

Supplementary Materials

Photocatalytic Properties of Core-Shell Structured Wool-TiO₂ Hybrid Composite Powders

Haoshuai Gu^{1,2}, Hui Zhang^{1,2,*}, Xinyue Zhang³, Yani Guo³, Limeng Yang^{1,2}, Hailiang Wu², and Ningtao Mao^{4,*}

¹ Research Centre for Functional Textile Materials, School of Textile Science and Engineering, Xi'an Polytechnic University, Xi'an, China; hsgu1117@163.com (H.G.); hzhangw532@xpu.edu.cn (H.Z.); yanglm@xpu.edu.cn (L.Y.)

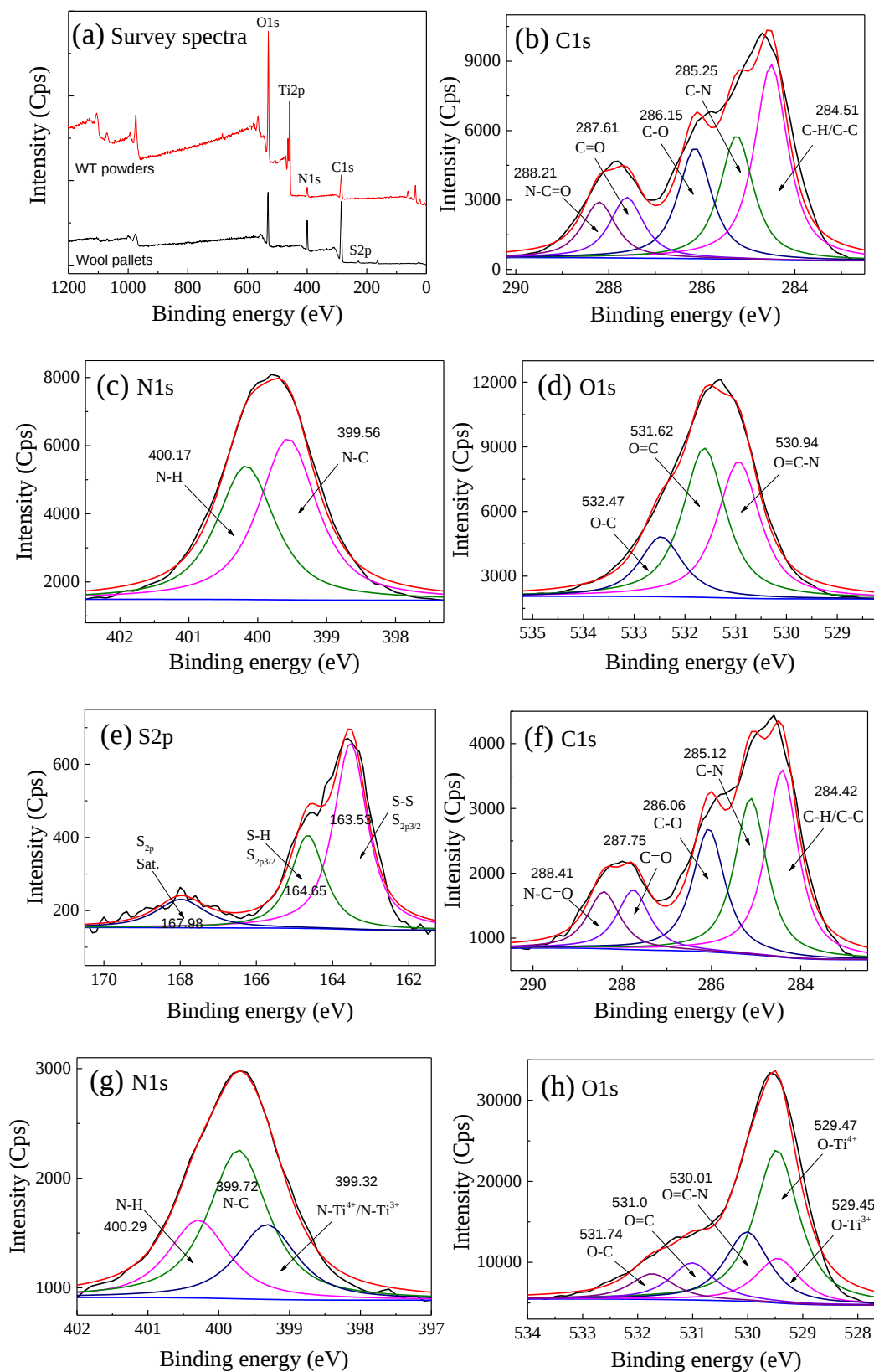
² Key Laboratory of Functional Textile Material and Product (Xi'an Polytechnic University), Ministry of Education, Xi'an, Shaanxi 710048, China; whl@xpu.edu.cn (H.W.)

³ School of Environmental and Chemical Engineering, Xi'an Polytechnic University, Xi'an 710048, China; 41504040228@stu.xpu.edu.cn (X.Z.); 19940706@xpu.edu.cn (Y.G.)

⁴ School of Design, University of Leeds, Leeds, LS2 9JT, United Kingdom; n.mao@leeds.ac.uk (N.M.)

* Correspondence: hzhangw532@xpu.edu.cn (H.Z.); n.mao@leeds.ac.uk (N.M.)

S1. XPS and FT-IR spectra of wool fibers, wool pallets and wool-TiO₂ (WT) hybrid composite powders



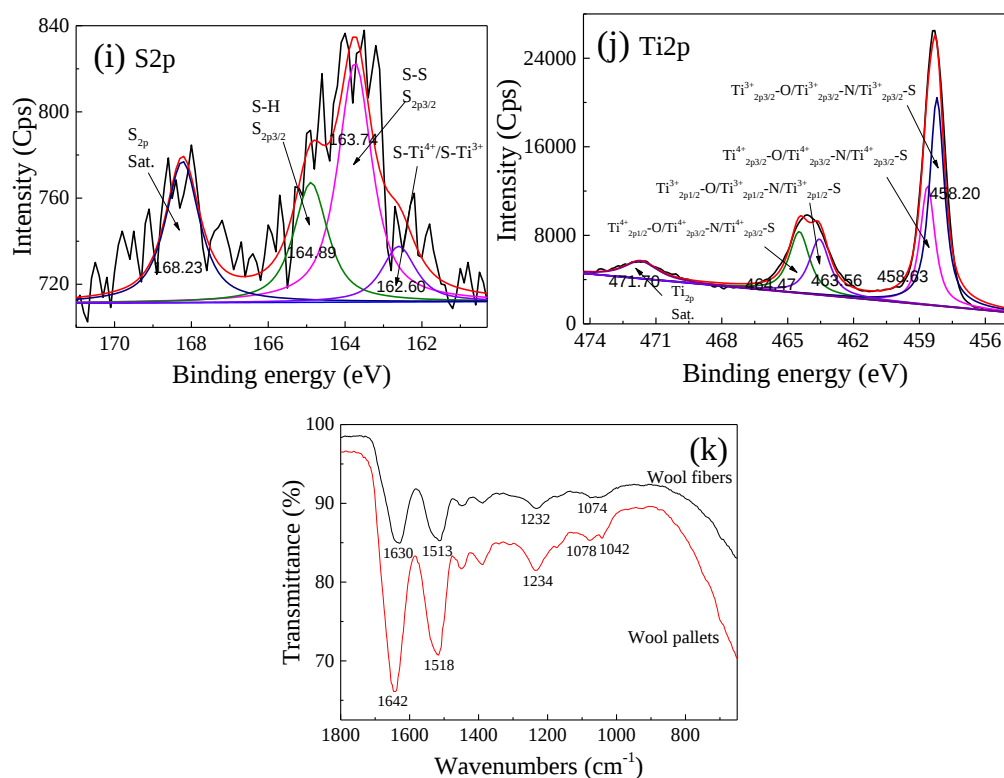


Figure S1. XPS spectra of wool pallets before and after loading TiO₂: (a) survey spectra; wool pallets for (b) C1s, (c) N1s, (d) O1s, and (e) S2p; the WT powders for (f) C1s, (g) N1s, (h) O1s, (i) S2p, and (j) Ti2p; and (k) FT-IR spectra of wool fibers and wool pallets

S2. The XPS elemental analysis data of the wool pallets and WT hybrid composite powders

Table S1. The XPS elemental analysis data

Samples	Peak	Position BE (eV)	FWHM (eV)	Atomic Concentration (%)
Wool pallets	C1s	284.80	2.42	62.93
	N1s	399.82	1.51	16.78
	O1s	531.82	1.89	18.68
	S2p	163.63	2.06	1.61
WT powders	C1s	284.80	2.37	25.82
	N1s	399.72	1.53	5.74
	O1s	529.55	1.33	47.56
	S2p	163.76	2.30	0.90
	Ti2p	458.32	1.12	19.98

S3. The fitting data of the time-resolved PL spectra

Table S2. The fitting parameters of the time-resolved PL spectra using biexponential decay kinetics

Samples	τ_1 (ns)	B ₁ (%)	τ_2 (ns)	B ₂ (%)	τ_{average} (ns)	χ^2
TiO ₂ nanoparticles	0.47	0.522	/	0.0	/	1.191
WT powders	0.29	0.601	10.02	0.017	5.10	1.301

S4. Optimization of the amount of TBT

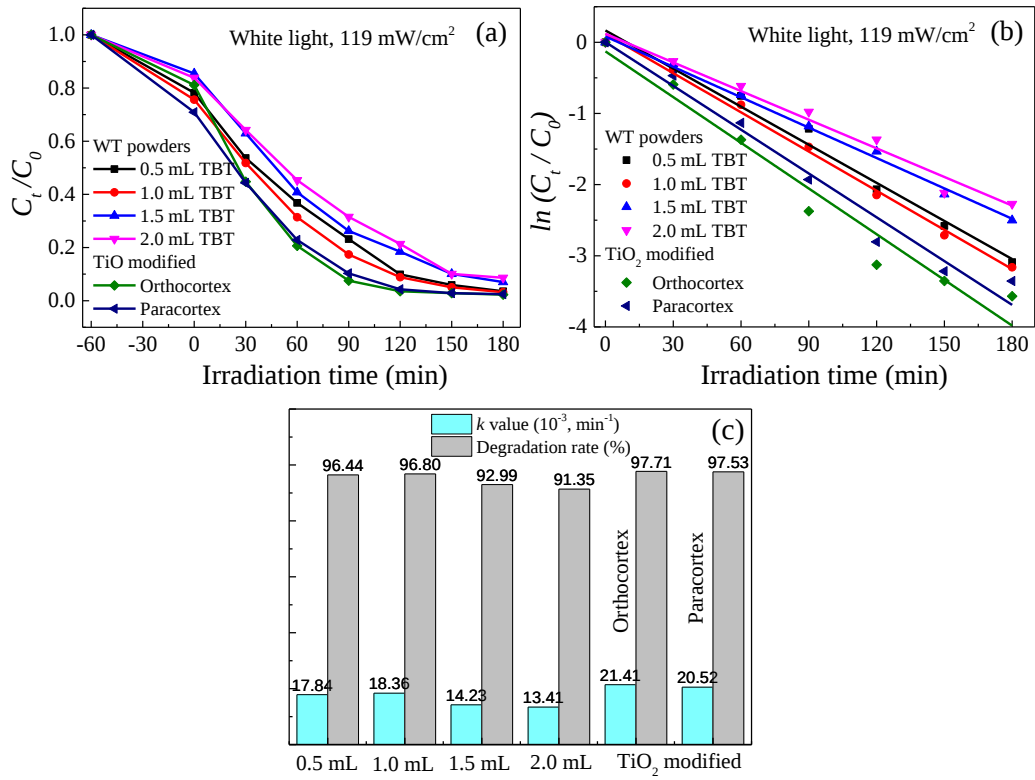


Figure S2. Photo-degradation of MB dye solutions exposed to white light at the light power density of 119 mW/cm² for 180 min

S5. Effect of the wavelength of light

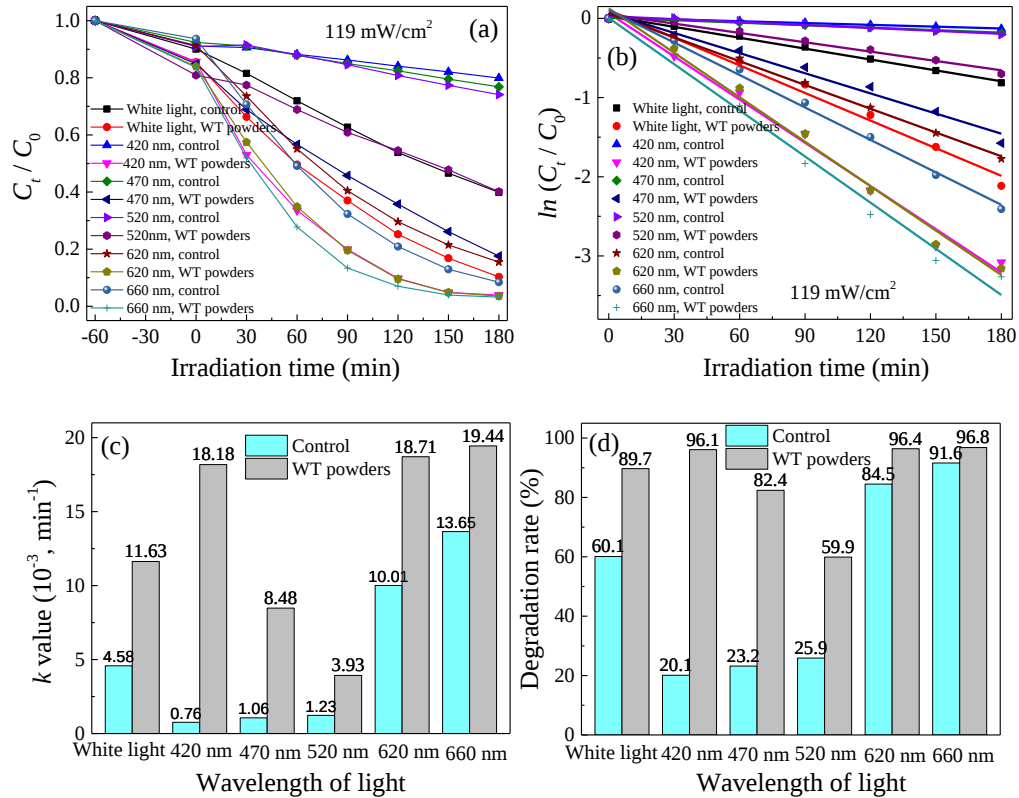


Figure S3. Photo-degradation of MB dye solution exposed to different wavelength lights at the light power density of 119 mW/cm² for 180 min

S6. Effect of the irradiation intensity

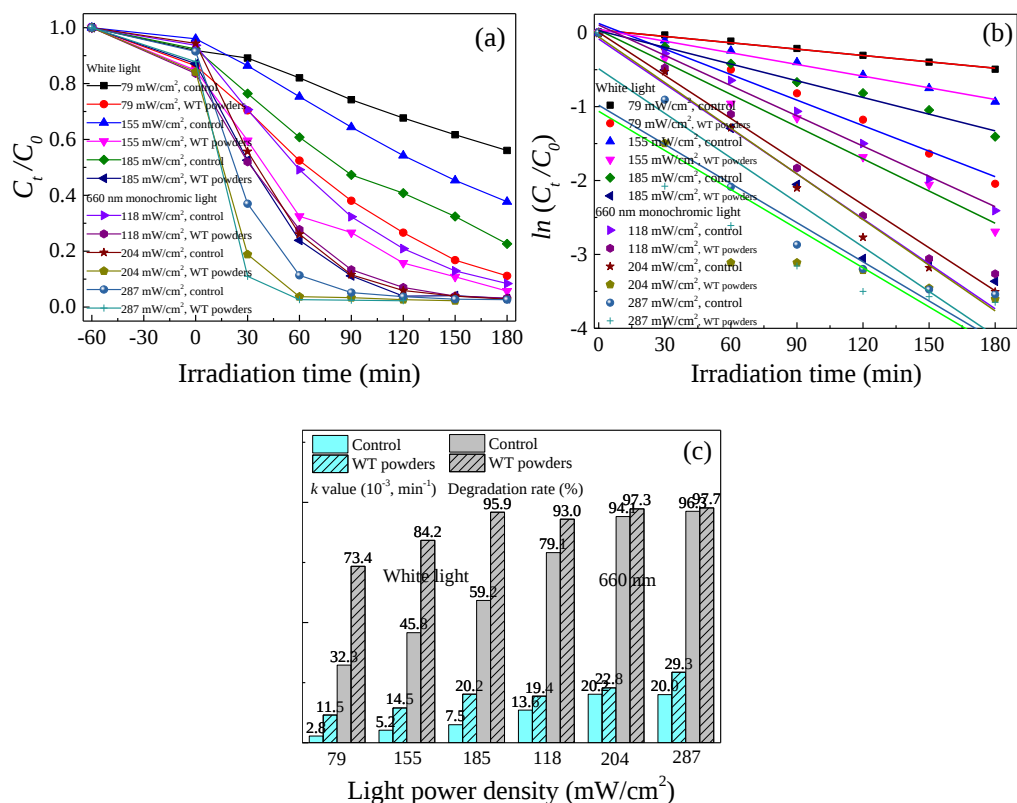


Figure S4. Photo-degradation of MB dye solution exposed to white light at the light power densities of 79, 155, and 185 mW/cm², and exposed to 660 nm monochromatic light at the light power densities of 118, 204, and 287 mW/cm² for 180 min, respectively

S7. Effect of the photocatalyst dosage

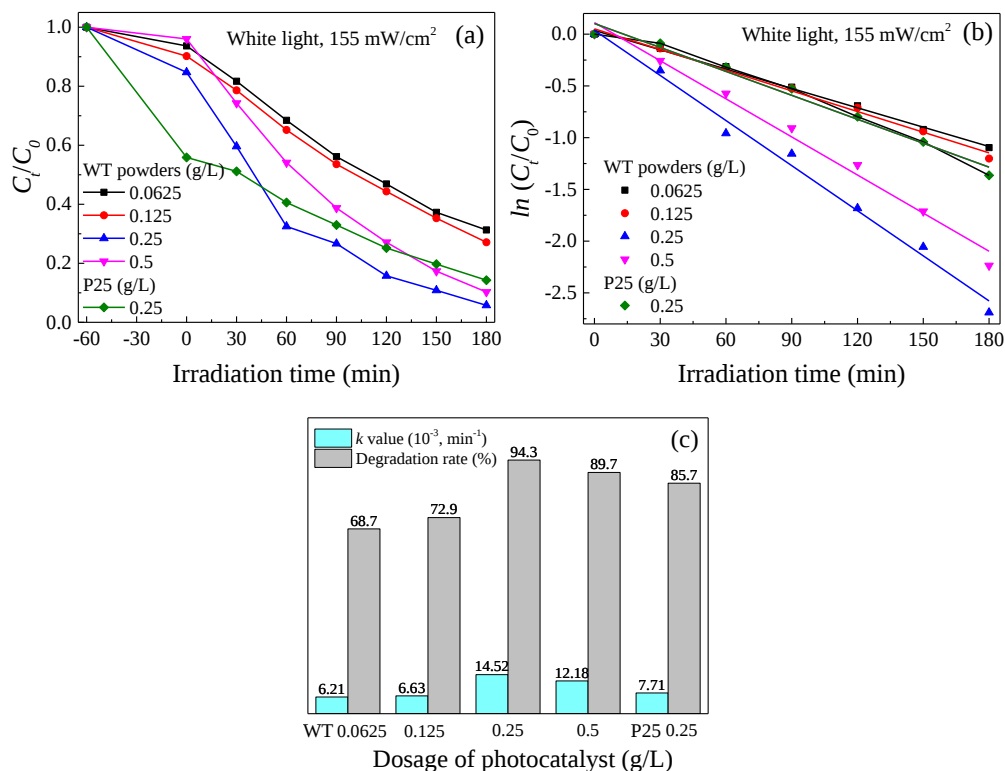


Figure S5. Photo-degradation of MB dye solution by different dosages of WT powders under 155 mW/cm² white light irradiation for 180 min

S8. Effect of the initial dye concentration

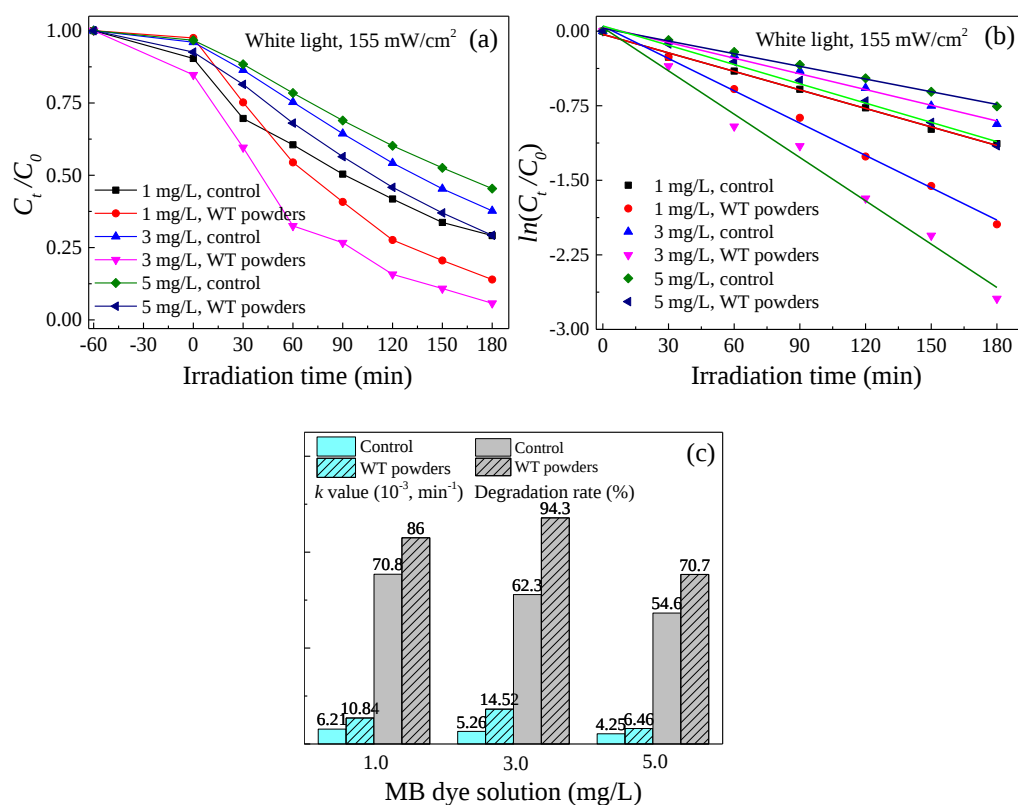


Figure S6. Photo-degradation of MB dye solution with the concentrations of 1, 3, and 5 mg/L exposure to white light at the light power density of 155 mW/cm² for 180 min

S9. Effect of the pH value of solution

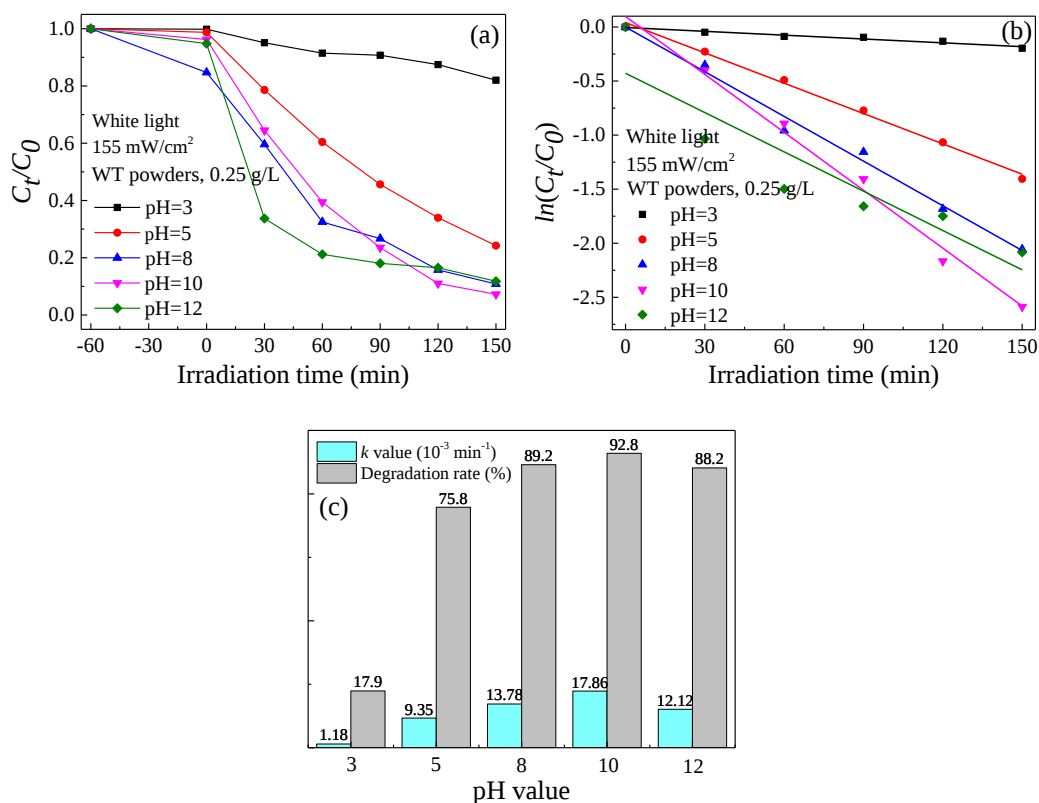


Figure S7. Effect of the pH value of dye solution on the photo-degradation efficiency of MB dye exposed to white light at the light power density of 155 mW/cm² for 150 min

S10. Effect of the oxidant agent H₂O₂

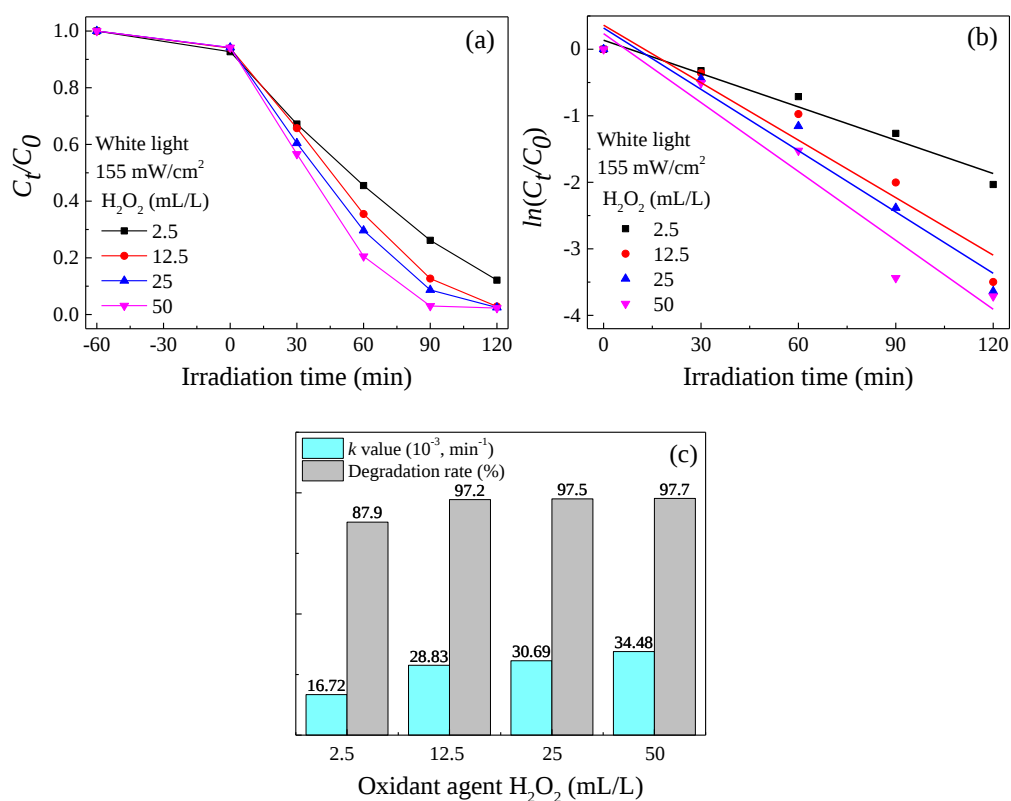


Figure S8. Effect of the co-catalyst H_2O_2 on the photo-degradation efficiency of MB dye solution exposed to white light at the light power density of 155 mW/cm² for 120 min

S11. Effects of air and N_2

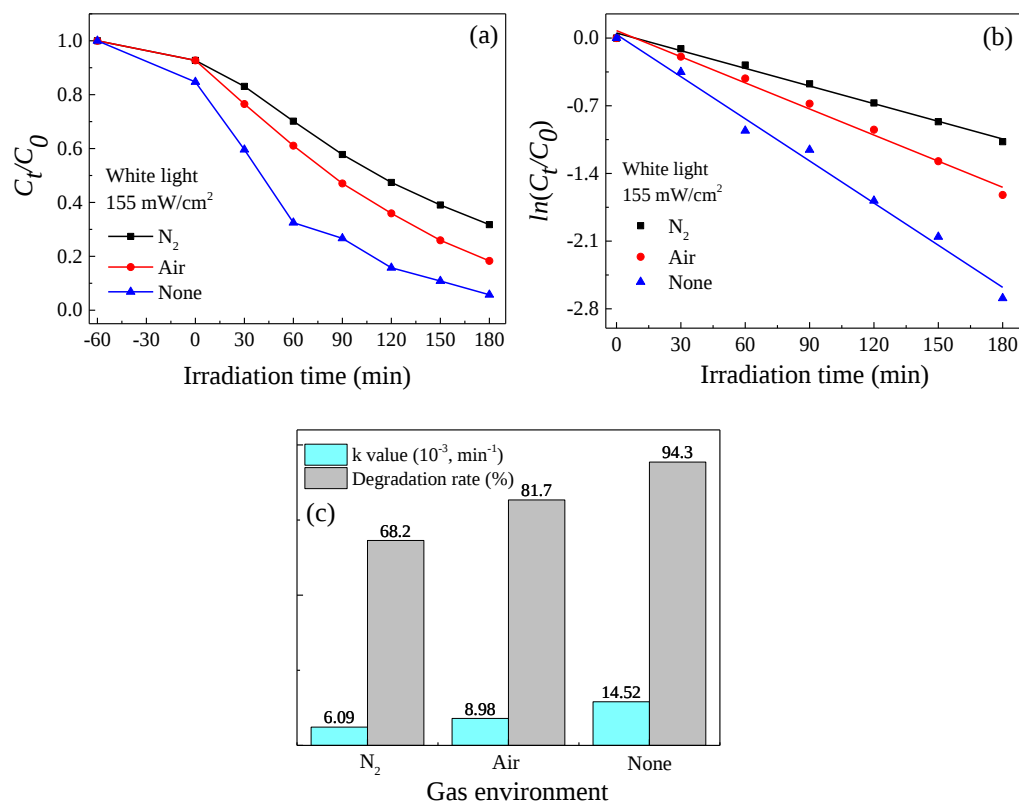


Figure S9. Effect of a gas environment on the photo-degradation efficiency of MB dye solution exposed to white light at the light power density of 155 mW/cm² for 180 min

S12. Comparison of the photo-degradation efficiency of MB dye solution by the WT powders

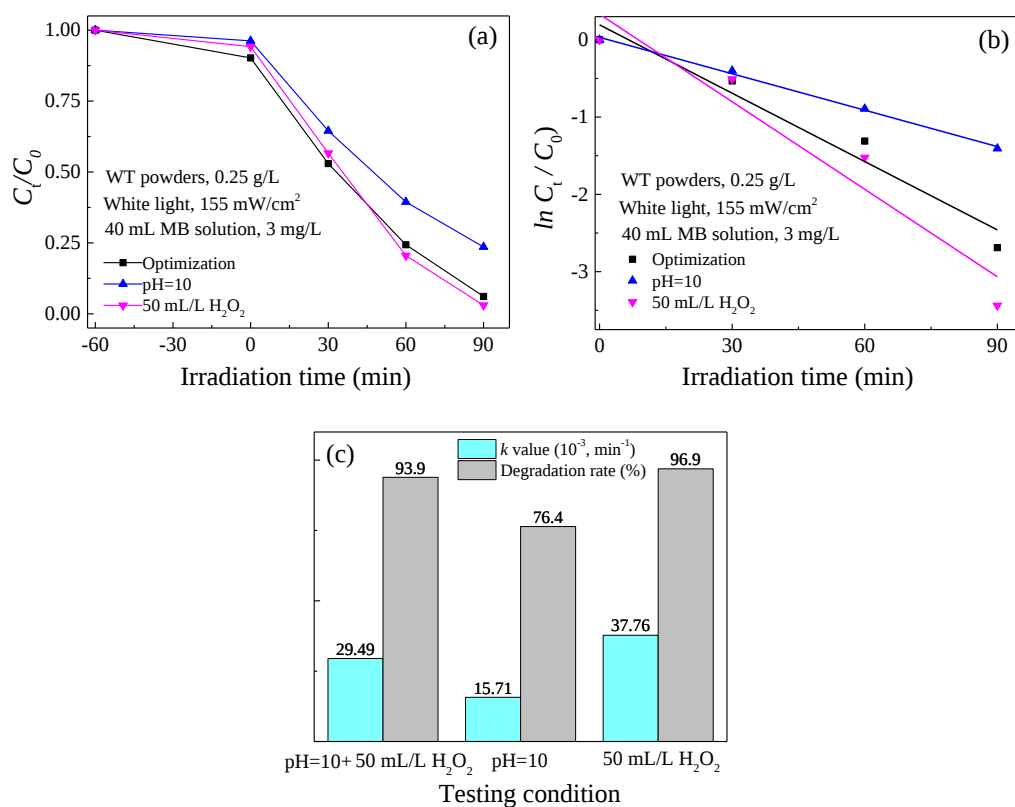


Figure S10. Comparison of photo-degradation efficiency of MB dye solution under different testing conditions for 90 min

S13. Comparison of photo-degradation of different types of dyes by the WT powders

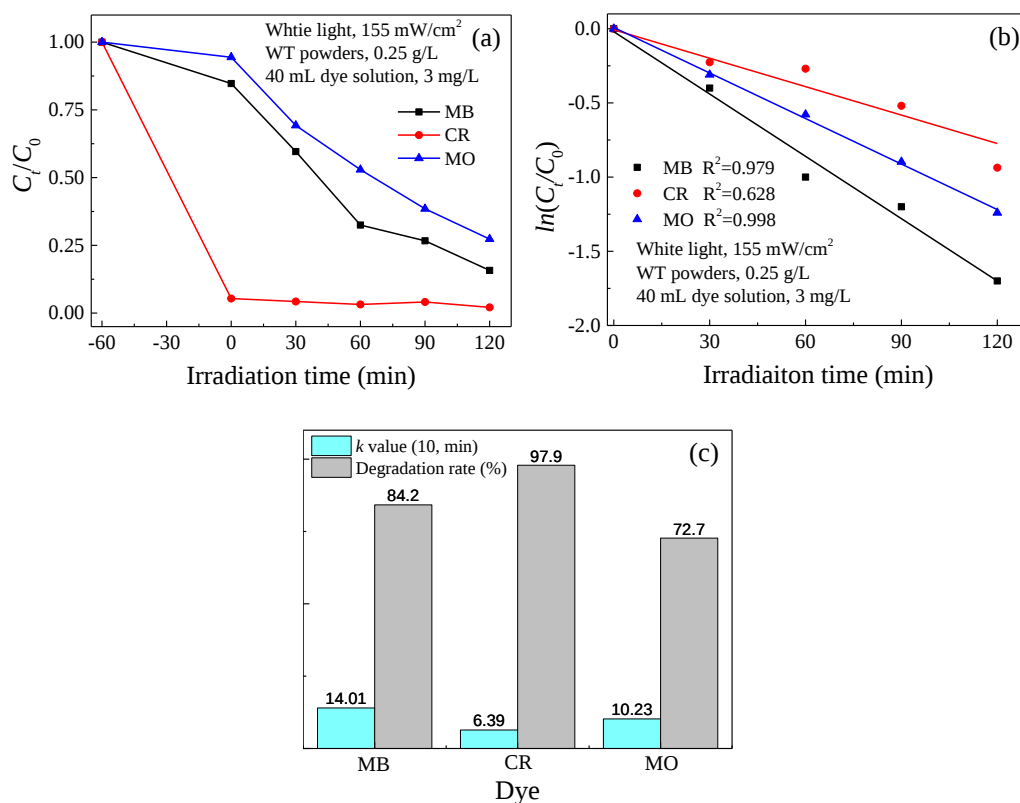


Figure S11. Comparison of photo-degradation of MB, CR and MO dye solution by the WT powders under 155 mW/cm² white light irradiation for 120 min

S14. Reusability and stability of the WT powders

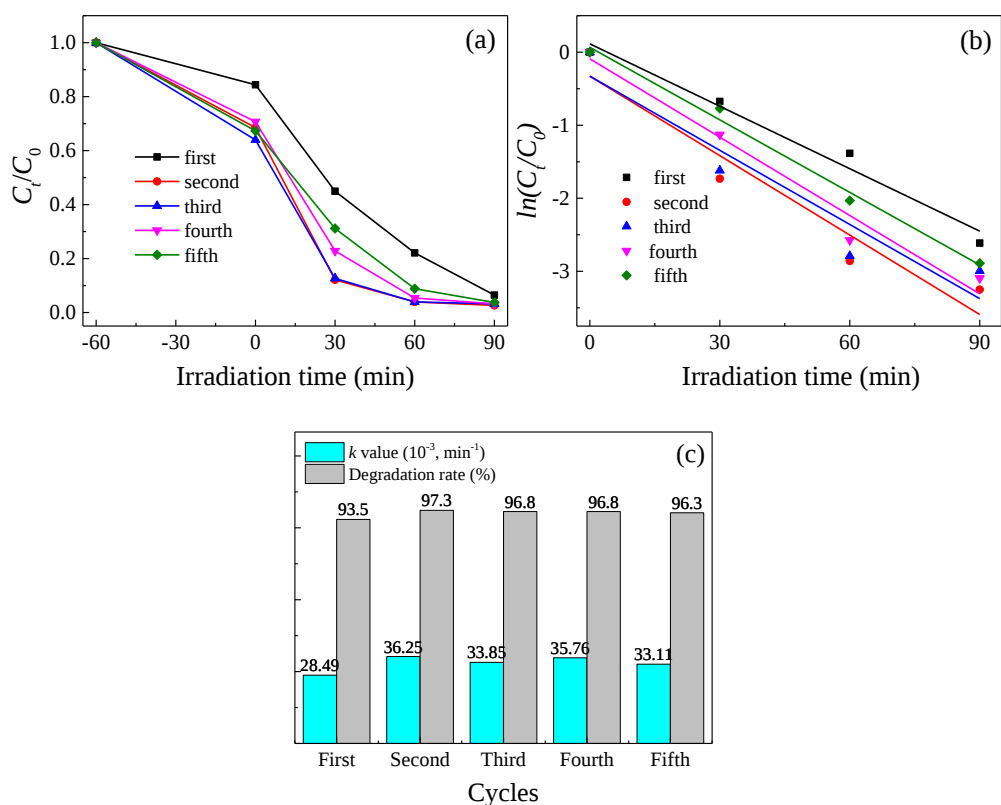


Figure S12. Recycle photo-degradation of MB dye solution by the WT powders under 155 mW/cm² white light irradiation for 90 min

S15. The trapping experiments for photo-degradation of MB dye solution

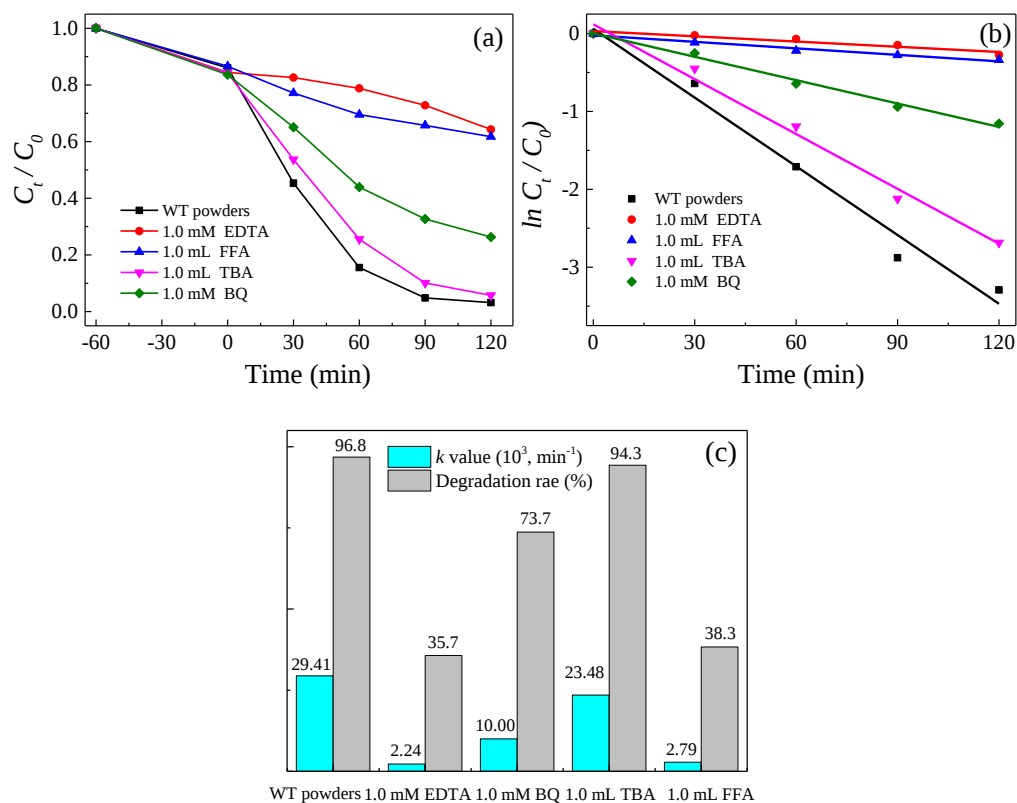


Figure S13. Trapping experiments for photo-degradation of MB dye solution by the WT powders by adding 1.0 mM EDTA, 1.0 mM BQ, 1.0 mL TBA, and 1.0 mL FFA, respectively under 155 mW/cm² white light irradiation for 120 min