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Fig. S2 The signal intensity of DMPO-OH by EPR.

Table S1 Characteristics of soil materials for the preparation of active Fe-SOM and Fe-SOM.

Properties	S1 for active Fe-SOM	S2 for Fe-SOM
Component of soil organic matter	humic acid-like and related to hydrophobic acids	aromatic protein and soluble microbial by- product-like
Soil organic Matter (%)	3.75 ± 0.13	4.65 ± 0.16
Humic acid (%)	0.71 ± 0.03	1.27 ± 0.05
Sand (%)	29.28	4.84
Silt (%)	64.92	79.35
Clay (%)	5.28	18.81
pH	7.85	7.32
Easy exchangeable iron (mg/kg)	13.5 ± 0.4	49.8 ± 1.6
Iron carbonates (mg/kg)	22.6 ± 0.7	91.7 ± 3.1
Iron oxides (mg/kg)	2823.1 ± 97.4	2967.7 ± 114.2
Organic iron (mg/kg)	2071.3 ± 76.5	1068.5 ± 36.8
Total iron (mg/kg)	4930.4 ± 153.2	4177.6 ± 134.5

Values are given as mean ± standard error (3 replicates).

Table S2 Analysis of the Fe-SOM content in soil samples.

Samples	Exchangeable iron (mg/kg)	Carbonate binding iron (mg/kg)	Fe oxides (mg/kg)	Organic Fe (mg/kg)	Total Fe (mg/kg)	Fe-SOM oxides (mg/kg)	Organic Fe-SOM (mg/kg)	Fe-SOM (mg/kg)
S1 (without SOM before transfer)	8.8	5.6	358.5	40.7	413.7	-	-	-
S1 (without SOM after transfer)	10.4	12.6	482.4	56.2	561.7	-	-	-
S1(with SOM before transfer)	13.5	22.6	2823.1	2071.3	4930.4	-	-	-
S1(0%HA)	16.4	35.6	3254.3	2463.5	5769.8	307.3	376.7	684.0
S1(2%HA)	21.5	54.7	3743.4	2786.0	6605.6	796.4	699.0	1495.4
S1(5%HA)	93.0	173.9	3750.7	3047.9	7065.5	803.7	960.9	1764.6
S1(10%HA)	125.7	95.1	3454.2	3494.8	7169.8	507.2	1407.8	1915.0
S2 (without SOM before transfer)	7.3	2.9	266.5	54.1	330.8	-	-	-
S2 (without SOM after transfer)	17.7	16.1	363.5	65.2	462.5	-	-	-
S2(with SOM before transfer)	49.8	91.7	2967.7	1068.5	4177.6	-	-	-
S2(0%HA)	75.2	124.9	3248.0	1459.5	4907.5	183.3	379.9	563.2
S2(2%HA)	159.6	266.0	3620.3	1850.6	5896.5	555.6	771.0	1326.6
S2(5%HA)	147.4	392.9	4151.7	2107.8	6799.8	1087.0	1028.2	2115.2
S2(10%HA)	131.0	327.4	4636.0	2778.3	7872.7	1571.3	1698.7	3270.0

Notes: Fe-SOM oxides = the oxidation of iron content (including the inherent SOM iron transfer) - oxidation of iron content (including the inherent SOM blank) - [oxidation of iron content (excluding natural SOM blank iron after transfer) - oxidation of iron content (does not contain the inherent in SOM blank)] (1)

Organic Fe-SOM = organic bound iron content (including natural SOM iron transfer) - organic bound iron content (including inherent SOM blank) - [organic bound iron content (excluding intrinsic SOM blank iron transfer) - organic combination state iron content (excluding inherent SOM blank)] (2)

Fe-SOM = (Fe-SOM oxides) + (Organic Fe-SOM) (3)

Table S3 X-ray photoelectron spectroscopy (XPS) analysis in the soil samples

Peak	Position (eV)	FWHM (eV)	Active Fe-SOM Area					Fe-SOM Area				
			0 (control)	684 mg/kg	1495 mg/kg	1765 mg/kg	1915 mg/kg	0 (control)	563 mg/kg	1327 mg/kg	2115 mg/kg	3270 mg/kg
0	708.3 (FeO)	1.5	0	159.6	18.6	0	0	84.9	0.1	0	0	0
1	709.8 (Fe ₃ O ₄)	1.5	117.0	196.3	23.8	0	39.1	181.5	4.0	0	32.1	0
2	710.6 (Fe ₂ O ₃)	1.5	48.3	196.7	44.0	49.8	0	74.9	38.5	5.0	29.4	0
3	711.6 (FeOOH)	1.8	469.7	508.4	381.7	214.4	221.1	477.4	221.5	470.8	389.2	412.1
4	713.1 (α -FeOOH)	1.8	304.0	402.3	486.0	490.7	570.9	502.2	362.0	183.3	197.1	404.8
5	713.6 (γ -FeOOH)	2.7	132.2	133.2	250.7	329.7	425.6	132.7	212.4	137.2	277.1	250.8

Table S4 The characteristics of producing $\bullet$ OH and removal of TPH

Type	Concentration (mg/kg)	$\bullet$ OH properties		Low concentration of TPH		High concentration of TPH	
		Yield of $\bullet$ OH(a.u.)	Ability of producing $\bullet$ OH(a.u. $\bullet$ OH/g $\cdot$ kg ⁻¹ Fe-SOM)	Removal rate (%)	Removal ability (g TPH/g Fe-SOM)	Removal rate (%)	Removal ability (g TPH/g Fe-SOM)
Active Fe-SOM (S1)	0 (control)	1.67	/	5.0	/	3.1	/
	684	2.32	3.39	36.1	7.7	32.1	8.7
	1495	4.57	3.06	48.1	4.7	47.4	5.9
	1765	5.99	3.39	58.2	4.8	56.6	5.9
	1915	8.92	4.66	66.0	5.0	65.1	6.3
Fe-SOM (S2)	0 (control)	1.26	/	2.5	/	2.4	/
	563	1.69	2.99	20.5	5.3	20.0	6.5
	1327	3.32	2.50	29.7	3.3	32.5	4.5
	2115	4.81	2.27	44.4	3.1	47.4	3.8
	3270	5.40	1.65	50.6	2.6	48.9	2.8

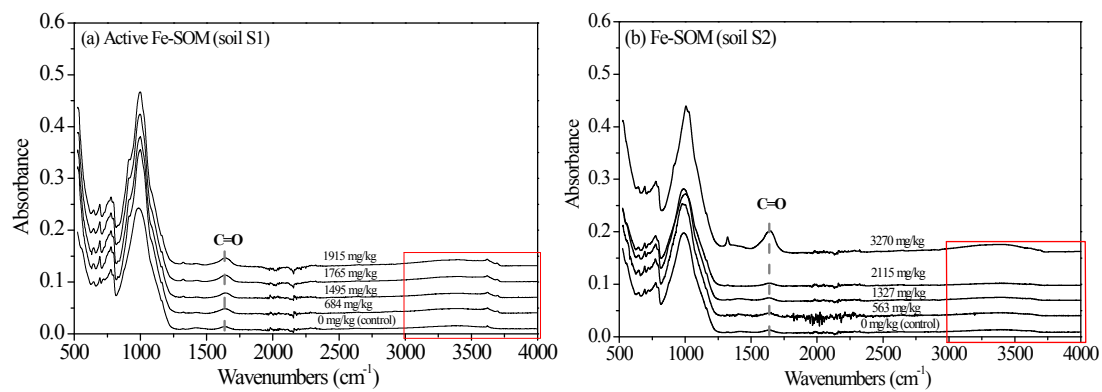


Fig. S1 Fourier transformation infrared spectrum analysis (FTIR) in the soil samples with (a) Active Fe-SOM (S1) and (b) Fe-SOM (S2).

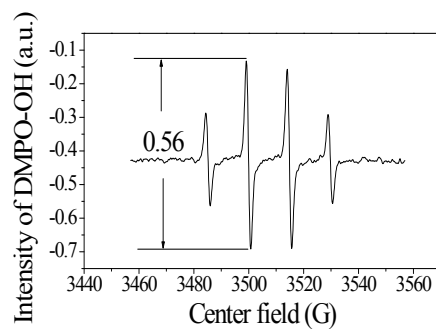


Fig. S2 The signal intensity of DMPO-OH by EPR.