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Appendix A Supplementary data

Preparation of $Fe/CuFe_2O_4$ embedded in porous carbon composites for removal of tetracycline from aqueous solution

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Text S1.Synthesis process of two precursors and FC materials

Fe-MOF was prepared by a simple solvothermal method. Firstly，1 mol of $FeCl_3$•6 H_2O (2.70g) was dissolved in 15 mL N,N-dimethylformamide (DMF) solution, and then 15 mL DMF solution containing 5 mmol H_2BDC (0.830 g) was gradually added under ultrasonic mixed thoroughly for 20 min. The precursor solution was transferred into a 100 mL Teflon-lined stainless- steel autoclave and place it in the temperature controlled oven at 110 degree celsius for 24 h. After the temperature was cooled to room temperature, the resulting precipitates were collected by centrifugation, washed by ethanol and deionized water three times and dried under vacuum at 65 degree celsius for 12 h.Fe-MOF is the precursor material of Fe-MOF@C. Fe-MOF@C nanocomposite was prepared by annealing the sample powder in a tube furnace at 700 degree celsius in flowing N_2 for 2 h (heating rate: 5 degree celsius min^{-1}).The preparation process of Fe-Cu-MOF as the precursor material of FCC is shown in **Fig. 1**.

Text S2. FCC/PS System Adaptation Experiment

The degradation of sulfamethoxazole (SMX) by FCC/PS system was studied to further explore the general applicability of FCC nanocatalyst to other antibiotics. A series of experimental results showed that the degradation rate of SMX by FCC/PS system reached about 99% in 60 minutes when the dosage of FCC nano-catalyst was 0.2g/L, the dosage of PS was 1mmol/L, the initial concentration of SMX was 10mg/L, and the pH value of solution was neutral.See **Fig. S6**. for details.

Text S3. TOC analysis

The total organic carbon (TOC) of tetracycline (TC) before and after advanced oxidative degradation was measured using a TOC-L analyzer (TOC-L cph , shimadzu, China) in order to investigate the mineralization efficiency. The mineralization efficiency of TC was calculated using the following equation:

$$\text{Mineralization efficiency (\%)} = (1 - TOC_t / TOC_0) \times 100\%$$

where TOC_0 and TOC_t are the TOC values of the target TC in samples solution before degradation and at the degradation time t, respectively.

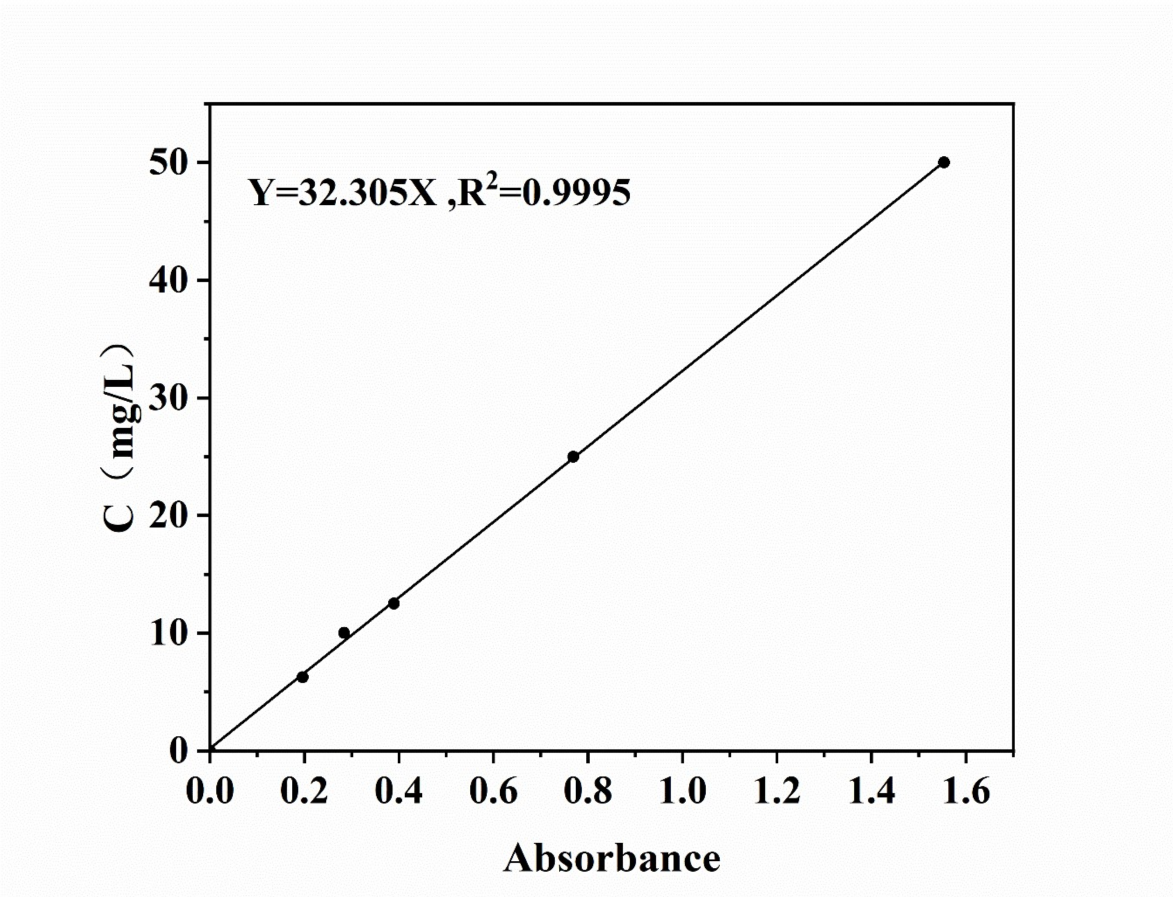

Figure S1 The corresponding calibration curve of TC (6.25, 10. 0, 12.5, 25.0, and 50.0 mg/L, respectively).

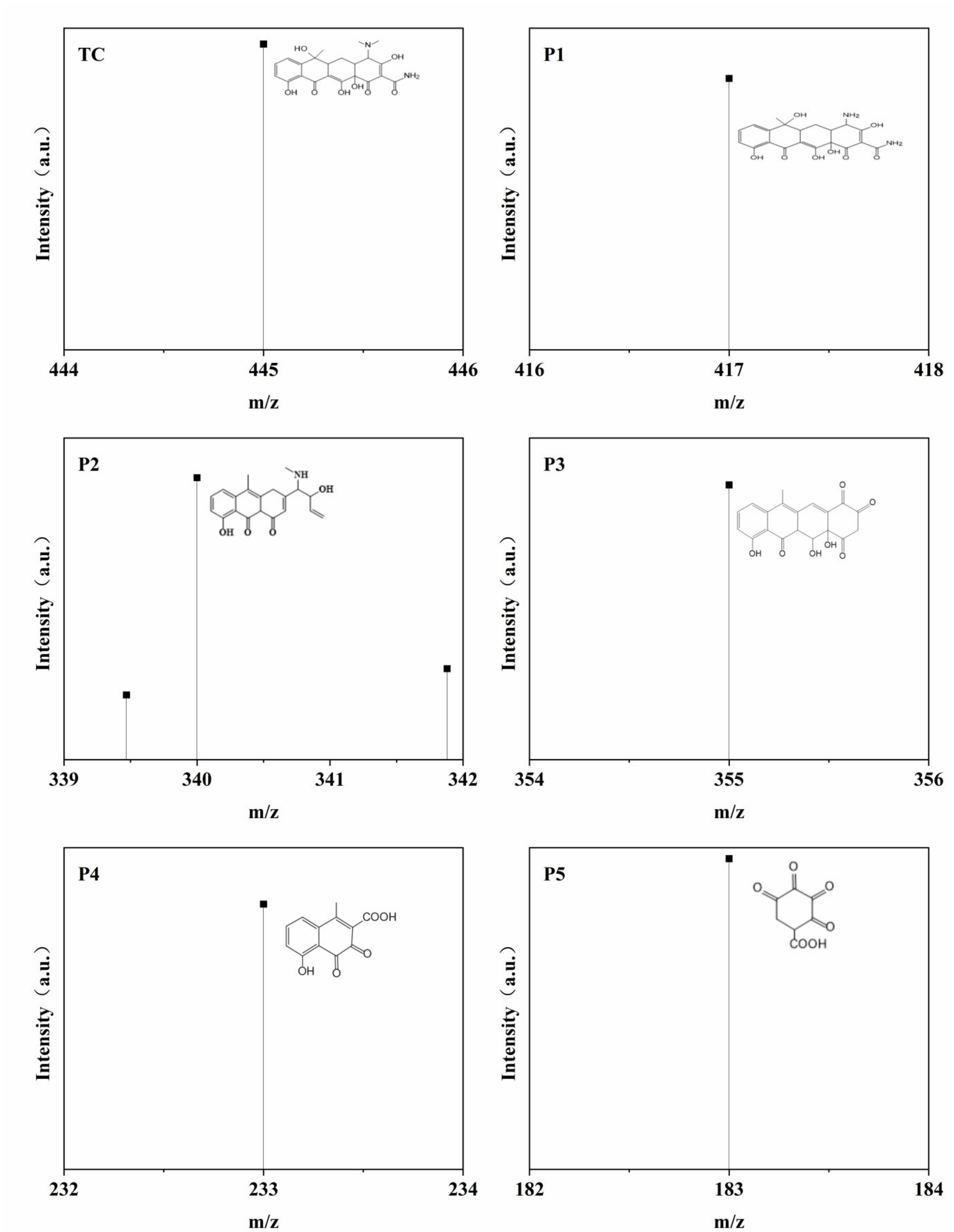

Figure S2 Typical MS fragments (m/z) of main intermediates detected by LC-MS during TC advanced oxidation degradation.

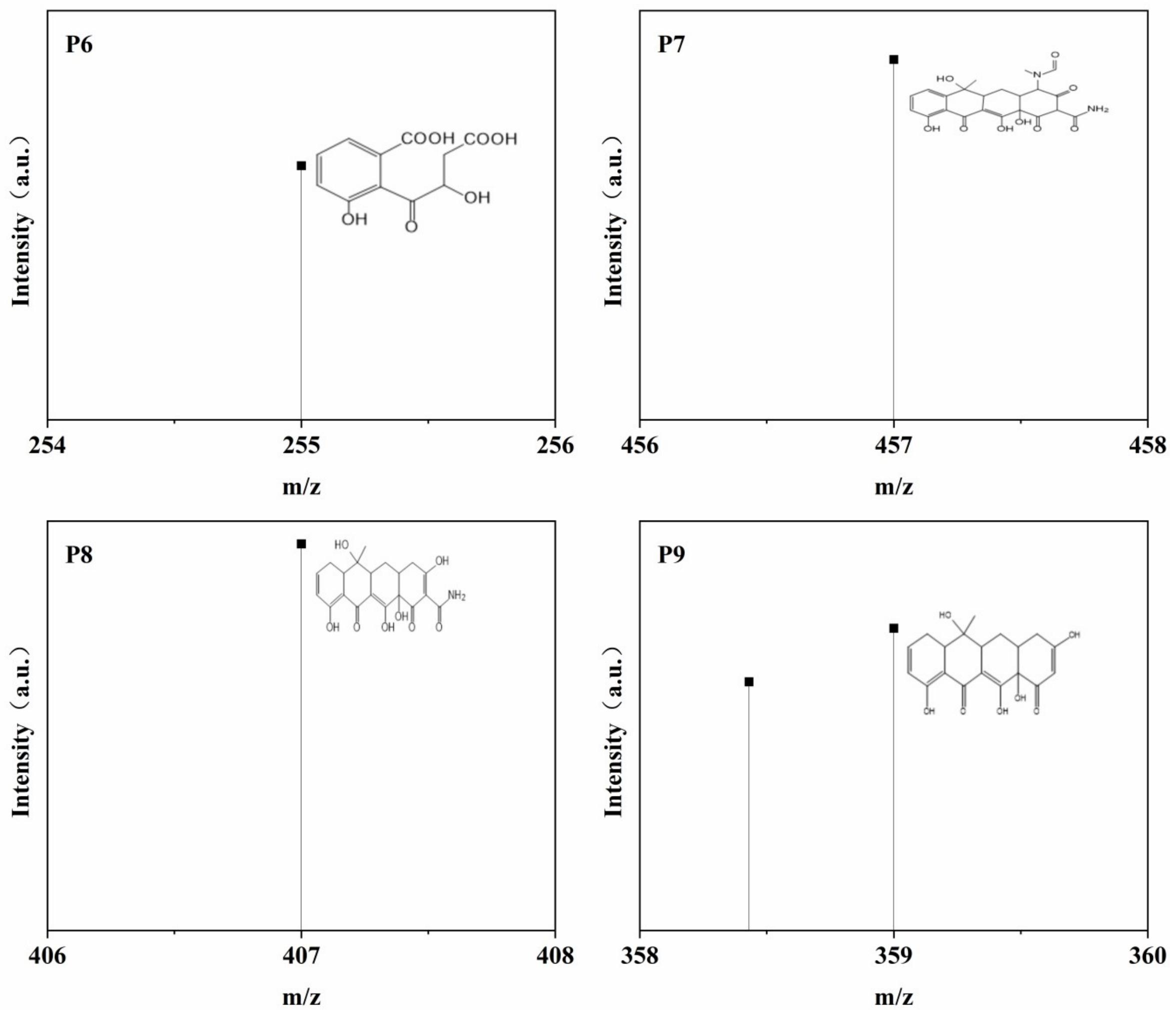

Figure S3 Typical MS fragments (m/z) of main intermediates detected by LC-MS during TC advanced oxidation degradation.

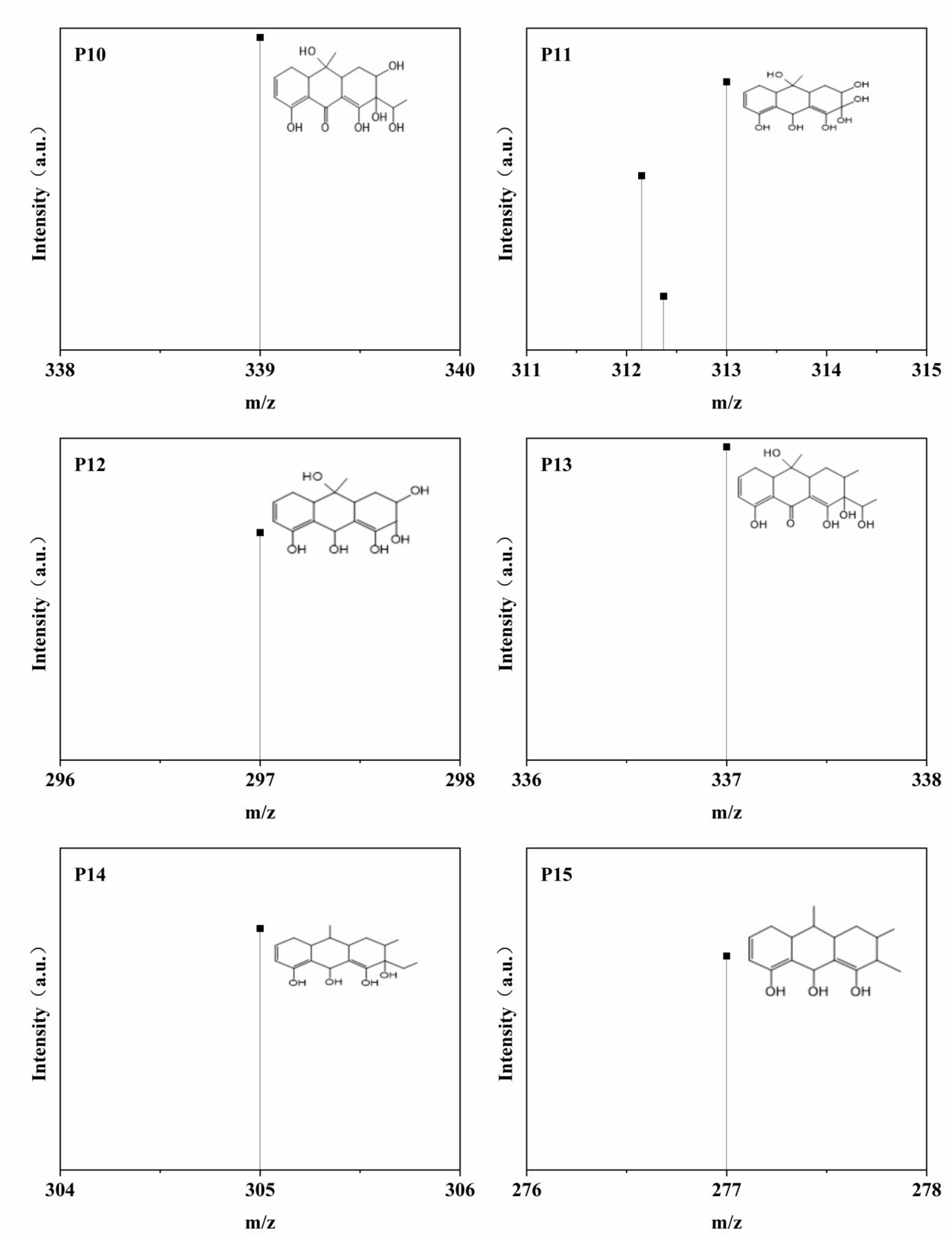

Figure S4 Typical MS fragments (m/z) of main intermediates detected by LC-MS during TC advanced oxidation degradation.

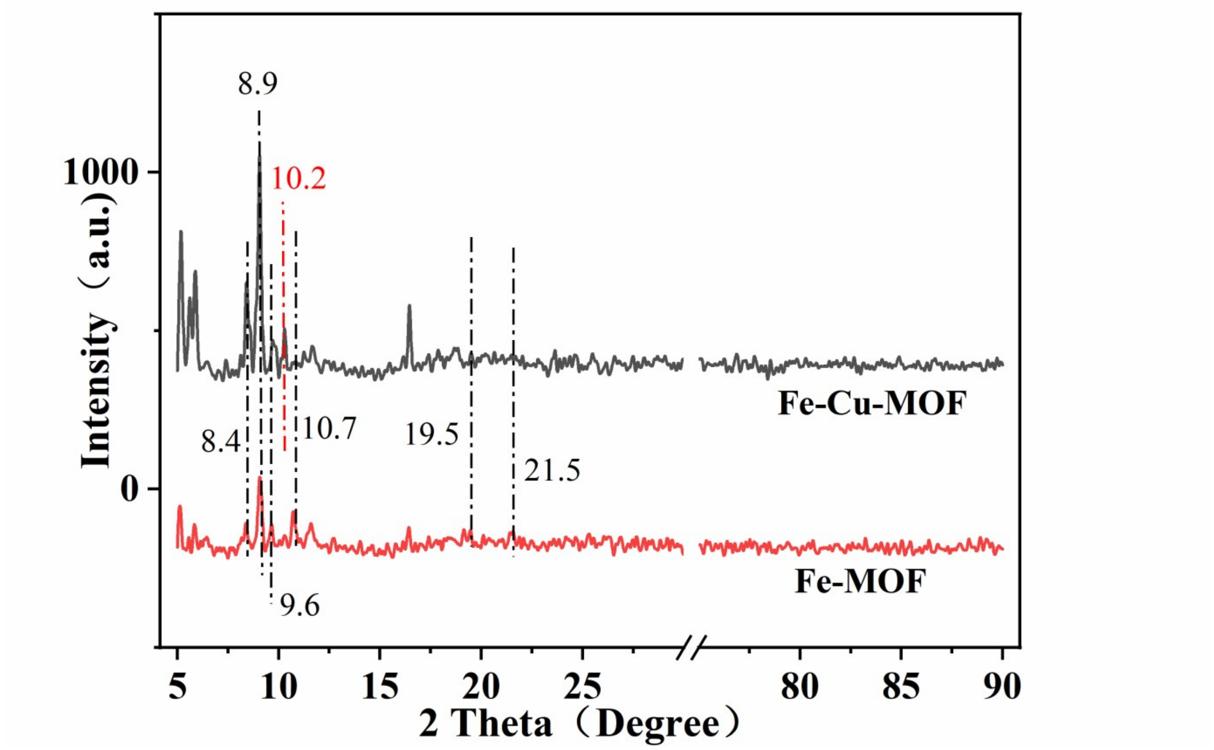

Figure S5 Amplified XRD pattern of Fe-MOF and Fe-Cu-MOF.

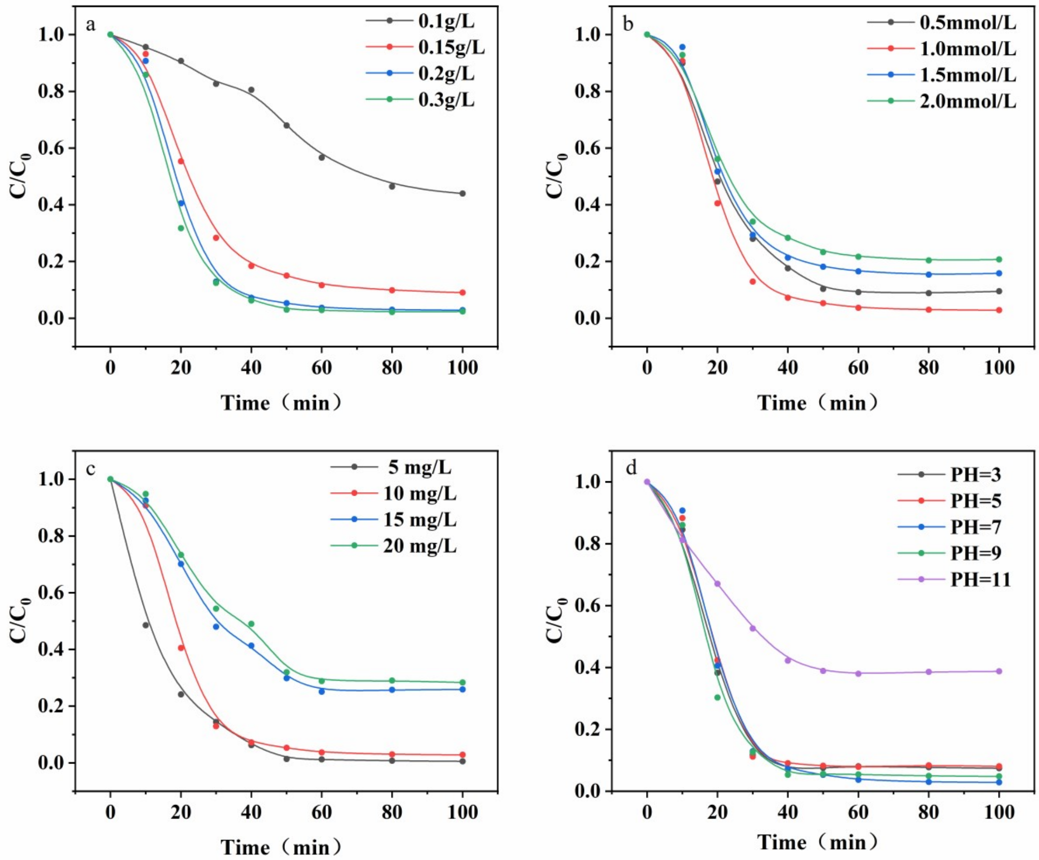

Figure S6 (a) Effect of catalyst dosage on the SMX removal by FCC (initial pH = 7.0, [PS] = 1 mmol/L, [SMX] = 10 mg/L, temperature = 25 ◦C). (b) Effect of PS concentration on the SMX removal by FCC (initial pH = 7.0, [catalyst dosage] = 0.2 g/L, [SMX] = 10 mg/L, temperature = 25 ◦C). (c) Effect of SMX concentration on the SMX removal by FCC (initial pH =7.0, [catalyst dosage] = 0.2 g/L, [PS] = 1 mmol/L, temperature = 25 ◦C). (d) Effect of pH on the SMX removal by FCC (initial [catalyst dosage] = 0.2 g/L, [PS] = 1 mmol/L, [SMX] = 10 mg/L, temperature = 25 ◦C). (e) Effect of inorganic ions on the SMX removal by FCC (initial pH = 7.0, [PS] = 1 mmol/L, [SMX] = 10 mg/L, temperature = 25 ◦C, [catalyst dosage] = 0.2 g/L).

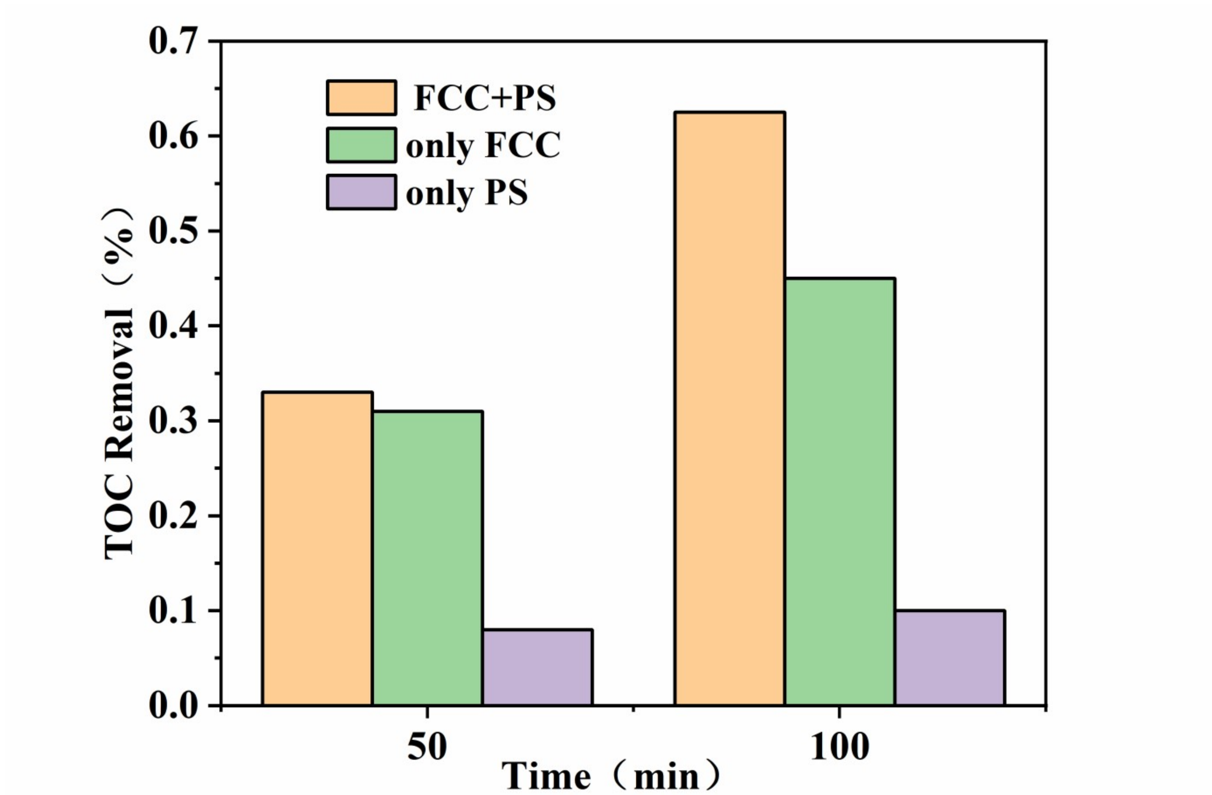

Fig. S7. Removal efficiency of TOC after advanced oxidative degradation of TC in FCC/PS system.

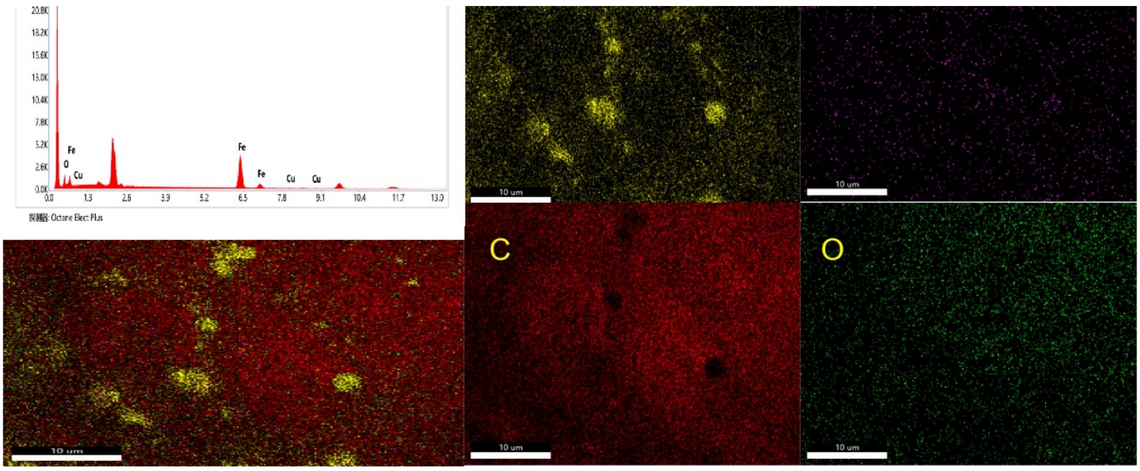

Fig. S8. EDAX and elemental mapping images of Fe, Cu, C, O in-plane

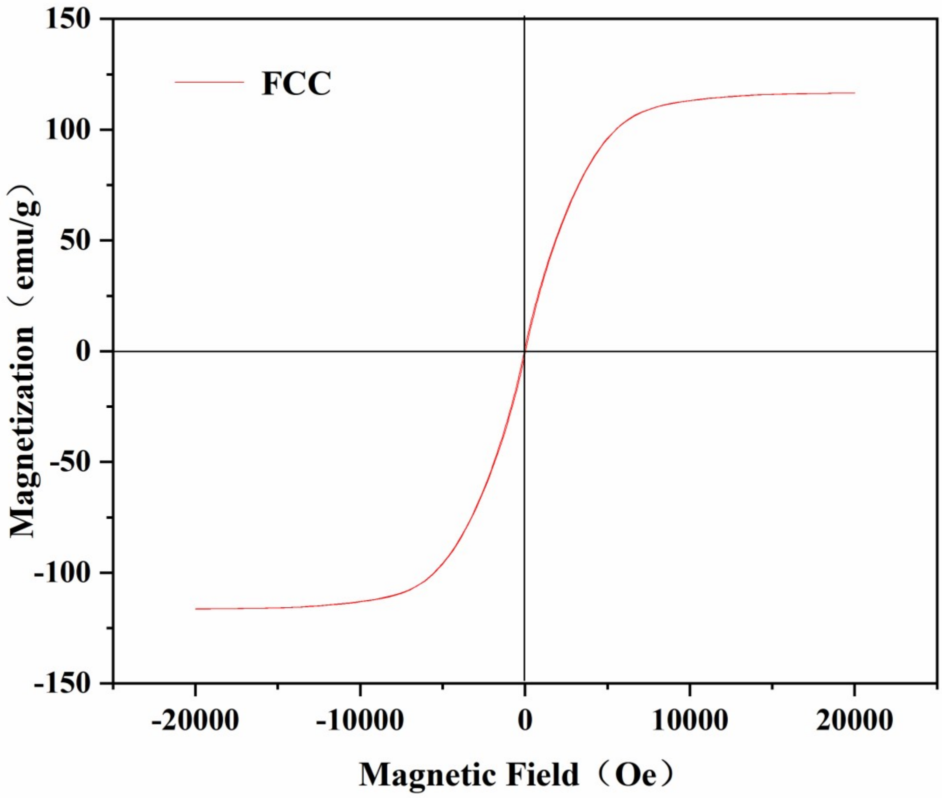

Fig. S9. The hysteresis curve of FCC.

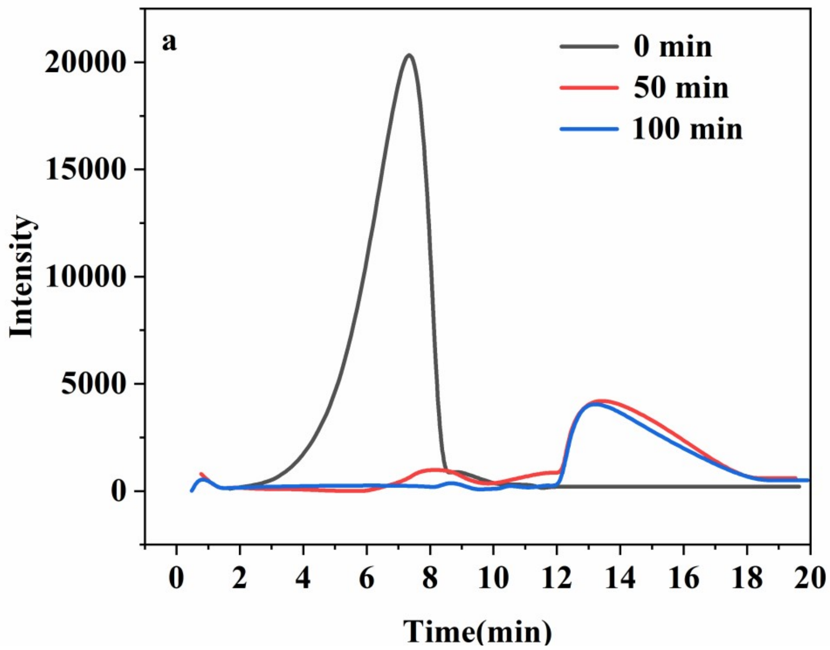

Fig. S10. Typical HPLC-UV chromatography of TC degraded by FCC/PS system (0, 50, 100min).

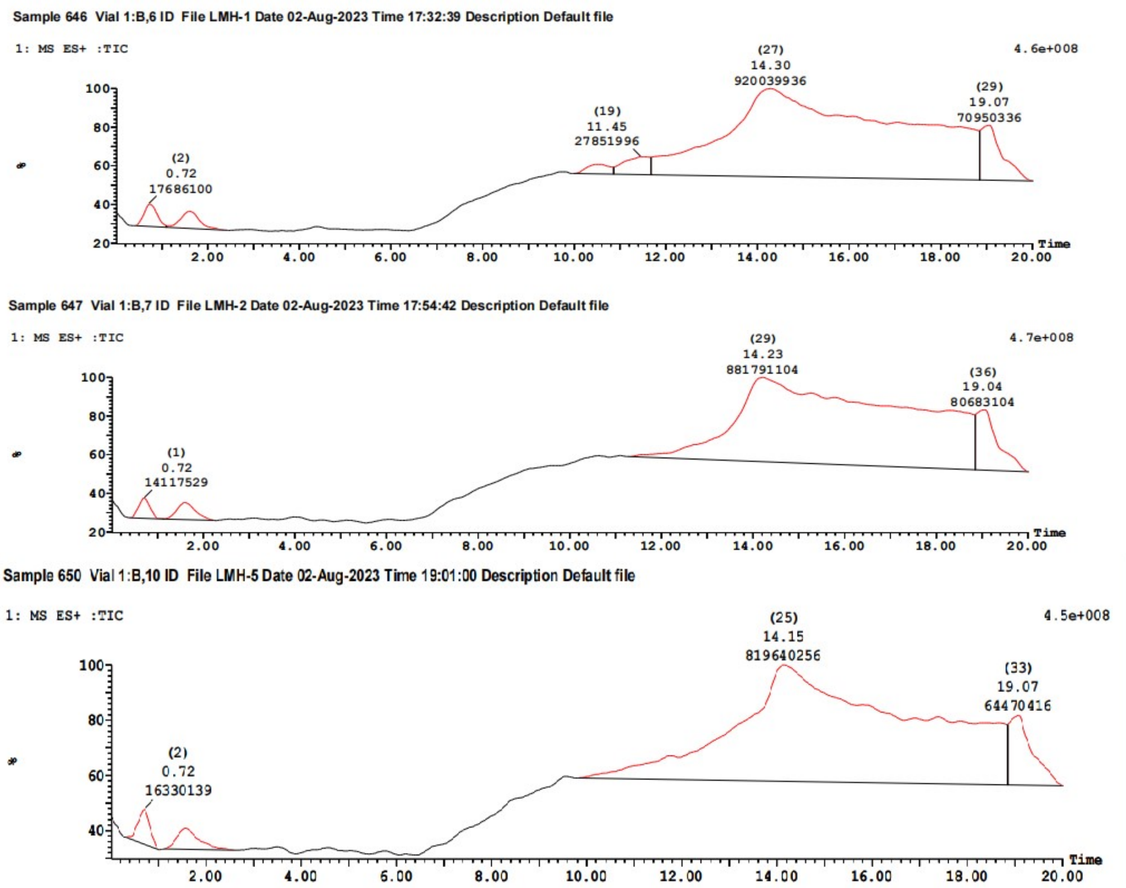

Fig. S11. TIC chromatogram of TC degraded by FCC/PS system.

Table S1 Comparison of the fabricated MOF-derived FCC with the other reported materials for removal of pollutants

Materials	Pollutant (mg/L)	Time (min)	Products	Removal efficiency	Referencev
FCC	TC (50)	100	CO_2 H_2O	98%	This work
KPCN/GO/$ZnFe_2O_4$	RhB (10) TC (35)	90 120	CO_2 H_2O	96% 87%	[1]
OSGCN	SMX (10)	60	CO_2 H_2O	99%	[2]
BiOCl/$Bi_{12}O_{17}Cl_2$	BPA (10) TCH (10)	240	CO_2 H_2O	73. 3% 62. 5%	[3]
WO_3/$Bi_{12}O_{17}Cl_2$	TCH (20)	60	CO_2 H_2O	94%	[4]
WO_3/$Bi_{24}O_{31}Cl_{10}$	TCH (35)	60	CO_2 H_2O	80%	[5]

Table S2 Comparison of the fabricated MOF-derived FCC with the other reported materials for removal of pollutants

Materials	Surface Area (m^2/g)	IUPAC classification	Referencev
FCC	167.51	IV curve	This work
GCN/$CuFe_2O_4$/SiO_2	192.42	IV curve	[6]
CdS@MoS 2 –5%	17.35	IV curve	[7]
BiOIO3/BiOBr	3.40	IV curve	[8]
EG-CuFe2O4-U	34.99	IV curve	[9]

References

1. R. Kumar, A. Sudhaik, Sonu, P. Raizada, V.-H. Nguyen, Q. Van Le, T. Ahamad, S. Thakur, C. M. Hussain and P. Singh, Chemosphere, 2023, 337, 139267.
2. V. Hasija, P. Singh, S. Thakur, V.-H. Nguyen, Q. Van Le, T. Ahamad, S. M. Alshehri, P. Raizada, B. M. Matsagar and K. C. W. Wu, Chemosphere, 2023, 320, 138015.
3. L. Hao, H. Huang, Y. Guo, X. Du and Y. Zhang, Appl Surf Sci, 2017, 420, 303-312.
4. J. Zheng, F. Chang, M. Jiao, Q. Xu, B. Deng and X. Hu, J Colloid Interf Sci, 2018, 510, 20-31.
5. C.-Y. Wang, X. Zhang, X.-N. Song, W.-K. Wang and H.-Q. Yu, Acs Appl Mater Inter, 2016, 8, 5320-5326.
6. Sonu, V. Dutta, A. Sudhaik, A. A. P. Khan, T. Ahamad, P. Raizada, S. Thakur, A. M. Asiri and P. Singh, Materials Research Bulletin, 2023, 164, 112238.
7. K. Sharma, A. Kumar, T. Ahamad, Q. V. Le, P. Raizada, A. Singh, L. H. Nguyen, S. Thakur, V.-H. Nguyen and P. Singh, Journal of Materials Science & Technology, 2023, 152, 50-64.
8. X. Kuang, M. Fu, H. Kang, P. Lu, J. Bai, Y. Yang and S. Gao, Optical Materials, 2023, 138, 113690.
9. S. Liu, Y. Liu, M. Chen, L. Li, W. Tu and Z. Huang, Chem Eng J, 2022, 433, 133516.