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Facile synthesis of a highly effective g-C_3N_4-based catalyst for advanced oxidative degradation of organic pollutants

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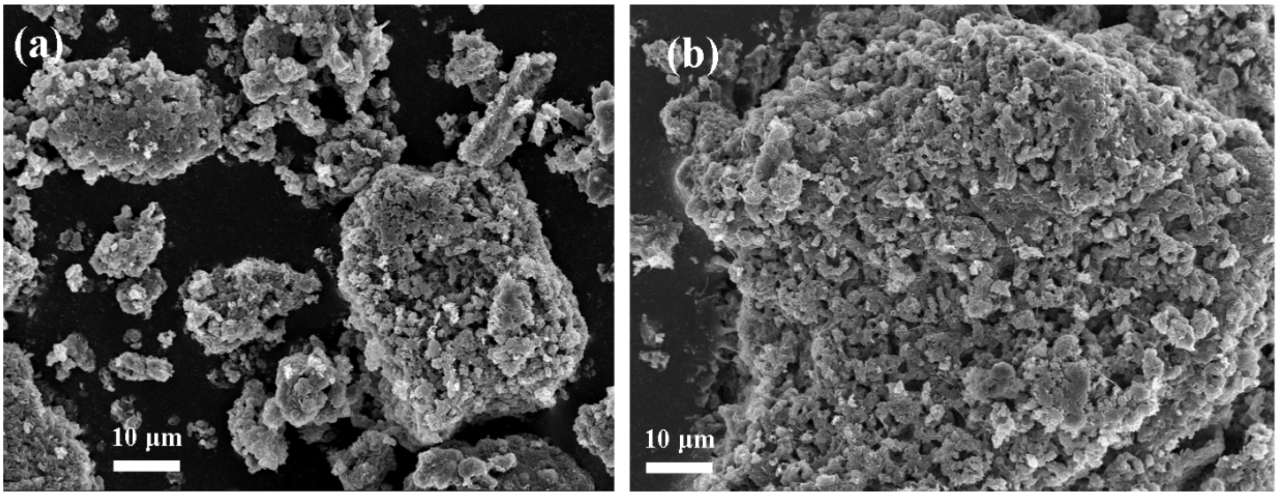

Fig. S1. SEM images of (a) Fe-C_3N_4 and (b) Mn-C_3N_4.

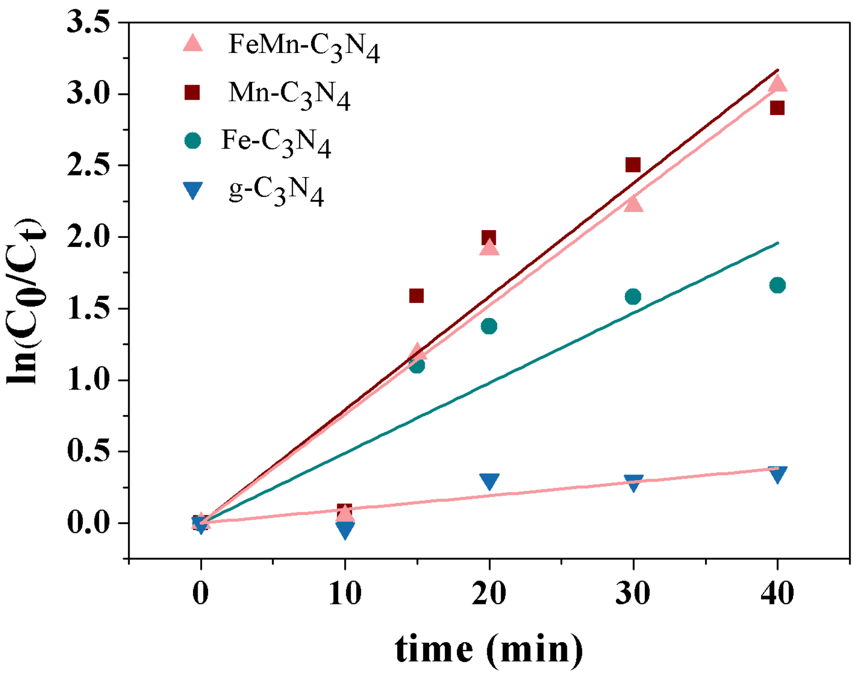

Fig. S2. The Pseudo-first order kinetic curves of degradation of RhB by persulfate activation.

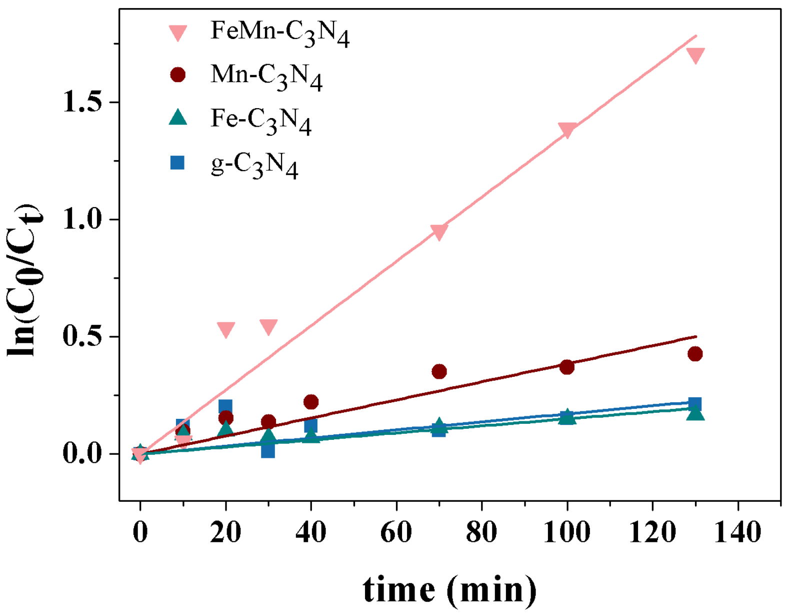

Fig. S3. The Pseudo-first order kinetic curves of degradation of RhB via Fenton reaction catalyzed by $FeMn\text{-}C_3N_4$ and the corresponding control materials ($Mn\text{-}C_3N_4$, $Fe\text{-}C_3N_4$ and $g\text{-}C_3N_4$).

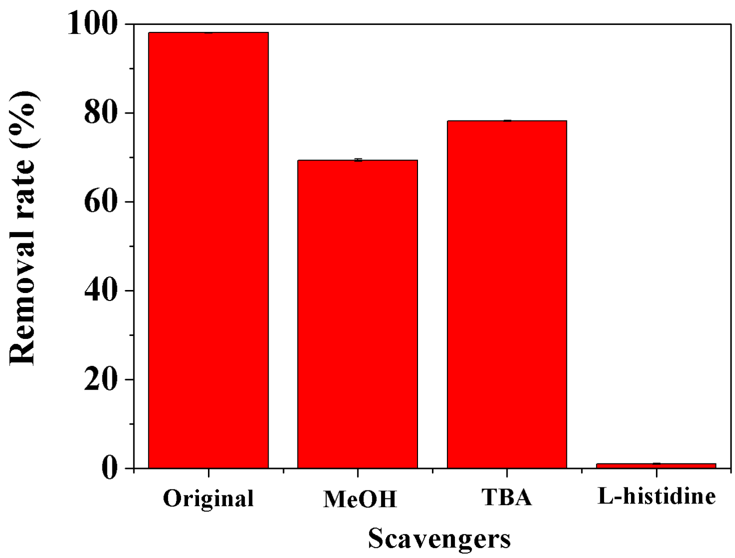

Fig. S4. The catalytic activity of $FeMn\text{-}C_3N_4$/PMS system for removing RhB (in %) in the presence of different scavengers (MeOH or methanol, which is used to quench $SO_4^{\cdot-}$ and ·OH; TBA or *tert*-butyl alcohol, which is used to quench ·OH; and *L*-histidine, which is used to quench $^1O_2$). The one in absence of quenching agents (denoted Orginal) is also included for comparison.

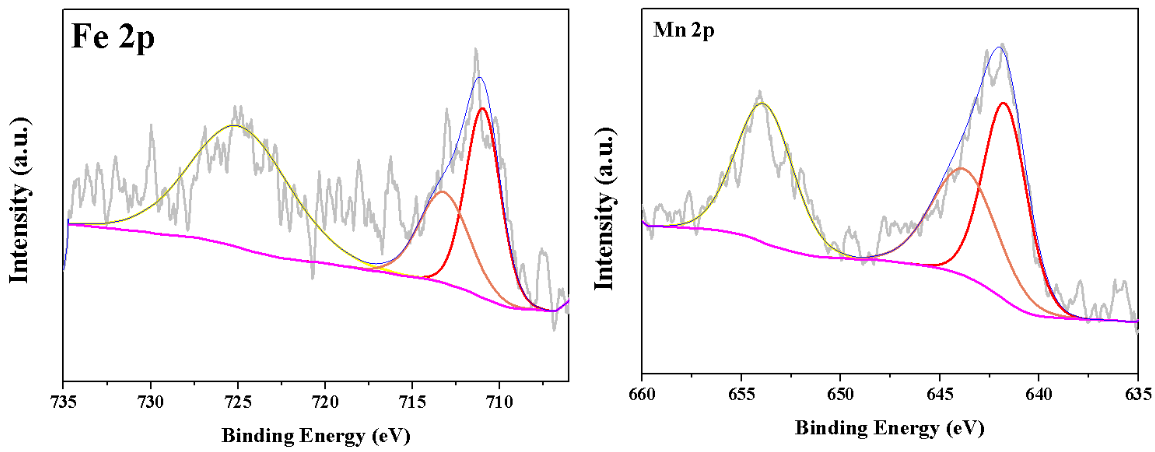

Fig. S5. XPS spectra of peaks associated with (a) Fe 2p and (b) Mn 2p in FeMn-C_3N_4/PMS after it is used persulfate activation reaction.

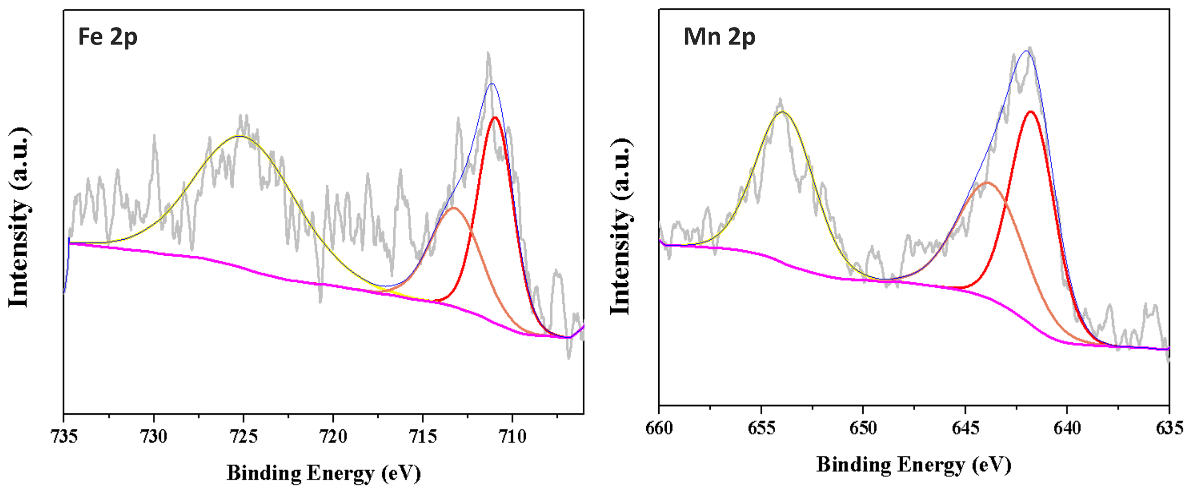

Fig. S6. XPS spectra of peaks associated with (a) Fe 2p and (b) Mn 2p in FeMn-C_3N_4/H_2O_2 after it is used in Fenton reaction.

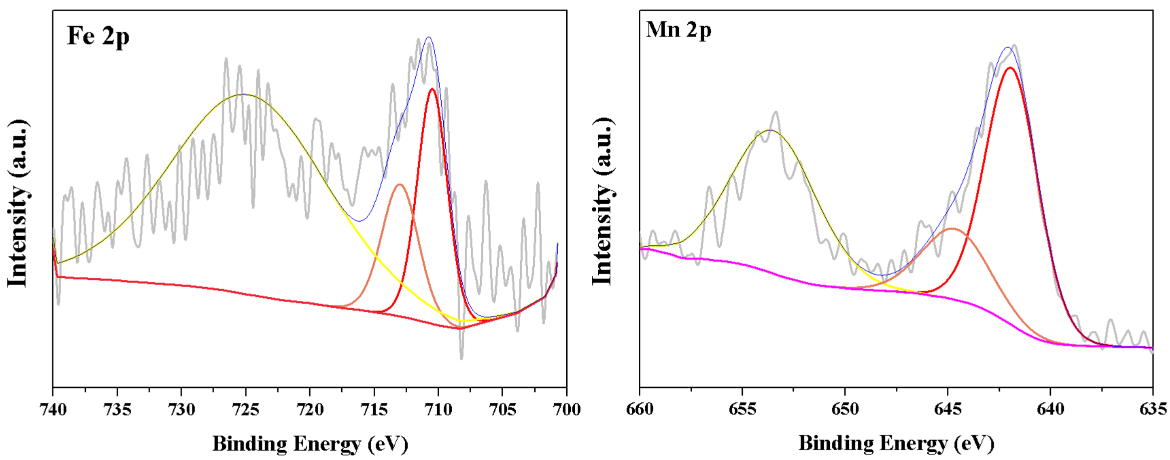

Fig. S7. XPS spectra of peaks associated with (a) Fe 2p and (b) Mn 2p in FeMn-C_3N_4 after it is used visible-light photocatalytic reaction.

Table S1. The kinetic parameters (K_1, 10^{-3} min^{-1}) of persulfate (PMS) activation, heterogeneous Fenton reaction and photocatalysis as catalyzed by the different C_3N_4-based materials studied.

Samples and Reactions	C_3N_4	Fe-C_3N_4	Mn-C_3N_4	FeMn-C_3N_4
Activation of PMS	9.55	48.97	79.21	76.05
Fenton-like reaction	1.72	1.50	3.85	13.70
Visible-light photocatalytic test	4.92	12.30	4.42	10.80

Table S2. Comparison of the catalytic performance of FeMn-C_3N_4 in the Fenton-like reaction to degrade different compounds with respect to those of different heterogeneous and solid catalysts reported in the literature for the same reaction.

Heterogeneous Catalysts	Reaction Type	Removal Efficiency	Experimental conditions	References
γ-Fe_2O_3/Mn_3O_4	Persulfate activation	Removal rate of RhB = 95.6%	Persulfate concentration = 50 mg/L; catalyst dosage = 50 mg/L; initial pH = 5.1	(Ma, et al. 2019)
Porous Mn/Fe_3O_4	PMS activation	Removal rate of bisphenol A = 87%	PMS concentration = 2 mmol/L; catalyst dosage = 0.2 g/L; initial pH = 3	(Du, et al. 2019)
g-C_3N_4/$MnFe_2O_4$	PMS activation	Removal rate of triclosan (TCS) = 95.9%	PMS concentration = 0.5 mmol/L; catalyst dosage = 0.5 g/L; TCS = 9 mg/L; initial pH = 11	(Wang, et al. 2019)
Mn doped g-C_3N_4	PMS activation	Removal rate of acetaminophen (ACT) = 100%	PMS concentration = 0.8 g/L; catalyst dosage = 0.2 g/L; ACT = 20 mg/L; initial pH = 6.5	(Fan, et al. 2019)

FeMn-C_3N_4	**PMS activation**	**Removal rate of RhB = 98.20%**	**PMS concentration = 50 mg/L; catalyst dosage = 0.5 g/L; pH = 6.80**	**This paper**
Fe doped g-C_3N_4	Fenton-like reaction	Oxidation of RhB = 80%	H_2O_2 concentration = 200 mmol/L; catalyst dosage = 0.5 g/L; initial pH = 6.5	(Bicalho, et al. 2017)
FeMn-C_3N_4	**Fenton-like reaction**	**Removal rate of RhB = 81.87%**	**H_2O_2 concentration = 21.76 mmol/L; catalyst dosage = 0.5 g/L; initial pH = 3;**	**This paper**
Fe/C_3N_4	Photocatalysis	Removal rate of RhB = 79%	catalyst dosage = 0.4 g/L; pH=3.5; light source: 350 W Metal halide-Xenon lamp ; with addiction of 3 mmol/L persulfate; reaction time: 40 min	(Heidarpour, et al. 2020)
g-C_3N_4-Mn-H	Photocatalysis	Removal rate of RhB = 51.4%	catalyst dosage = 0.5 g/L; light source: 300 W Xe arc lamp; reaction time: 60 min	(Wang, et al. 2017)
FeMn-C_3N_4	**Photocatalysis**	**Removal rate of RhB = 94%**	**pH = 6.80; catalyst dosage = 0.5 g/L; light source: 30 W LED light; reaction time：210 min**	**This paper**

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