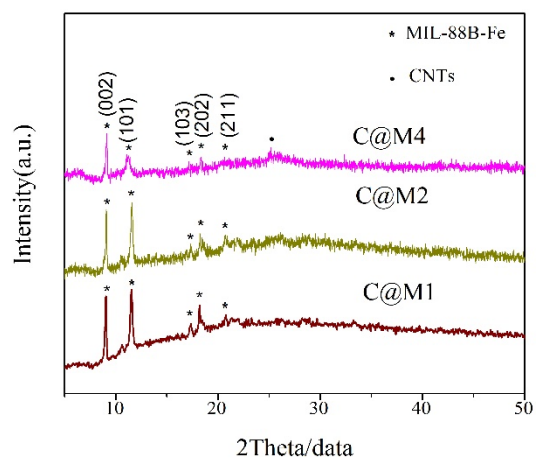


Fig. S2 XRD patterns for C@M with different CNT loadings

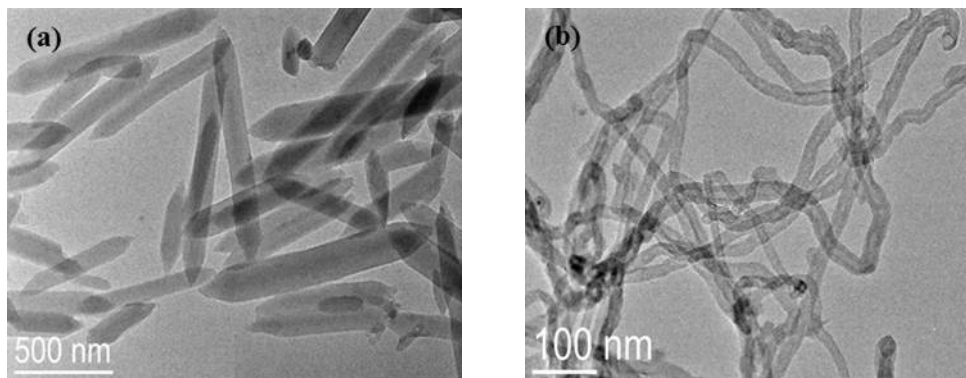


Fig. S3 TEM images for (a) MIL-88B-Fe and (b) CNTs

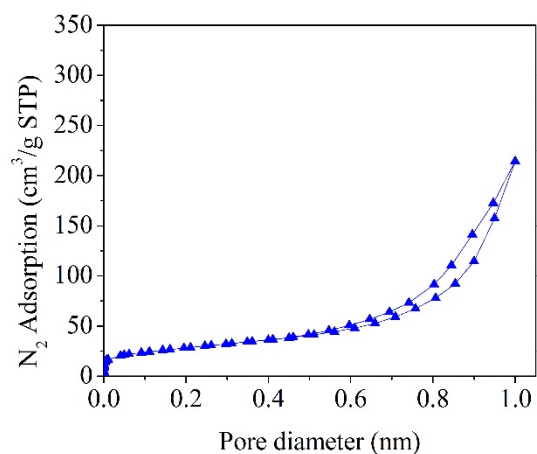


Fig. S4 N_2 nitrogen adsorption-desorption isotherms for CNTs

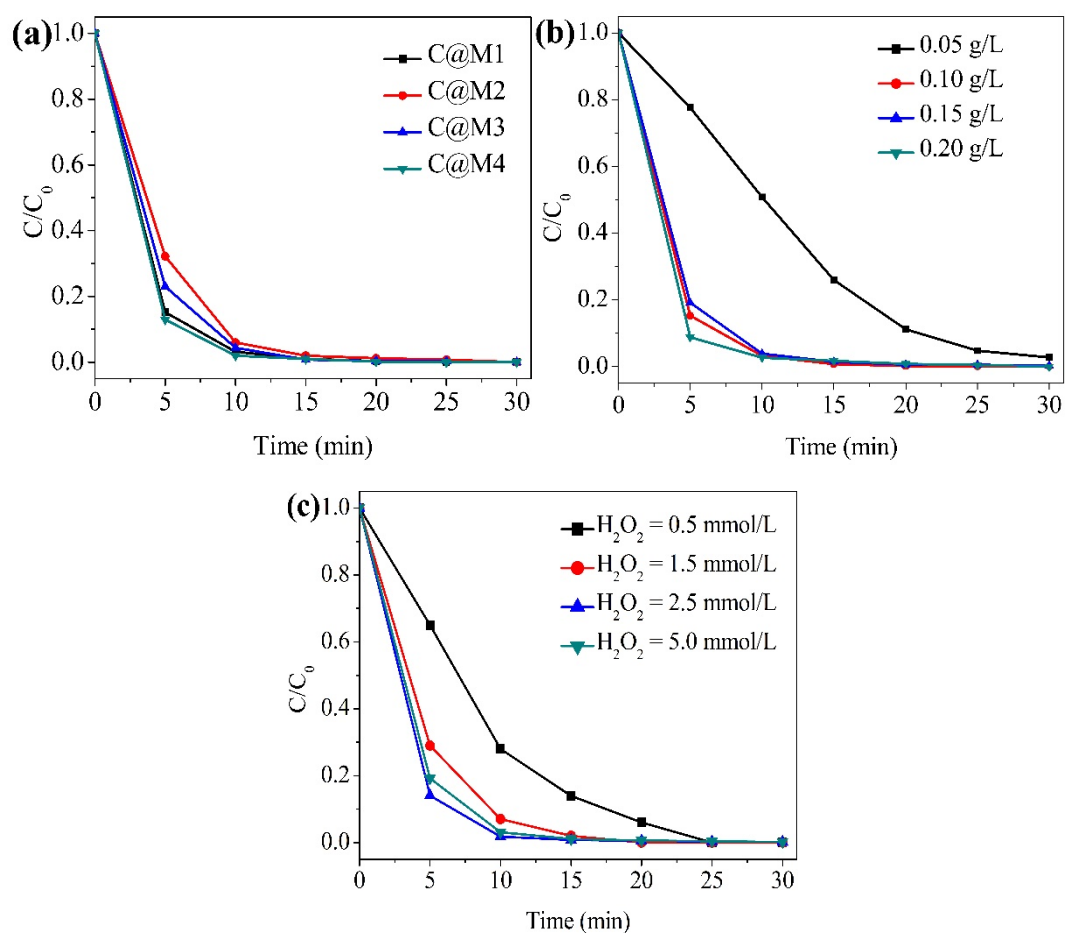


Fig. S5 Effect of (a) CNT loadings, (b) catalyst dosage, (c) H_2O_2 concentration on the catalytic degradation of phenol. Except for the investigated factors, other factors are fixed: [CNTs] = 26.23%, [catalyst] = 0.10 g/L, [H_2O_2] = 2.5 mmol/L, [phenol] = 25 mg/L, pH = 4.0, T = 25°C

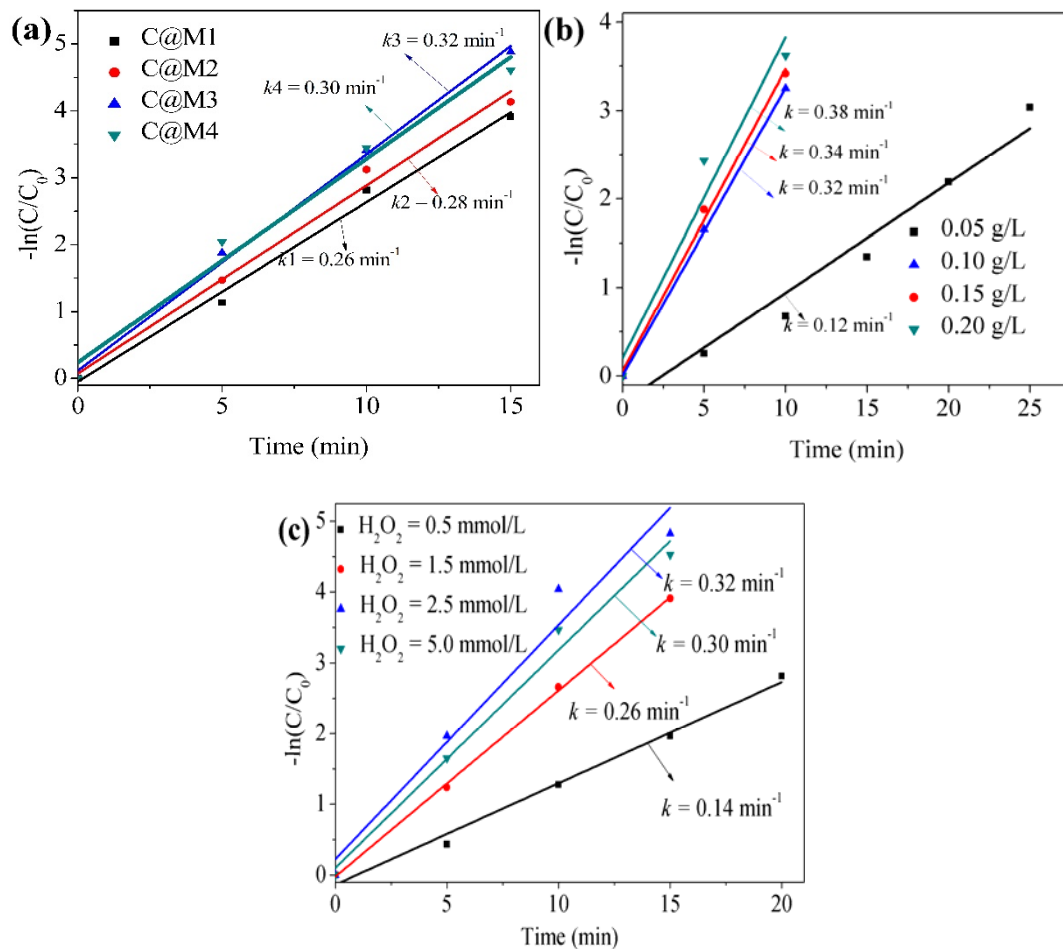


Fig. S6 The kinetics for degradation of phenol with different (a) CNT loadings, (b) catalyst dosage, and (c) H_2O_2 concentrations. Except for the investigated factors, other factors are fixed: $[\text{CNTs}] = 26.23\%$, $[\text{catalyst}] = 0.10 \text{ g/L}$, $[\text{H}_2\text{O}_2] = 2.5 \text{ mmol/L}$, $[\text{phenol}] = 25 \text{ mg/L}$, $\text{pH} = 4.0$, $T = 25^\circ\text{C}$

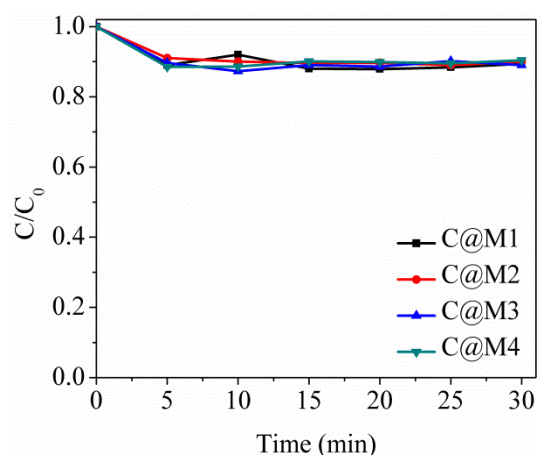


Fig. S7 The adsorption of the composites for phenol

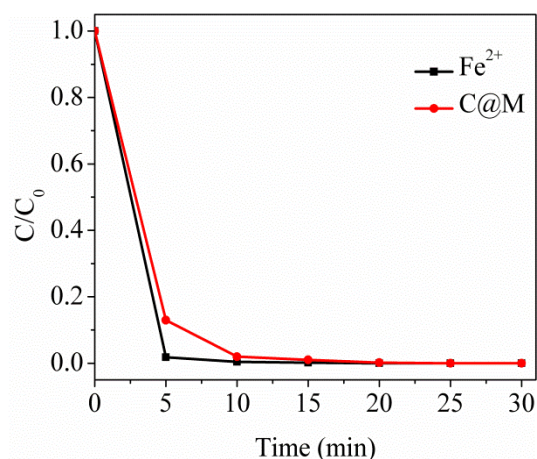


Fig. S8 Degradation of phenol by C@M and homogenous Fenton catalyst with the same Fe content. Reaction conditions: $[\text{H}_2\text{O}_2] = 2.5 \text{ mmol/L}$, $[\text{catalyst}] = 0.10 \text{ g/L}$, $[\text{pollutants}] = 25 \text{ mg/L}$, $\text{pH} = 6.3$ and $T = 25^\circ\text{C}$. Reaction conditions: $\text{pH} = 4$, $\text{H}_2\text{O}_2 = 2.5 \text{ mmol/L}$, $\text{phenol} = 25 \text{ mg/L}$ and $T = 25^\circ\text{C}$

Table S3 Comparison of the Fenton-Like catalytic activity between C@M and various heterogeneous Fenton catalysts reported in literature

Catalyst	Target pollutant	Reaction condition	Performance	Ref
CUS-MIL-100(Fe)	SMX(20 mg/L)	$\text{pH}=3$; catalyst: 0.5 g/L ; $[\text{H}_2\text{O}_2]$: 6.0 mmol/L ; $T: 25^\circ\text{C}$	100%(60 min)	(Tang and Wang, 2018)
CUS-MIL-100(Fe)	SMX(20 mg/L)	$\text{pH}=4$; catalyst: 0.5 g/L ; $[\text{H}_2\text{O}_2]$: 6.0 mmol/L ; $T: 25^\circ\text{C}$	98.4%(240 min)	(Tang and Wang, 2018)
$\text{BiFe}_{0.8}\text{Cu}_{0.2}\text{O}_3$	Phenol(10 mg/L)	$\text{pH}=4$; catalyst: 0.5 g/L ; $[\text{H}_2\text{O}_2]$: 25 mmol/L ; $T: 25^\circ\text{C}$	100%(120 min)	(Mao et al., 2018)
CuFeO_2	BPA(23 mg/L)	$\text{pH}=5.0$; catalyst: 1.0 g/L ; $[\text{H}_2\text{O}_2]$: 20 mmol/L ; $T: 30^\circ\text{C}$	100%(120 min)	(Zhang et al., 2014)
DCS Ns	BPA(23 mg/L)	$\text{pH}=7$; catalyst: 1.0 g/L ; $[\text{H}_2\text{O}_2]$: 10 mmol/L ; T : room temperature	100%(60 min)	(Lyu et al., 2016)
C@M	Phenol(25 mg/L)	$\text{pH}=4$; catalyst: 0.1 g/L ; $[\text{H}_2\text{O}_2]$: 2.5 mmol/L ; $T: 25^\circ\text{C}$	100%(10 min)	this
C@M	BPA/SMX/2, 4-DCP(25 mg/L)	$\text{pH}=4$; catalyst: 0.1 g/L ; $[\text{H}_2\text{O}_2]$: 2.5 mmol/L ; $T: 25^\circ\text{C}$	100%(30 min)	this

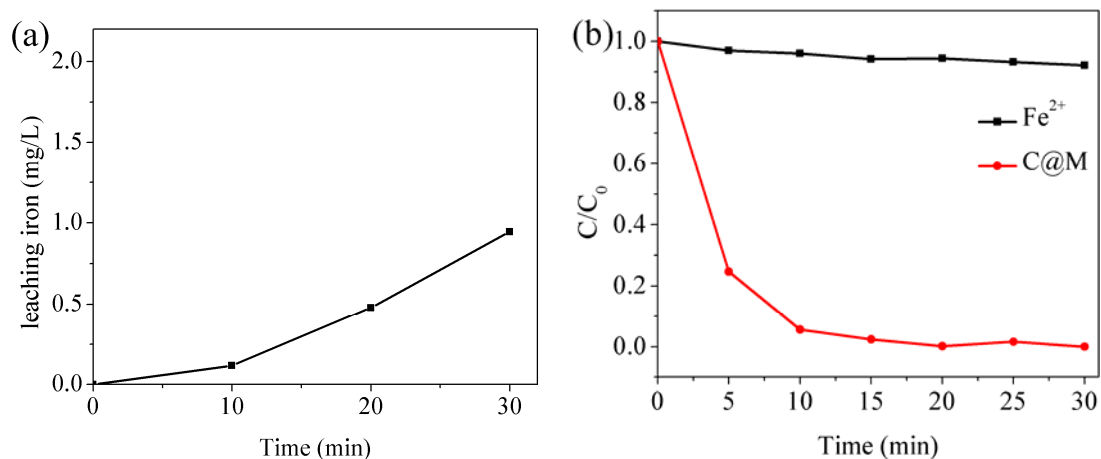


Fig. S9 (a) Variation of leaching iron ions concentration during reaction. Reaction conditions: [H₂O₂] = 2.5 mmol/L, [catalyst] = 0.10 g/L, [phenol] = 25 mg/L, and T = 25°C; (b) catalytic performance of leaching iron ions from C@M. Reaction conditions: pH = 4, H₂O₂ = 2.5 mmol/L, phenol = 25 mg/L and T = 25°C

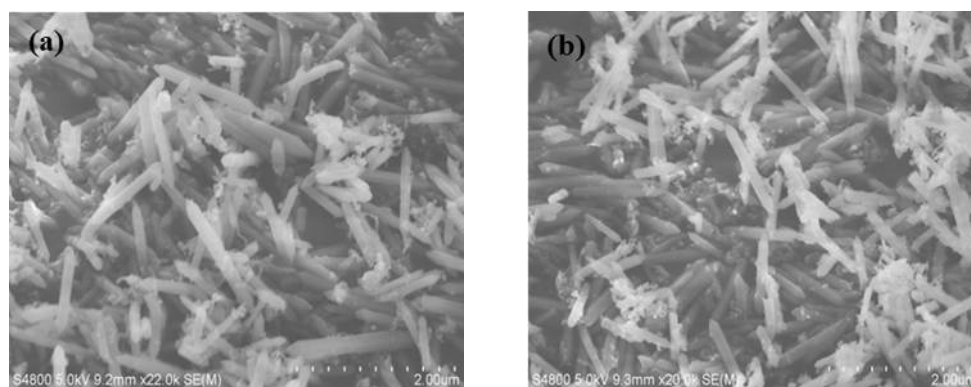


Fig. S10 SEM images of (a) fresh C@M and (b) used C@M

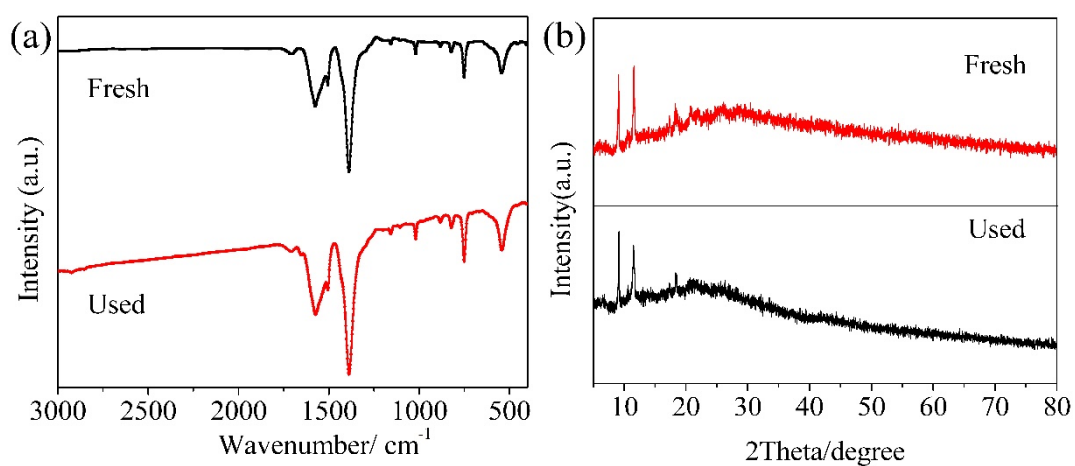


Fig. S11 (a) FT-IR spectra of fresh and used C@M; (b) XRD pattern of fresh and used C@M

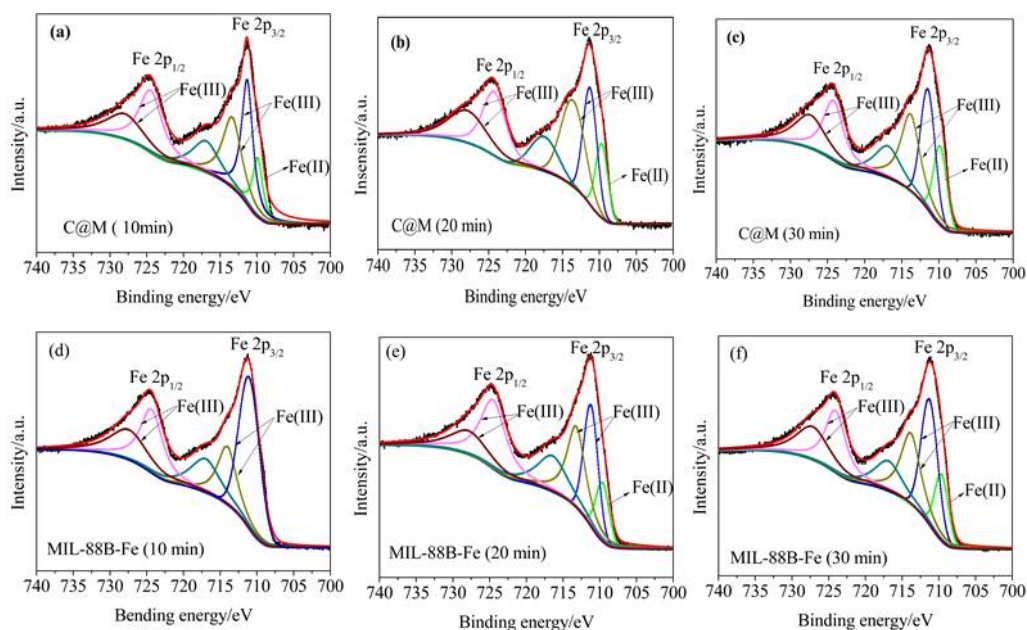


Fig. S12 Fe2p XPS survey spectra of C@M after reaction for (a) 10 min, (b) 20 min, and (c) 30 min; Fe 2p XPS survey spectra of MIL-88B-Fe after reaction for (d) 10 min (e) 20 min (f) 30 min

Table S4 Functional groups content resulting from curve fitting of C1s spectra (at.%)

Sample	Functional groups content			
	C-C/C=C	C-O	COOH	$\pi \rightarrow \pi^*$ shake-up
CNT (40°C)	70.5%	16.1%	4.0%	9.4%
CNT (60°C)	66.7%	19.0%	6.3%	7.8%
CNT (80°C)	59.0%	21.6%	8.0%	10.6%

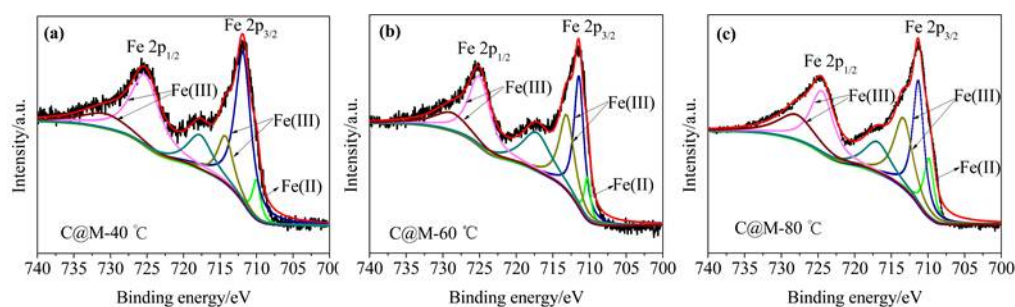
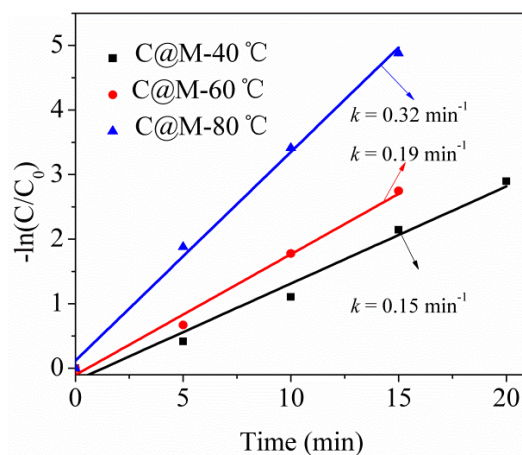


Fig. S13 Fe2p XPS survey spectra of C@M-40°C, C@M-60°C and C@M-80°C

Table S5 The Fe(II)/Fe(II)+Fe(III) ratio in different catalysts

Catalyst	Fe(II)/Fe(II)+Fe(III) ratio
C@M-40°C	3.6%
C@M-60°C	5.2%
C@M-80°C	9.0%

**Fig. S14** The kinetics of C@M-40°C, C@M-60°C and C@M-80°C. Reaction Conditions: pH = 4, $[\text{H}_2\text{O}_2] = 2.5$ mmol/L, [catalyst] = 0.10 g/L, [phenol] = 25 mg/L, and T = 25°C

References

Lyu L, Zhang L, Hu C, Yang M (2016). Enhanced Fenton-catalytic efficiency by highly accessible active sites on dandelion-like copper-aluminum-silica nanospheres for water purification. *Journal of Materials Chemistry A*, 4(22): 8610–8619

Mao J, Quan X, Wang J, Gao C, Chen S, Yu H T, Zhao Y B (2018). Enhanced heterogeneous Fenton-like activity by Cu-doped BiFeO_3 perovskite for degradation of organic pollutants. *Frontiers of Environmental Science & Engineering*, 12(6): 10

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Zhang X Y, Ding Y B, Tang H Q, Han X Y, Zhu L H, Wang N (2014). Degradation of bisphenol A by hydrogen peroxide activated with CuFeO_2 microparticles as a heterogeneous Fenton-like catalyst: Efficiency, stability and mechanism. *Chemical Engineering Journal*, 236(15): 251–262