Electronic Supplementary Material (ESI) for Photochemical & Photobiological Sciences.

Supplementary information for

Construction of a multipurpose photochemical reactor with on-line spectrophotometric detection

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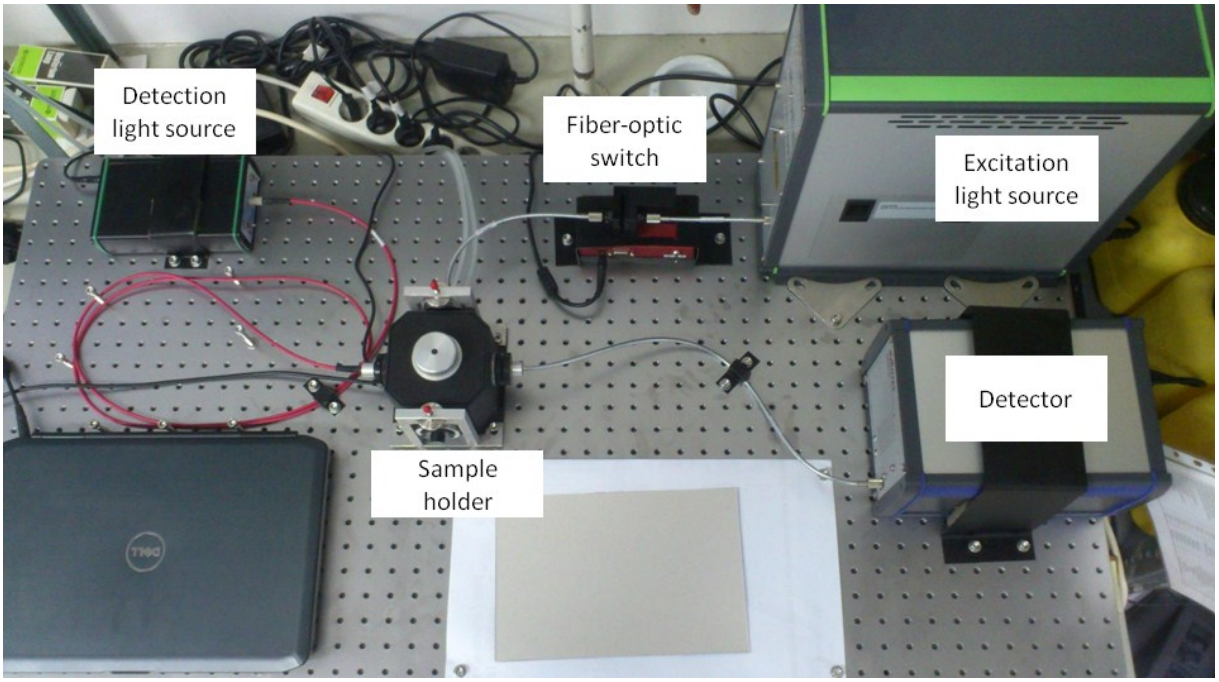

Fig. S1 Photograph of the photoreactor.
Note: the attenuator is not present in this setup.

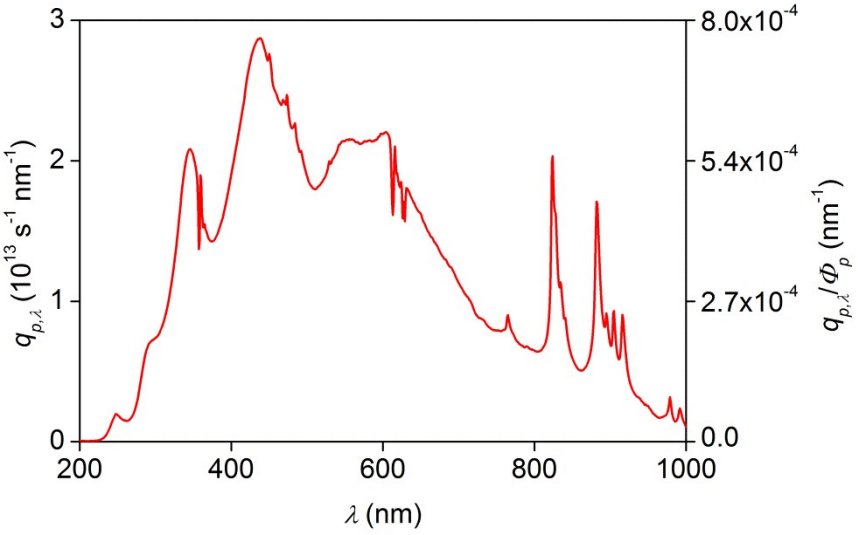

Fig. S2 Spectral photon flux of the excitation lamp as a function of wavelength as determined by relative energy measurements and actinometry ($\Phi_{p:}$ total photon flux of the lamp).

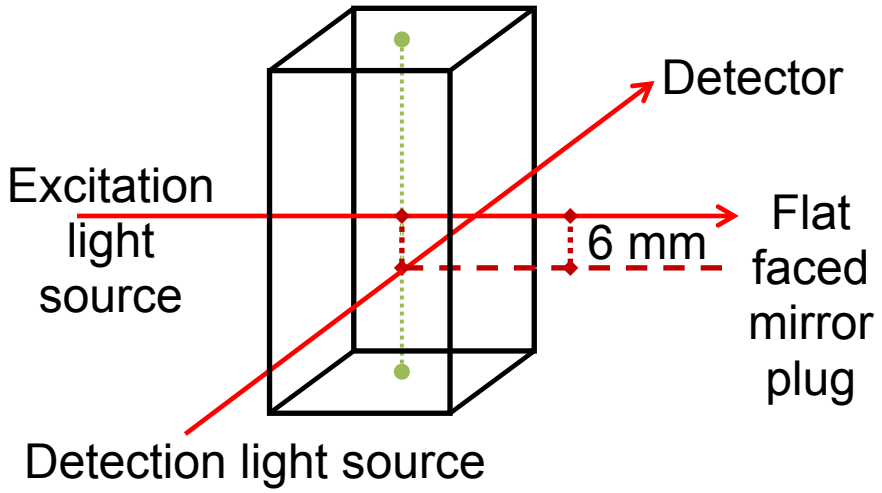

Fig. S3 Separation of the detection and excitation planes inside the cuvette.

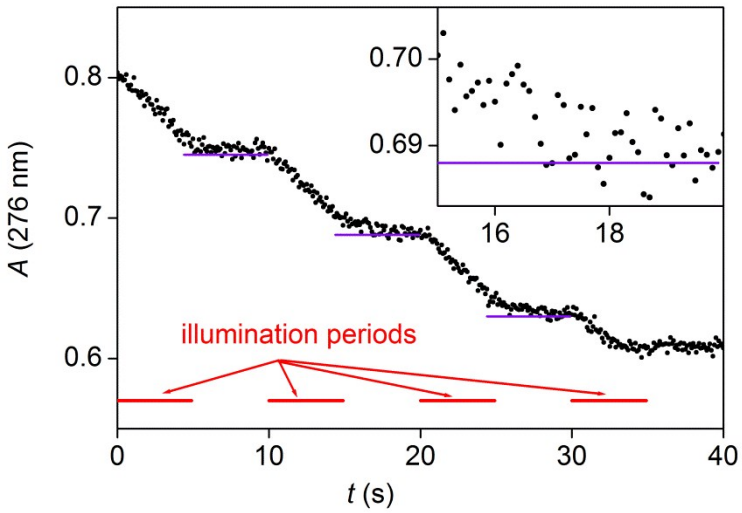

Fig. S4 Disappearance of aqueous sulfur(IV) in the photoinitiated and cerium(III)-catalyzed autoxidation of $H_2O{\cdot}SO_2$ detected at 276 nm. [Ce(III)] = 1.0 mM; [S(IV)] = 2.0 mM; [H_2SO_4] = 0.10 M; [O_2] = 0.20 mM; path length: 1.00 cm; V = 3.00 cm^3; T = 25.0 °C; stirring: 800 rpm. Illumination pattern: 5 s periods of illumination (marked with red line) followed by 5 s of dark periods. (Inset: a closer view of the dark period between 15 and 20 s).

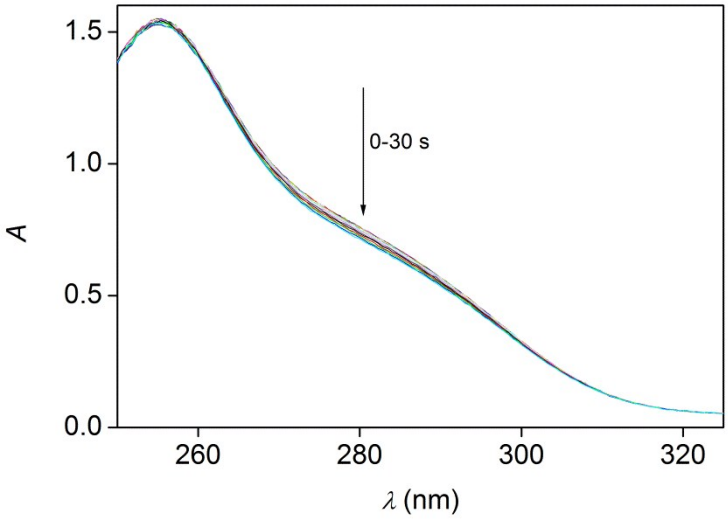

Fig. S5 Spectral changes observed during photoinitiated and cerium(III)-catalyzed autoxidation of $H_2O{\cdot}SO_2$. [Ce(III)] = 1.0 mM; [S(IV)] = 2.0 mM; [H_2SO_4] = 0.10 M; [O_2] = 0.20 mM; path length: 1.00 cm; V = 3.00 cm^3; T = 25.0 °C; stirring: 800 rpm.

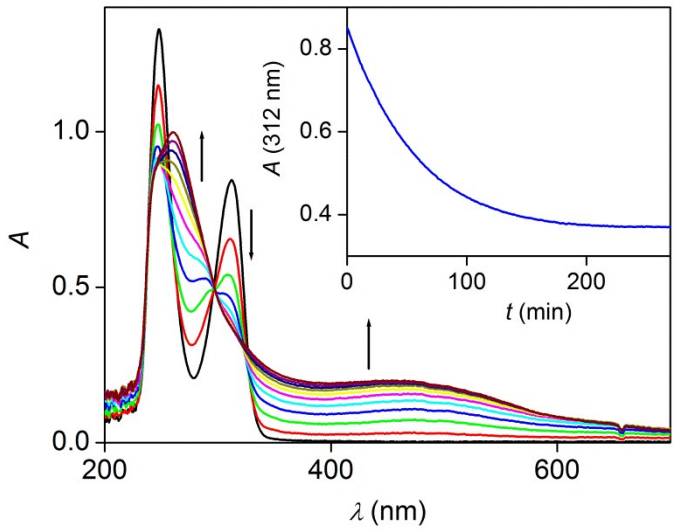

Fig. S6 Direct photochemical degradation of 2,4,6-trichlorophenol (TCP) in aqueous solution. [TCP] = 0.20 mM; [phosphate buffer] = 10.0 mM; path length: 1.00 cm; V = 3.00 cm^3; T = 25.0 °C; stirring: 800 rpm. Inset: kinetic trace measured at 312 nm.

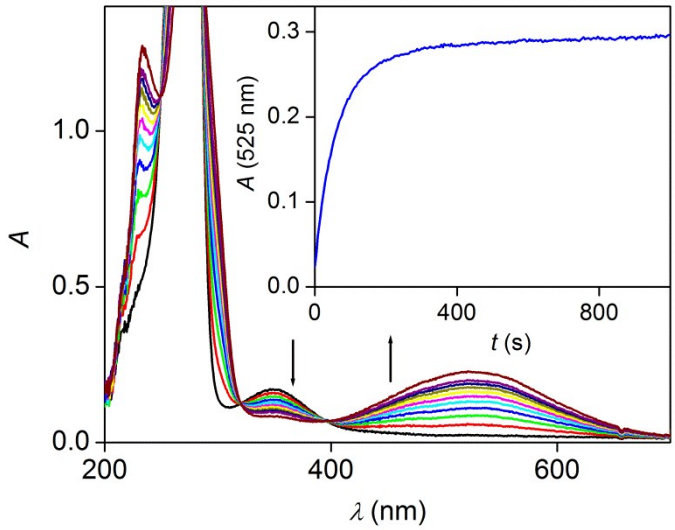

Fig. S7 Photochemical degradation of 2,6-dichloro-1,4-benzoquinone (DCQ) in aqueous solution. [DCQ] = 0.31 mM; path length: 1.00 cm; V = 3.00 cm^3; T = 25.0 °C; stirring: 800 rpm. Inset: kinetic trace measured at 525 nm.

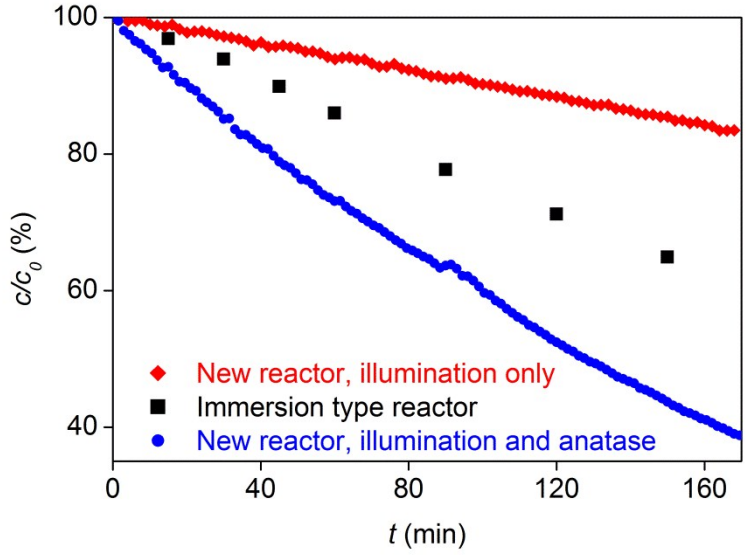

Fig. S8 Degradation of methylene blue under different conditions, 1.0 L of 50 µM MB irradiated by medium pressure mercury lamp (■), 2.00 cm^3 of 40 µM MB in the constructed photoreactor (●), 2.00 cm^3 of 30 µM MB with 114 µg anatase in the constructed reactor (▲). Path length: 1.00 cm; V = 2.00 cm^3; T = 25.0 °C; stirring: 1000 rpm.

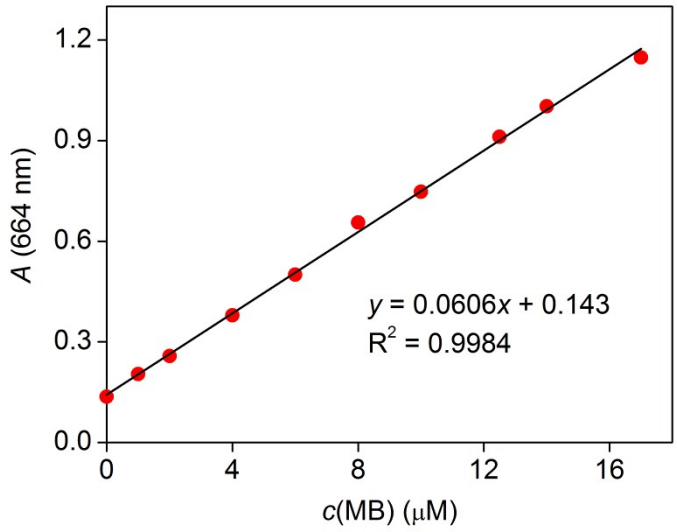

Fig. S9 Beer's plot for methylene blue in the presence of suspended anatase. $c(TiO_2)$ = 50.2 µg/mL, pH 7.15 (10.0 mM phosphate buffer), T = 25.0 °C; stirring: 1000 rpm.

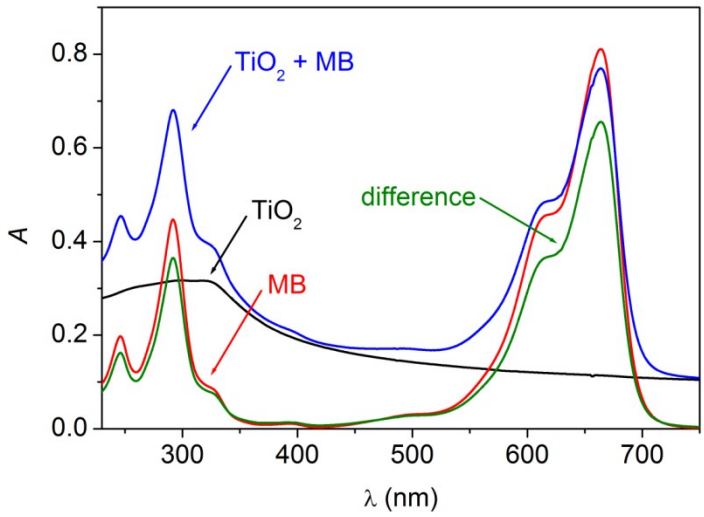

Fig. S10 Demonstration of the lack of additivity of absorbance values in the heterogeneous system containing anatase and methylene blue in a Agilent 8453 diode array spectrophotometer (stirring: 1000 rpm). MB: homogeneous solution of methylene blue; TiO_2: suspension of anatase in water; TiO_2 + MB: suspension of anatase in a solution of methylene blue; difference: the difference of spectra TiO_2 + MB and TiO_2.

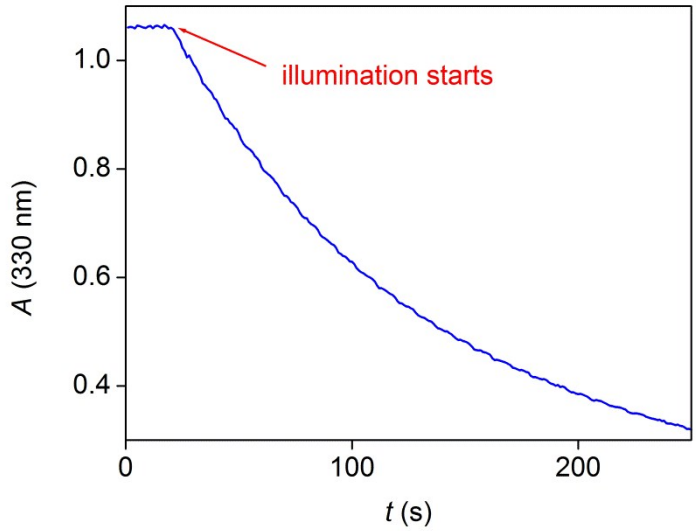

Fig. S11 Kinetic trace observed at 330 nm during the illumination of the actinometric solution. The illumination started after a 30-second initial dark period. 15 mg of solid $K_3[Fe(C_2O_4)_3]$ was dissolved in 25 cm^3 of 0.050 M H_2SO_4 to prepare the actinometric solution, 2.50 cm^3 of which was irradiated for 250 s in the experiment shown. T = 25.0 °C; stirring: 800 rpm.

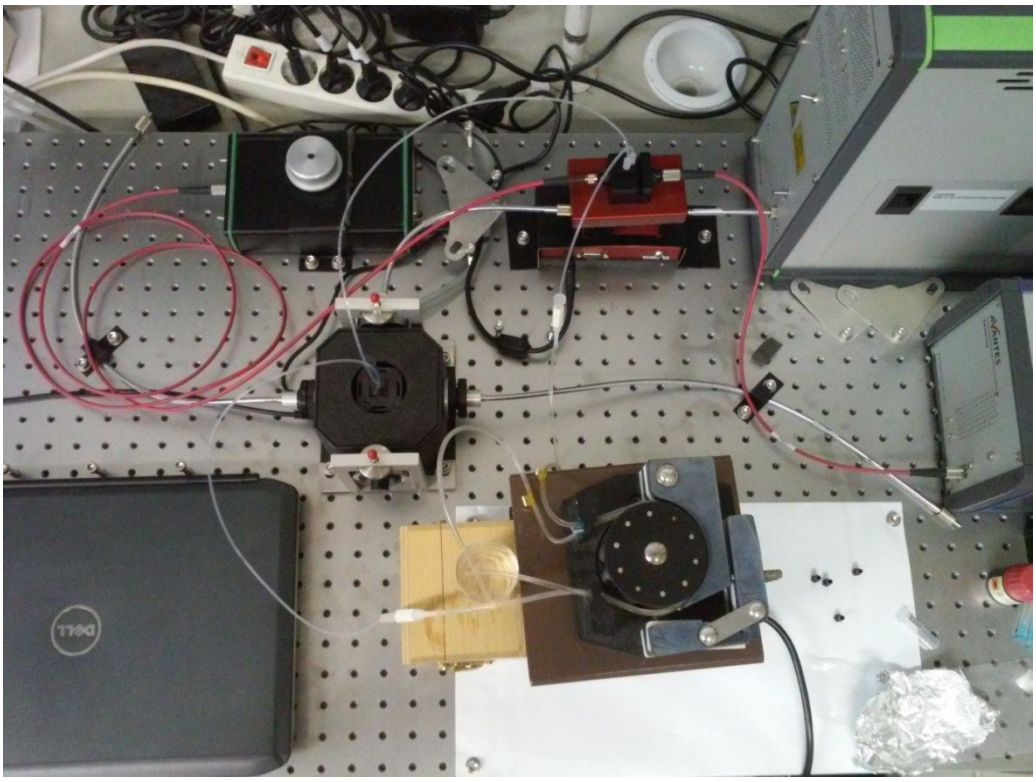

Fig. S12 Photo of the experimental setups with flow-through arrangement

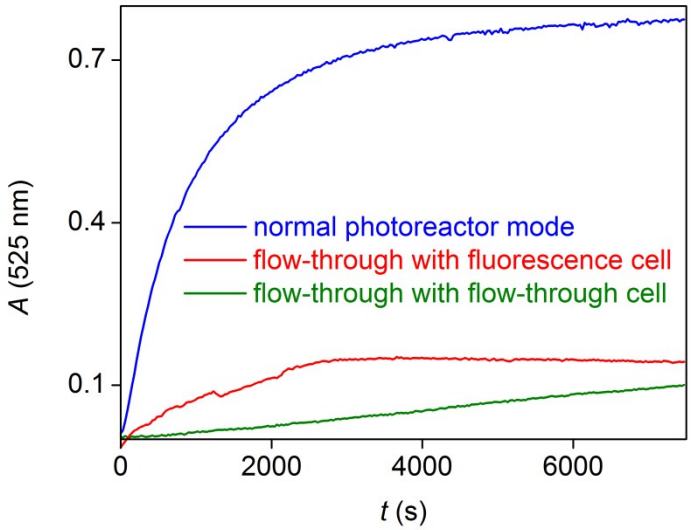

Fig S13 Kinetic traces detected during the demonstration experiments using the flow-through setup of the instrument. Test reaction: $Ru(bipy)_3^{2+}$-sensitized aqueous photochemical oxidation of 2,4,6-trichlorophenol (TCP) in the presence of $S_2O_8^{2-}$ as an oxidant. [$K_2S_2O_8$] = 20 mM; [HCl] = 1.0 mM; [$Ru(bipy)_3^{2+}$] = 3.33 μM; [TCP] = 0.56 mM; path length 1.00 cm; *T* = 25.0 °C. Flow rate (for red and green curves: 3.53 cm^3/min, ; stirring (for blue and red curves): 800 rpm.