Supporting information for

Hydrophilic and strengthened 3D reduced graphene oxide/nano-Fe_3O_4 hybrid hydrogel for enhanced adsorption and catalytic oxidation of typical pharmaceuticals

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Table S1 Kinetic parameters for the adsorption of CIP and TC on 3D-rGO/Fe_3O_4

Adsorbate	Pseudo second-order parameter			
	k (g/(μmol·h))	q_e (μmol/g)	v_0 (μmol/(g·h))	R^2
CIP	0.00026	546.3	77.6	0.979
TC	0.00031	556.7	96.1	0.962

Table S2 Calculated parameter values of the Langmuir model for CIP and TC adsorption on 3D-rGO/Fe_3O_4, 3D-rGO, GO, rGO and EG in the whole concentration range

Adsorbents	Adsorbates	Langmuir model [a]		
		b (L/μmol)	q_m (mmol/g)	R^2
3D-rGO/Fe_3O_4	CIP	0.005	2.78	0.933
	TC	0.007	4.76	0.989
3D-rGO	CIP	0.018	0.95	0.794
	TC	0.028	0.98	0.983
GO	CIP	3.285	0.52	0.689
	TC	0.142	0.61	0.912
rGO	CIP	7.664	0.21	0.994
	TC	0.316	0.12	0.561
EG	CIP	0.219	0.07	0.880
	TC	0.137	0.08	0.688

[a] $q_e = q_m C_e/(1/b+C_e)$

Table S3 Calculated parameter values of the Langmuir model for CIP and TC adsorption on 3D-rGO/Fe_3O_4, 3D-rGO, GO, rGO and EG at equilibrium concentrations below 100 μmol/L

Adsorbents	Adsorbates	Langmuir model [a]		
		b (L/μmol)	q_m (μmol/g)	R^2
3D-rGO/Fe_3O_4	CIP	0.116	842.9	0.781
	TC	0.022	1891.6	0.994
3D-rGO	CIP	0.065	596.3	0.937
	TC	0.097	623.8	0.991
GO	CIP	1.599	567.6	0.861
	TC	0.168	557.2	0.973
rGO	CIP	6.178	237.6	0.965
	TC	0.439	115.2	0.913
EG	CIP	0.221	71.2	0.826
	TC	0.143	73.7	0.599

[a] $q_e = q_m C_e/(1/b+C_e)$

Table S4 Surface area and pore volume of 3D-rGO/Fe_3O_4, 3D-rGO, GO, rGO and EG

Sample	Specific surface area (m^2/g) [a]	Total pore volume (cm^3/g) [b]
3D-rGO/Fe_3O_4	66.8	0.285
3D-rGO	55.8	0.214
GO	15.0	0.017
rGO	24.1	0.011
EG	123.2	0.097

[a] The specific surface area was calculated by the BET method.

[b] The pore volume was calculated by the DFT method.

Table S5 Specific surface area and pore volume of different activated carbons

Parameters	AC-1	AAC	CAC	AC-2
SSA (m^2/g) [a]	930.5	761.3	545.9	323.7
Pore volume (cm^3/g) [b]	0.597	0.496	0.353	0.353

[a] The specific surface area was calculated by the BET method.

[b] The pore volume was calculated by the DFT method.

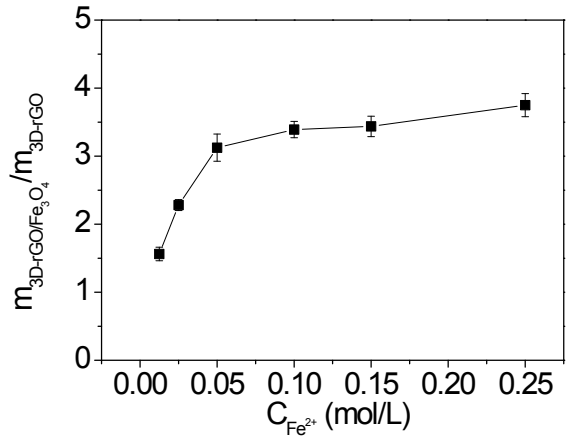

Fig. S1 Mass ratios of 3D-rGO/Fe_3O_4 to 3D-rGO prepared at different concentrations of Fe^{2+}.

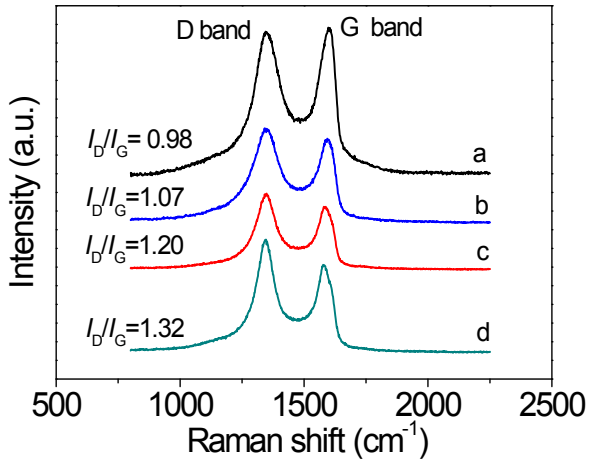

Fig. S2 Raman spectra of GO (a) and 3D-rGO/Fe_3O_4 prepared by 0.0125 (b), 0.05 (c) and 0.25 mol/L Fe^{2+}(d).

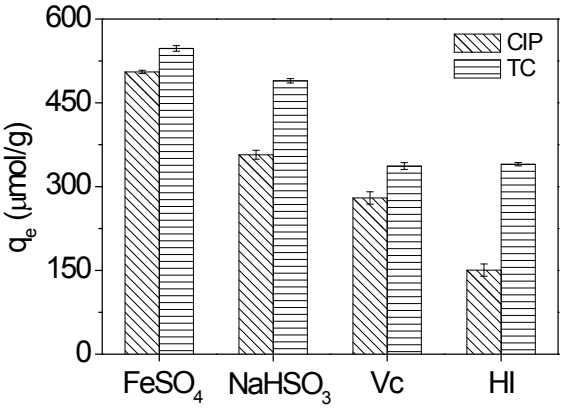

Fig. S3 Adsorption of CIP and TC on the hydrogels prepared by different reductants.

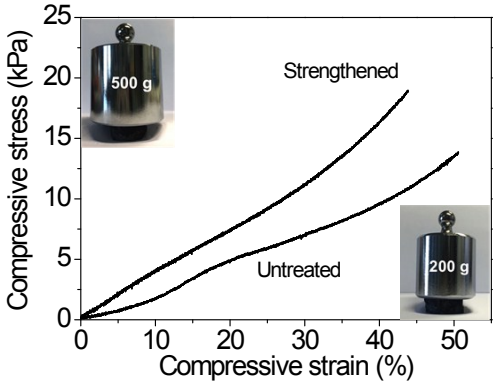

Fig. S4 Strain-stress curves of untreated and strengthened 3D-rGO/Fe_3O_4 before and after drying for 1 h.

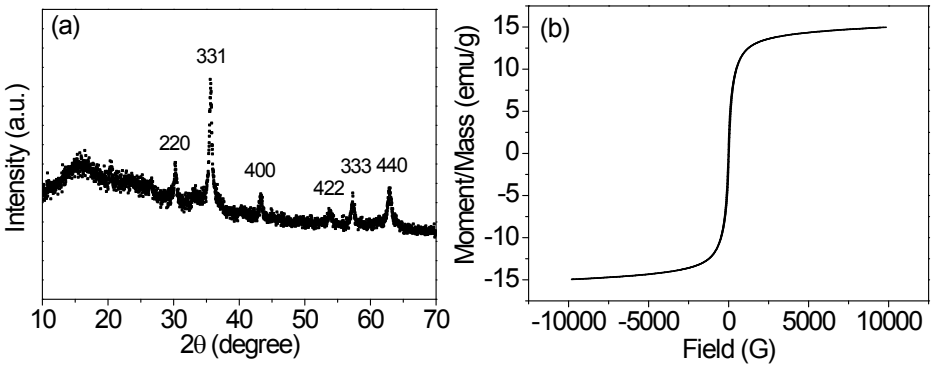

Fig. S5 XRD pattern (a) and hysteresis curve (b) of 3D-rGO/Fe_3O_4.

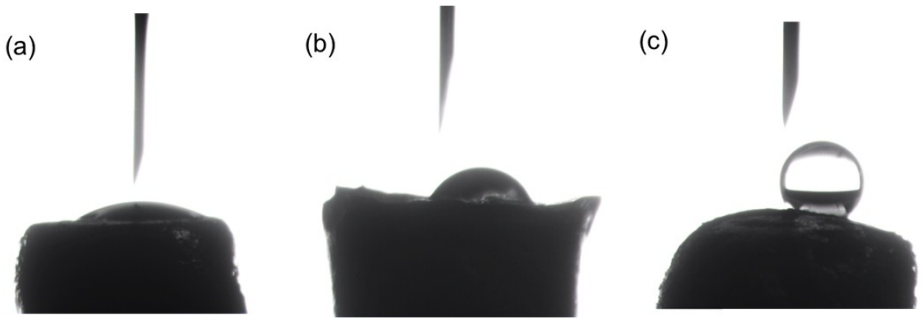

Fig. S6 Contact angles of 3D-rGO/Fe_3O_4 (a), 3D-rGO (reduced by $NaHSO_3$) (b) and corresponding freeze-dried 3D-rGO (c).

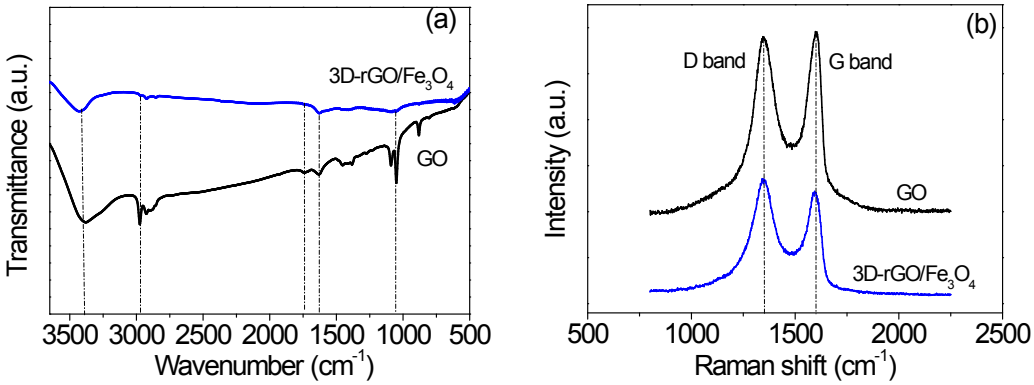

Fig. S7 FTIR (a) and Raman spectra (b) of GO and 3D-rGO/Fe_3O_4.

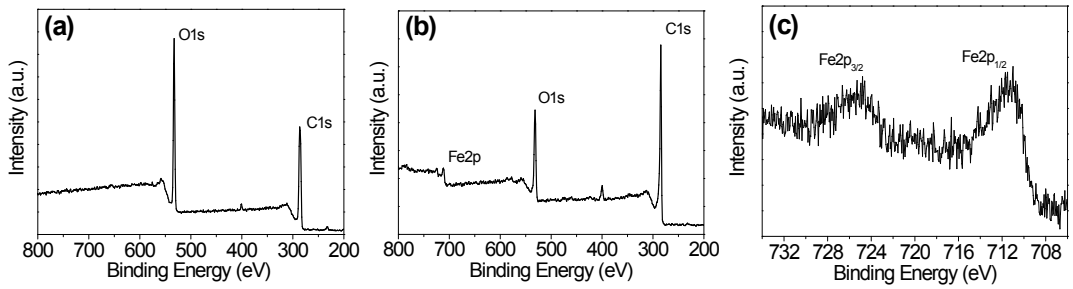

Fig. S8 XPS spectra of GO (a), 3D-rGO/Fe_3O_4 (b) and core-level Fe2p spectrum of 3D-rGO/Fe_3O_4.

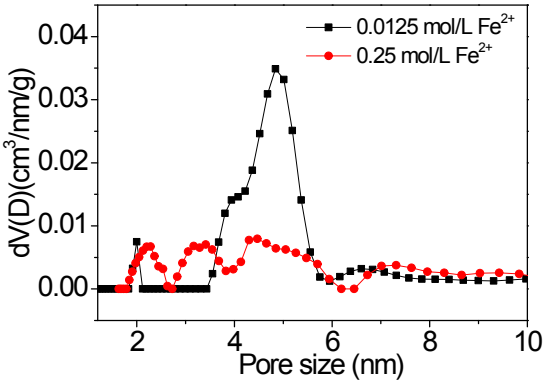

Fig. S9 Pore size distributions of 3D-rGO/Fe_3O_4 prepared at 0.0125 and 0.25 mol/L Fe^{2+} after 1 h heating.

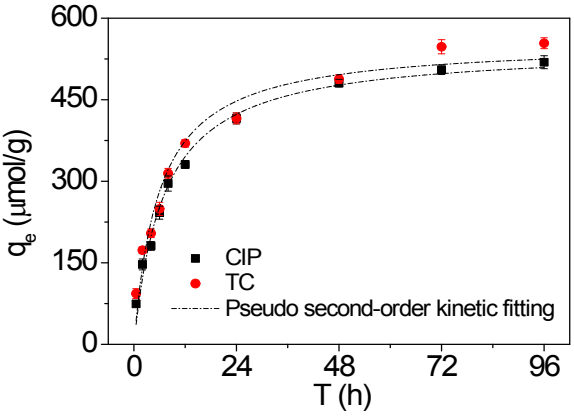

Fig. S10 Adsorption kinetics of CIP and TC on 3D-rGO/Fe_3O_4.

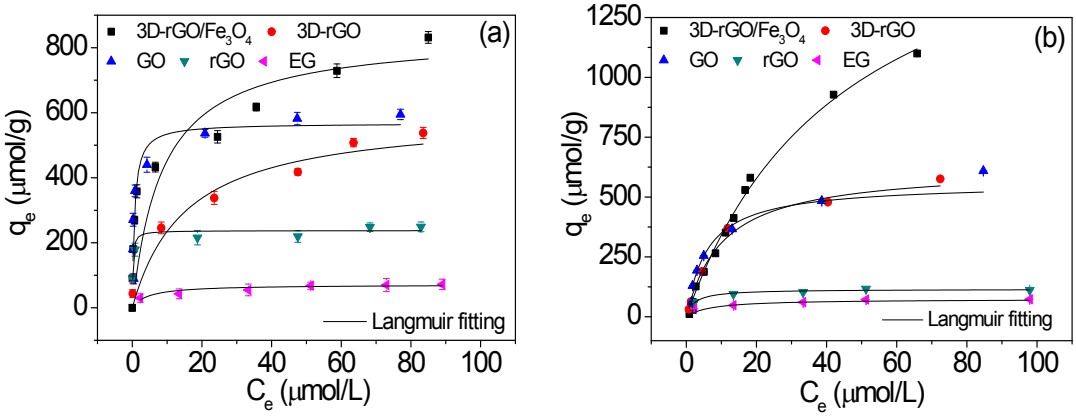

Fig. S11 Adsorption isotherms of CIP (a) and TC (b) on 3D-rGO/Fe_3O_4, 3D-rGO, GO, rGO and EG at the equilibrium concentrations below 100 μmol/L.

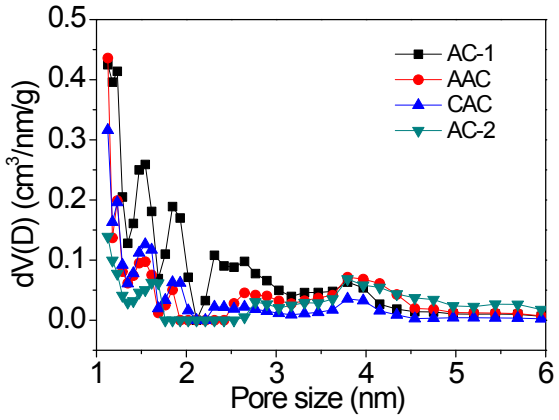

Fig. S12 Pore size distribution of different ACs.

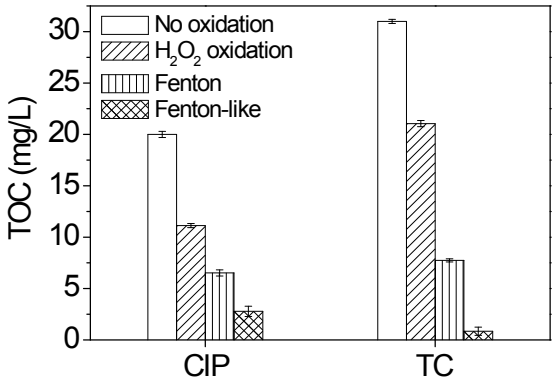

Fig. S13 TOC concentrations in CIP and TC solutions by Fenton-like (after adsorption), Fenton and H_2O_2 oxidation for 4 h.

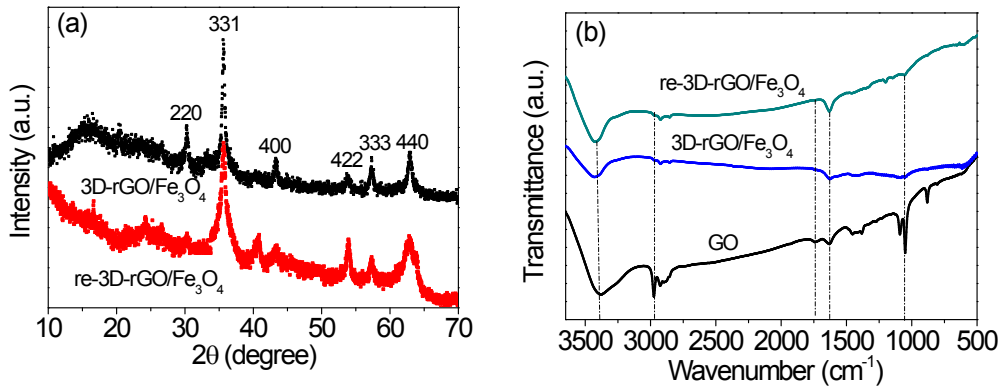

Fig. S14 XRD patterns of 3D-rGO/Fe_3O_4 and re-3D-rGO/Fe_3O_4 (a), as well as FTIR spectra of GO, 3D-rGO/Fe_3O_4 and re-3D-rGO/Fe_3O_4 (b).

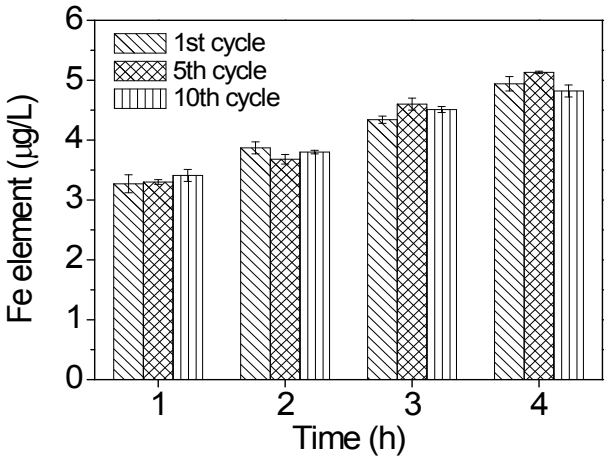

Fig. S15 Concentration of Fe in solution in the Fenton-like regeneration process.