Supplementary Information

Catalyst Recovery, Regeneration and Reuse during Large-Scale Disinfection of Water using Photocatalysis

Jonathan Bockenstedt [1], Niraj Vidwans[1], Terry Gentry [3] and Sreeram Vaddiraju [1,2]*

[1] Artie McFerrin Department of Chemical Engineering, Texas A&M University, College Station, TX 77843, USA;
[2] Department of Materials Science & Engineering, Texas A&M University, College Station, TX 77843, USA;
[3] Department of Soil and Crop Sciences, Texas A&M University, College Station, TX 77843, USA;
* Correspondence: Sreeram.vaddiraju@tamu.edu; Tel.: +1-979-862-1615

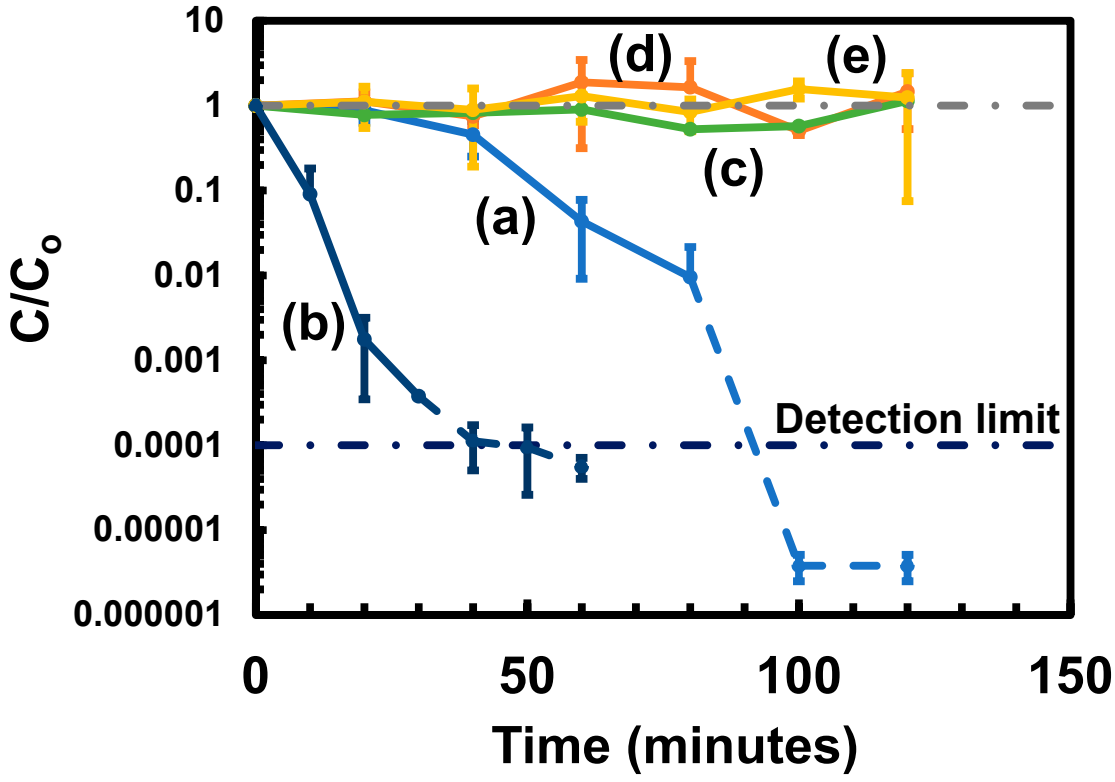


Figure S1. A plot indicating the kinetics of *E. coli* inactivation in the beaker-scale water disinfection system. Here, 30 ml suspensions contained within quartz beakers were exposed to UV-A light for performing photocatalytic studies. The letters in the plot indicate the following experimental conditions: (a) the disinfection kinetics of *E. coli*, using porous titanium dioxide nanowires as photocatalyst under exposure to UV-A light (b) the disinfection kinetics of Aeroxide® P25 nanoparticles under exposure to UV-A light (c)

control case of a suspension of *E. coli* bacteria under exposure to UV-A light (d) a control case of suspension of *E. coli* bacteria and porous titanium dioxide nanowires without any UV-A light (e) a control case with a suspension of *E. coli* bacteria stirred for the duration of the experiment. The plot indicates that Aeroxide® P25 nanoparticles exhibit faster disinfection kinetics relative to that obtained using TiO_2 porous nanowires. The photocatalyst concentration in all the relevant cases was 1g/L [1].

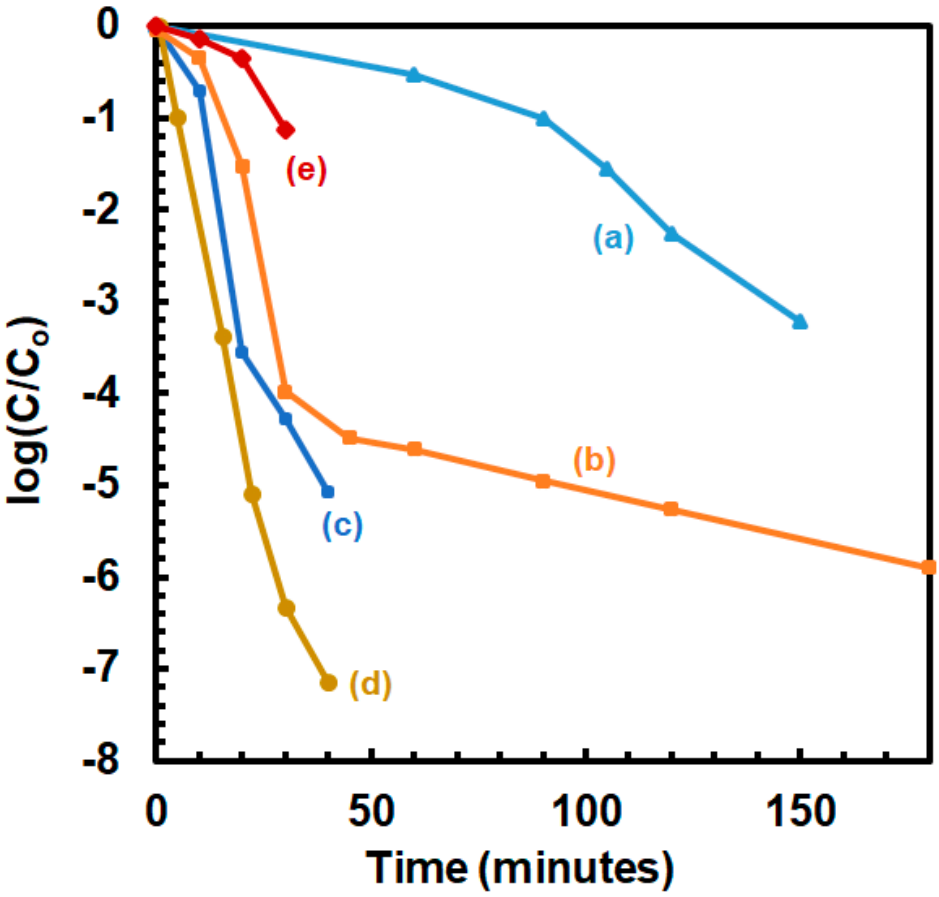


Figure S2. Comparison of kinetics for the disinfection of *E. coli* using TiO_2 Aeroxide® P25 as the photocatalyst activated using the following light sources. (a) 18-W black-light blue lamps [2], (b) irradiation produced by an HPK 125 lamp [3], (c) irradiation produced by a high intensity long-wave (highest emission at 365 nm) ultraviolet lamp [4], (d) irradiation produced by a solar simulation irradiation from a Hanau Suntest (AM1) lamp [5], (e) irradiation produced by 40-W black light tubes [6].

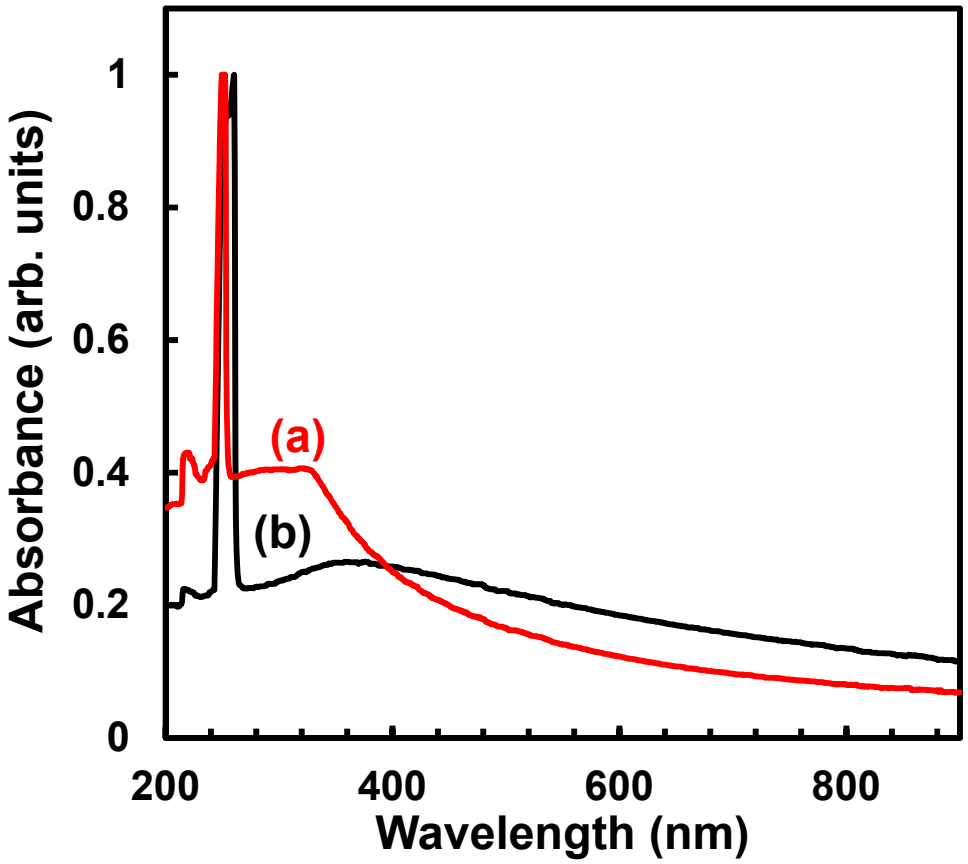
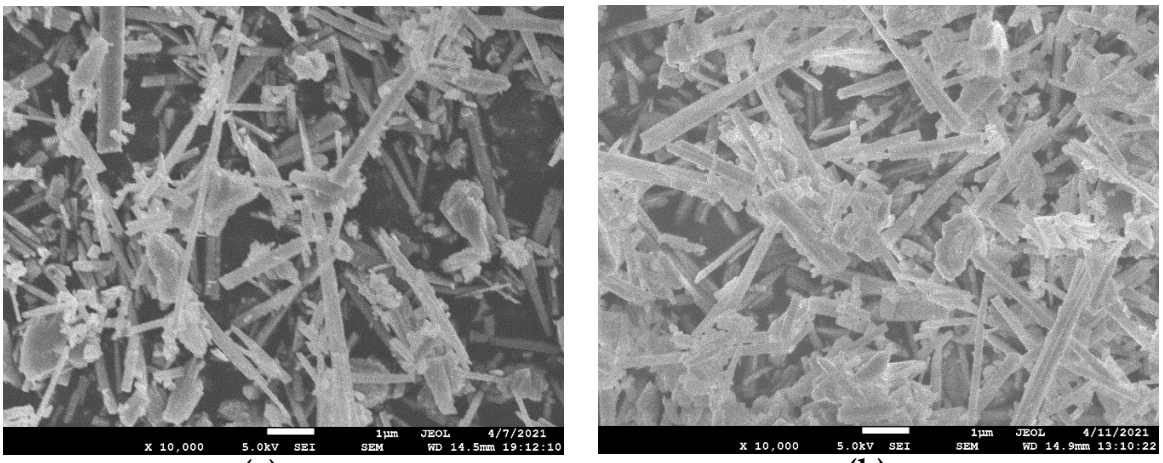


Figure S3. UV-Vis absorption spectra for (a) TiO_2 Aeroxide® P25 nanoparticles and (b) TiO_2 porous nanowires. Both the spectra indicate light absorbance in the UV-A regime (i.e., 315-400 nm wavelength range). The relative differences in the magnitudes of UV-A absorbed could be attributed to the differences in both the morphologies and the surface areas of the two different types of the photocatalysts. The concentration of the photocatalysts used for this UV-Vis study was 0.05 g/L.



(a) **(b)**

Figure S4. A comparison of morphologies of (a) as-obtained TiO_2 porous nanowires, and (b) TiO_2 nanowires recovered after photocatalysis. The micrographs indicate that the TiO_2 nanowires retain their morphology after their use as photocatalysts. This result is in line with the surface area analysis that indicated minimal change in the TiO_2 porous nanowire photocatalyst surface areas upon their use for *E. coli* inactivation in water.

References:

[1] G. Afreen, J.A. Lara-Ramos, N.A. Vidwans, V. Atla, V. Kumar, S. Vaddiraju, F. Machuca-Martinez, M.K. Sunkara, S. Upadhyayula, Bulk production of porous TiO2 nanowires by unique solvo-plasma oxidation approach for combating biotic and abiotic water contaminants, Journal of Materials Science: Materials in Electronics, (2021) 1-14.

[2] M. Cho, H. Chung, W. Choi, J. Yoon, Different inactivation behaviors of MS-2 phage and Escherichia coli in TiO2 photocatalytic disinfection, Applied and environmental microbiology, 71 (2005) 270-275.

[3] A. Benabbou, Z. Derriche, C. Felix, P. Lejeune, C. Guillard, Photocatalytic inactivation of Escherischia coli: Effect of concentration of TiO2 and microorganism, nature, and intensity of UV irradiation, Applied Catalysis B: Environmental, 76 (2007) 257-263.

[4] J.A. Ibáñez, M.I. Litter, R.A. Pizarro, Photocatalytic bactericidal effect of TiO2 on Enterobacter cloacae: Comparative study with other Gram (−) bacteria, Journal of Photochemistry and photobiology A: Chemistry, 157 (2003) 81-85.

[5] A.-G. Rincón, C. Pulgarin, Comparative evaluation of Fe3+ and TiO2 photoassisted processes in solar photocatalytic disinfection of water, Applied Catalysis B: Environmental, 63 (2006) 222-231.

[6] P.-C. Maness, S. Smolinski, D.M. Blake, Z. Huang, E.J. Wolfrum, W.A. Jacoby, Bactericidal activity of photocatalytic TiO2 reaction: toward an understanding of its killing mechanism, Applied and environmental microbiology, 65 (1999) 4094-4098.