

Supplementary Information

Immobilizing a Visible Light-Responsive Photocatalyst on a Recyclable Polymeric Composite for Floating and Suspended Applications in Water Treatment

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Text S1

Crystalline structures of TiO₂ was identified by X-ray diffraction (XRD) using D8 Advance (Bruker AXS) X-Ray diffractometer operated with Cu K α radiation ($\lambda=1.5418 \text{ \AA}$) at a scan rate (2θ) of 10°/min ranging from 20° to 80° and accelerating voltage of 40 kV. The morphology of the TiO₂ nanoparticles was imaged by field emission scanning electron microscope (FE-SEM, GeminiSEM 300 Zeiss, Germany) with an accelerating voltage of 5 kV after sputter coating with platinum under vacuum. Brunauer, Emmett and Teller- method (BET) was used to determine the specific surface area of TiO₂ measured at 77 K by nitrogen adsorption (Micromeritics ASAP 2020).

Thermogravimetric analysis (TGA) was conducted using a TGA-50 (Shimadzu, China) instrument in an air atmosphere at a ramping rate of 10 °C/min to 800 °C. Attenuated total reflection Fourier transform infrared spectroscopy (ATR-FTIR) was performed using Nicolet iS50 FT-IR (Thermo Scientific), equipped with diamond ATR, in the range of 400–4000 cm⁻¹ with a resolution of 1 cm⁻¹. Surface roughness of the beads was measured using a scanning probe microscope (Dimension Icon, Bruker). MB concentration in water was measured by a UV–visible spectrophotometer (Lambda 950, PerkinElmer) at 664 nm. Elemental analysis was performed by ICP-AES (ICPE-9000 Shimadzu).

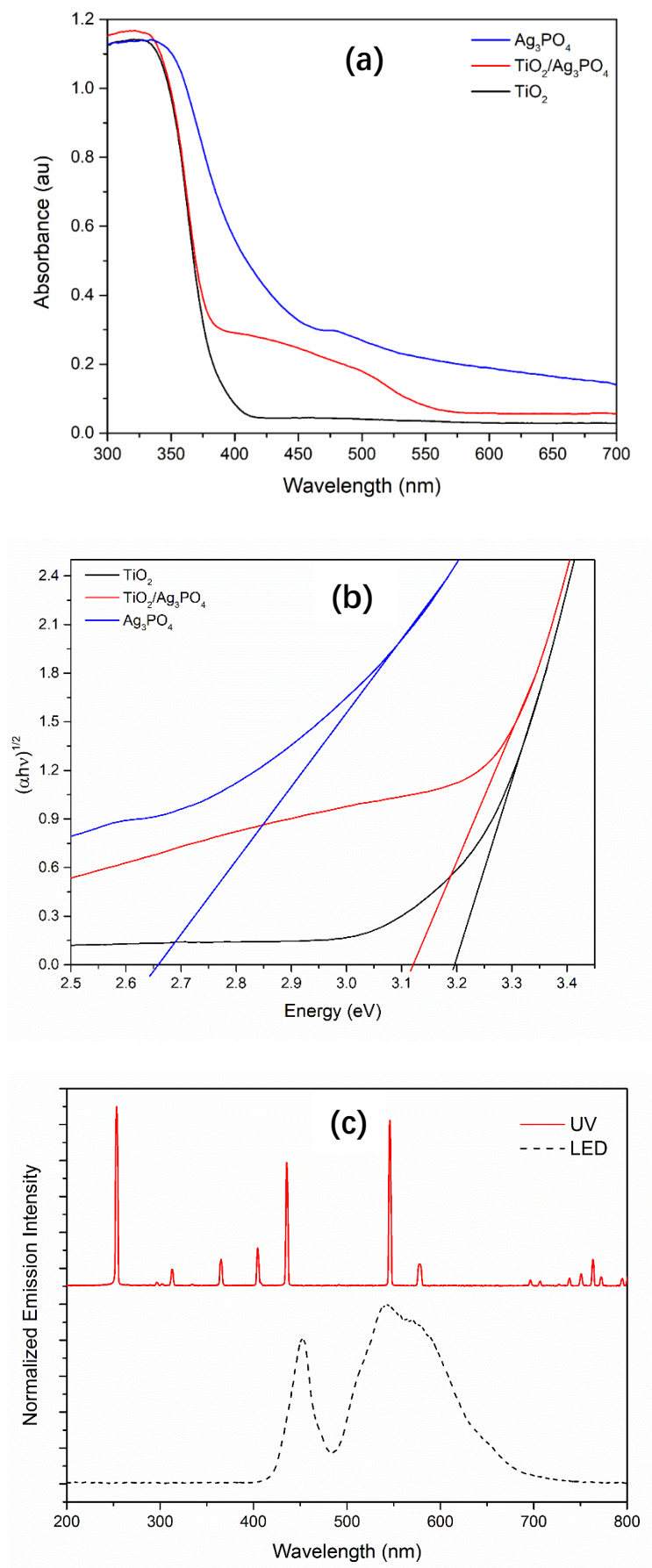


Fig. S1. UV-vis spectra (a), Tauc plot (b) of photocatalysts, and representative emission spectra of UV and LED light (c).

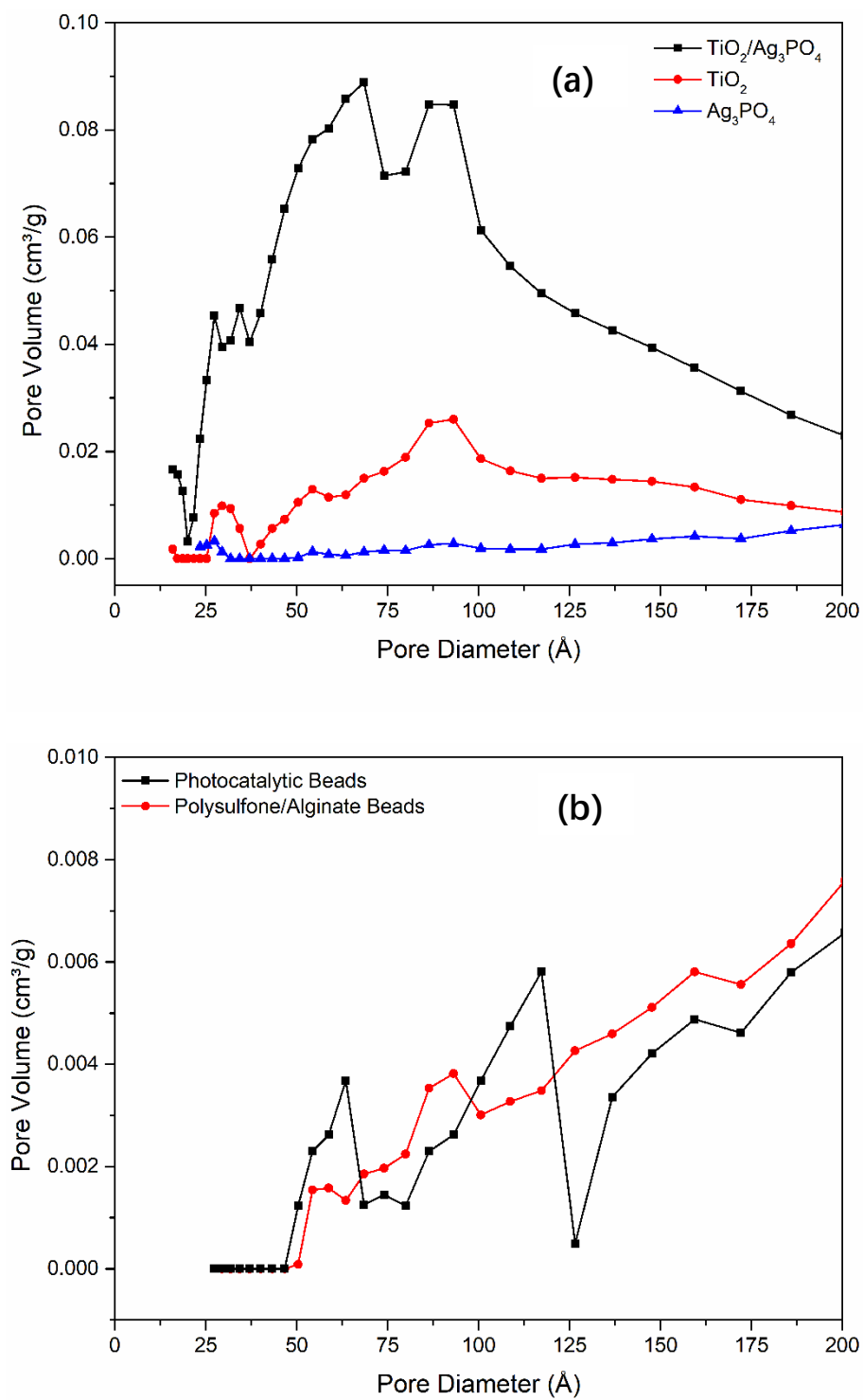


Fig. S2. Zoom-in (0-200 Å) pore size distribution curves of (a) photocatalyst powders and (b) polymer beads.

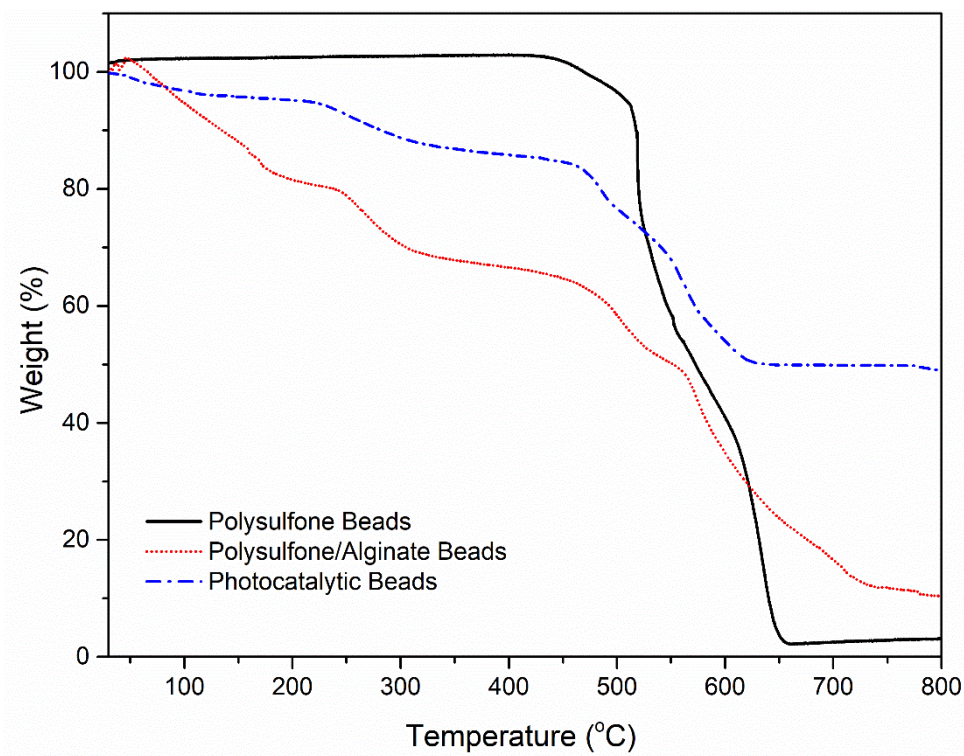


Fig. S3. TGA curves for different polymeric beads.

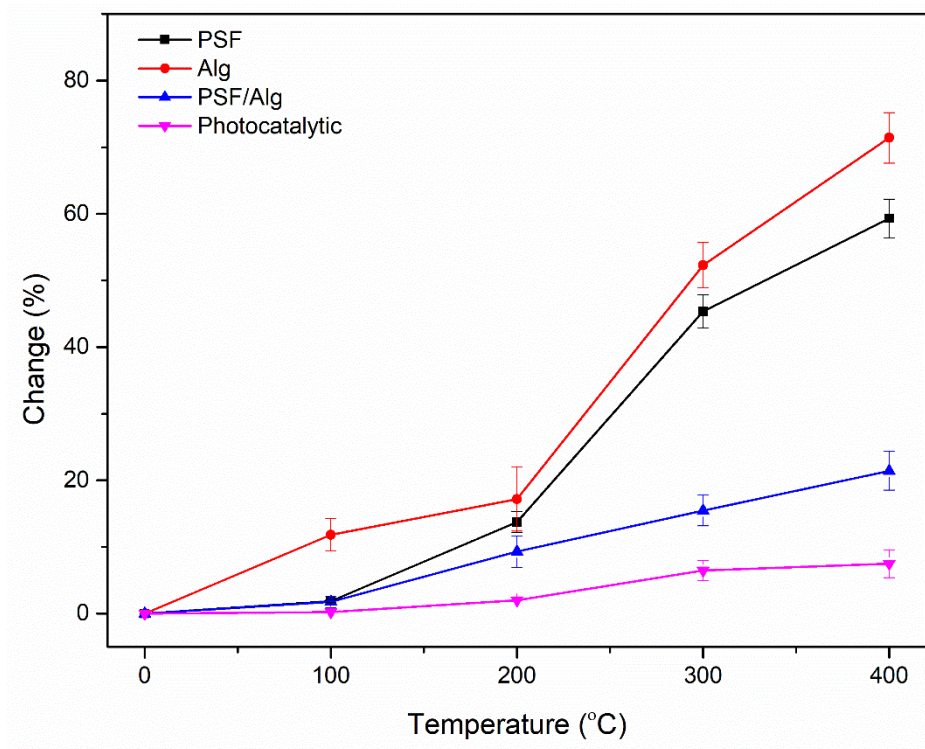


Fig. S4. Changes in the bead diameter after heat treatment at different temperature for 1 hour each. Heat treatment decreased the diameter of all the beads. Photocatalytic beads containing $\text{TiO}_2/\text{Ag}_3\text{PO}_4$ composite suffered minimum loss in the diameter.

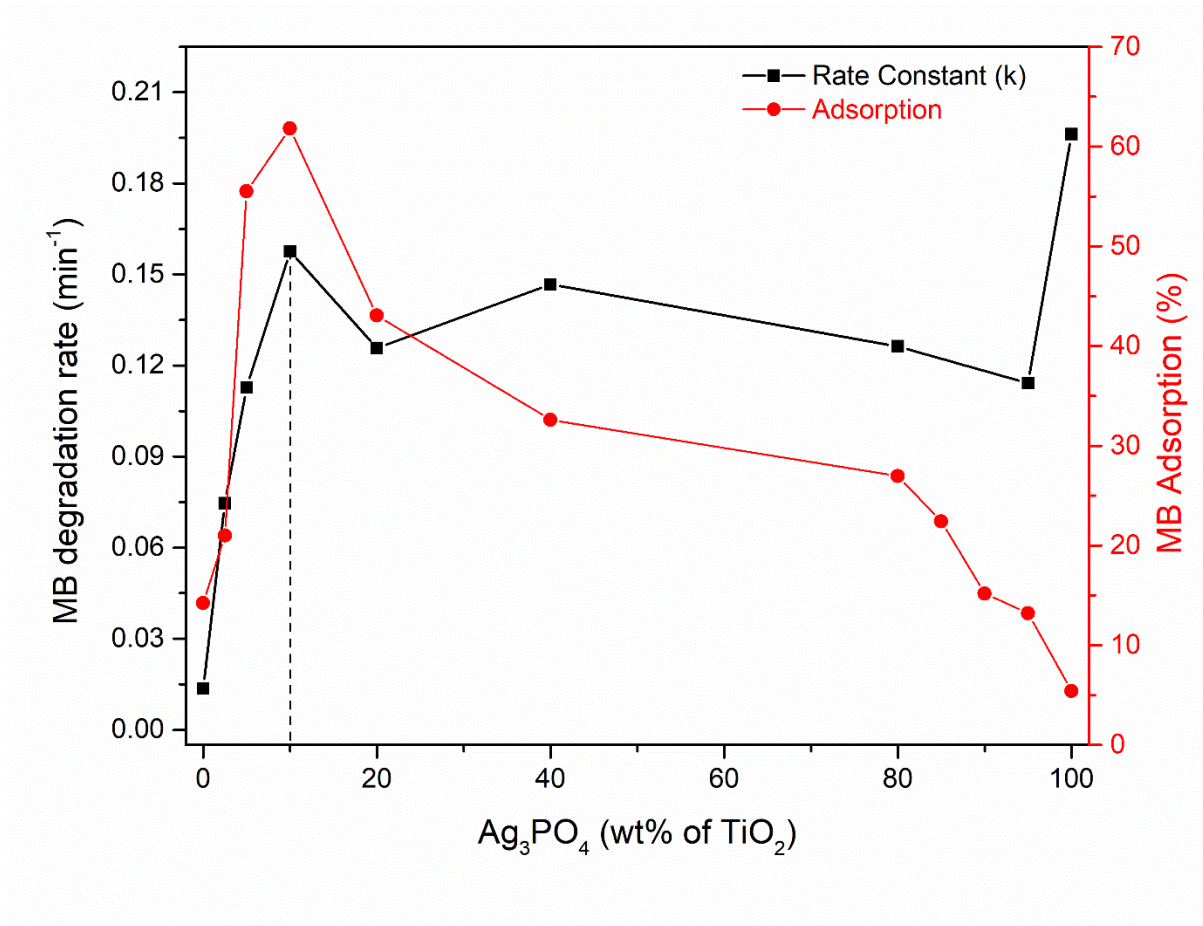


Fig. S5. Effect of Ag_3PO_4 weight percent on the adsorption and degradation rate of MB under visible light irradiation.

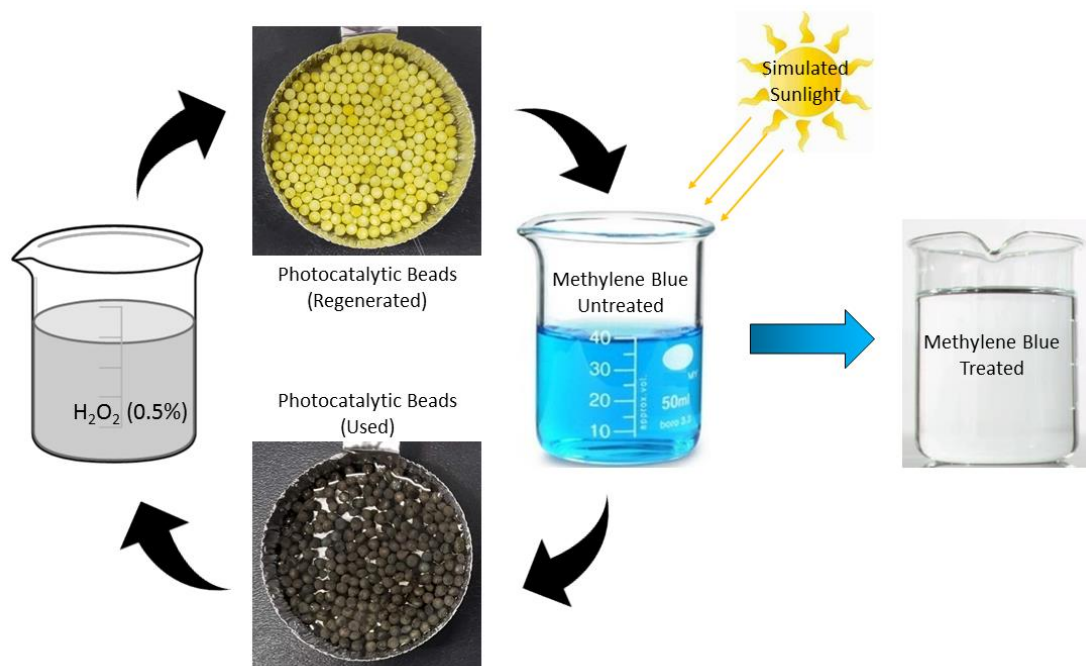


Fig. S6. Schematic illustration of MB degradation under visible light using photocatalytic beads and their regeneration by H₂O₂.

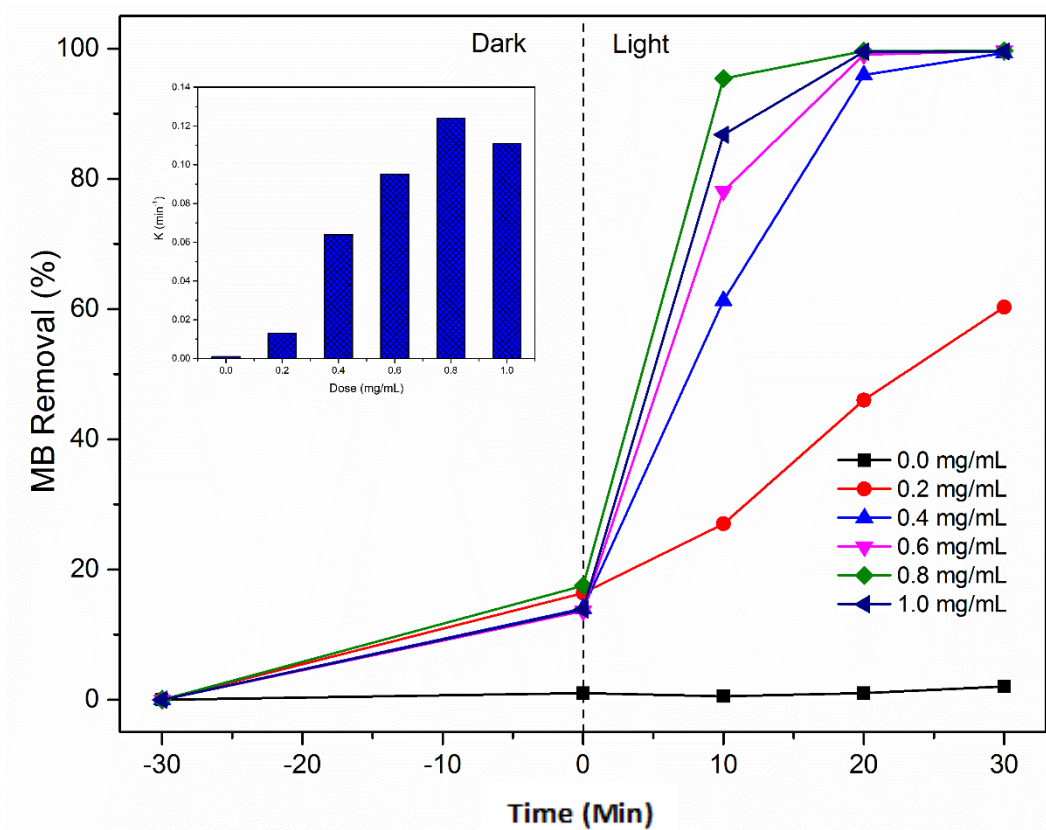


Fig. S7. Effect of powdered photocatalyst ($\text{TiO}_2/\text{Ag}_3\text{PO}_4$) dose for MB degradation under visible light.

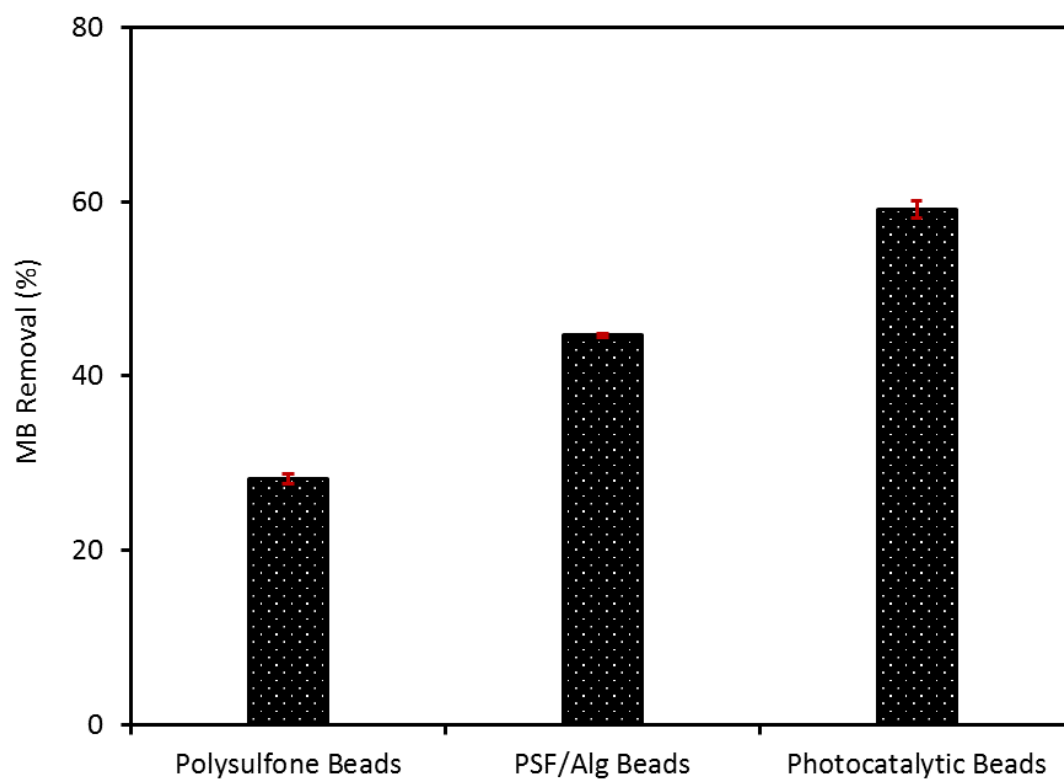


Fig. S8. Adsorption capacities of various beads.

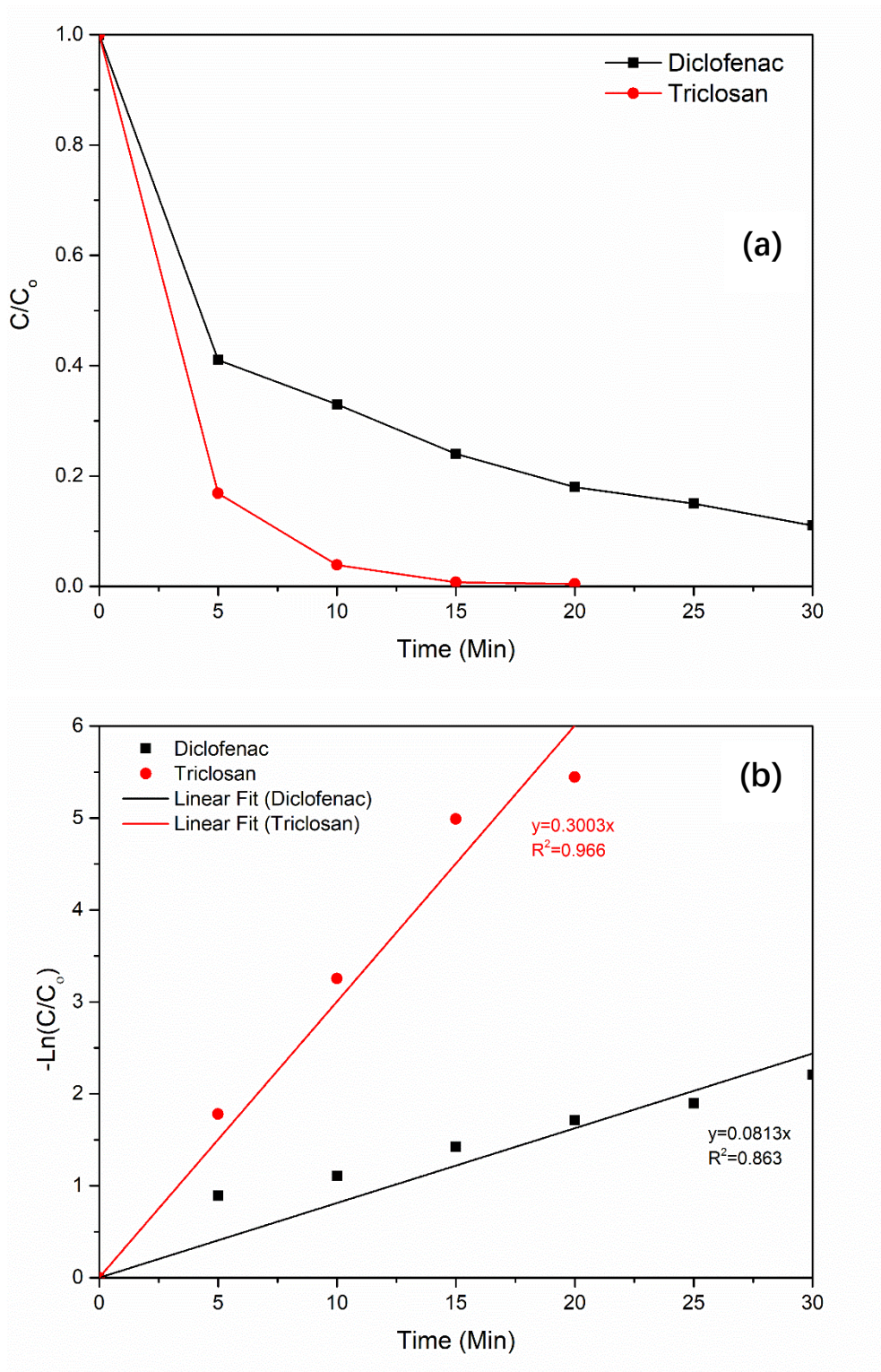


Fig. S9. Photocatalytic degradation (a) and rate constant (b) of pharmaceutical compounds by the powdered $\text{TiO}_2/\text{Ag}_3\text{PO}_4$ under visible light (initial drug concentration = 20 mg/L; photocatalyst loading = 50 mg/L; reaction volume = 0.8 L).

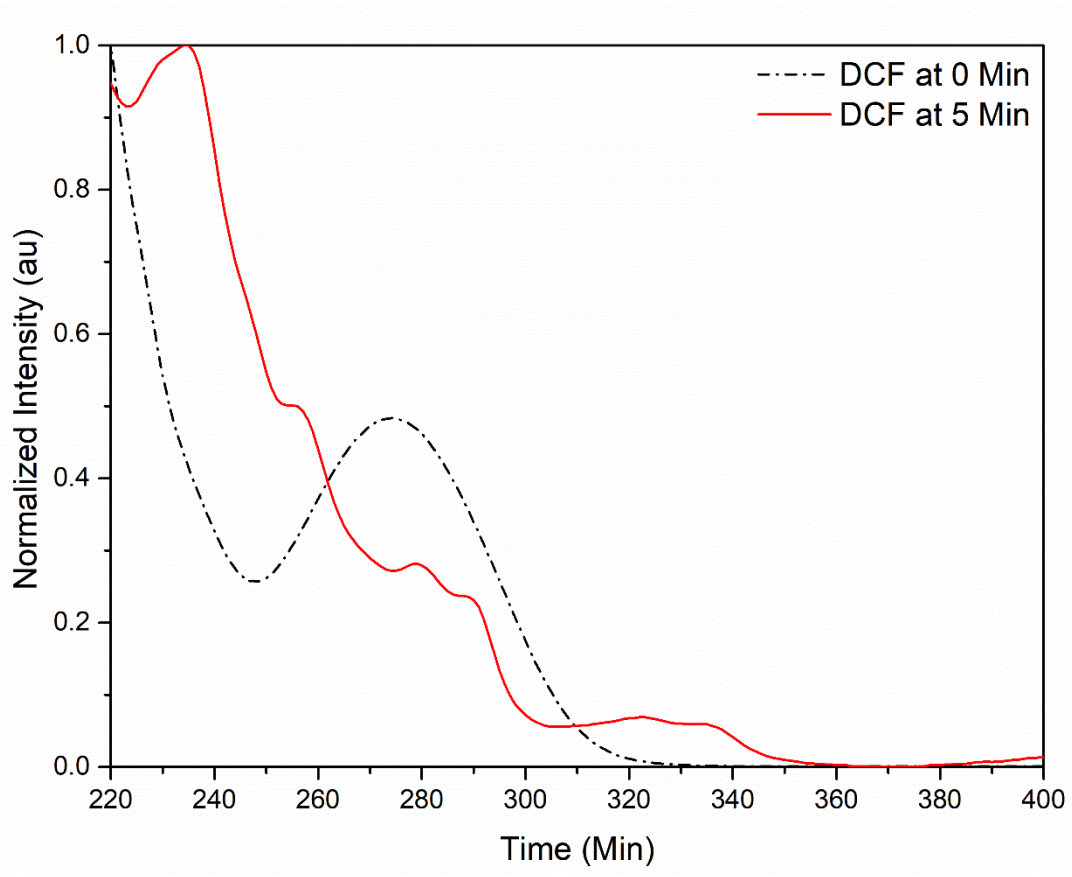


Fig. S10. UV-Vis spectra of DCF showing appearance of new peaks after 5 minutes of photocatalysis.

Table S1. Chemical analysis of the water used for the preparation of MB solution.

Parameter	Concentration (mg/L)
Ca ²⁺	13.7
Mg ²⁺	4.4
Na ⁺	2.1
K ⁺	0.7
HCO ₃ ⁻	57.0
SO ₄ ²⁻	3.3
NO ₃ ⁻	2.5
Cl ⁻	1.9

Table S2. Elemental analysis of supernatant from photocatalytic beads using ICP-AES analysis.

Elements		Beads store in ultrapure water for a year (Sample a)	Beads shaken in ultrapure water for 72 h (Sample b)
Major (mg/L)	Ag	n.d	n.d
	Ti	n.d	n.d
	Ca	1300	110
	Mg	2.9	n.d
	Na	170	2.2
	Rb	52	n.d
	S	14	1.2
	Si	3.8	4.5
	Minor (µg/L)	B	21
Ba		4.6	n.d
Be		1.1	1.2
Fe		190	n.d
K		170	26
Nb		32	31
Re		52	n.d
Sr		170	14

Experimental Note: Elemental analysis of supernatant from photocatalytic beads store in ultrapure water for a year (Sample a) and shaken in ultrapure water for 72 h (Sample b), using ICP-AES analysis. In a typical experiment, a certain number of photocatalytic beads were added in 50 mL ultrapure water and stirred for 72 hours. The supernatant was syringe filtered and analyzed. Additionally, supernatant from photocatalytic beads stored in ultrapure water for more than a year at room temperature under static condition was also analyzed using ICP-AES (ICPE-9000 Shimadzu). n.d = not detected