Electronic Supplementary Material (ESI) for Nanoscale

Understanding bactericidal performance on ambient light activated TiO_2-$InVO_4$ nanostructured films

Ziming He[a], Qingchi Xu[a] and Timothy Thatt Yang Tan[a]*

[a]*School of Chemical and Biomedical Engineering, 62 Nanyang Drive, Nanyang Technological University, Singapore 637459.*

* Corresponding Author: T.T.Y. Tan (E-mail: tytan@ntu.edu.sg), Telephone: +65-63168829, Fax: +65-67911761

Supplementary experimental section

Photocatalytic activity test

Photocatalytic activities of the as-prepared thin films were evaluated by the decomposition of stearic acid under ambient artificial light illumination (a regular 18 W Philips E27 fluorescent lamp with a UV-cutoff filter $\lambda < 400$ nm to simulate ambient light illumination) at ambient temperature according to a method proposed by Pore and coworkers.[1] The distance from lamp to samples was fixed at 1 cm. The decomposition of stearic acid was monitored at 6 hours intervals up to 24 hours using a FTIR spectrometer (Perkin-Elmer Spectrum GX) by evaluating the 2917 cm^{-1} peak corresponding to the asymmetric C-H stretching of the CH_2 group. The absorbance of 0.01 corresponds to a thickness of 12.5 nm of stearic acid layer spin-coated on obtained films. [1]

Supplementary results

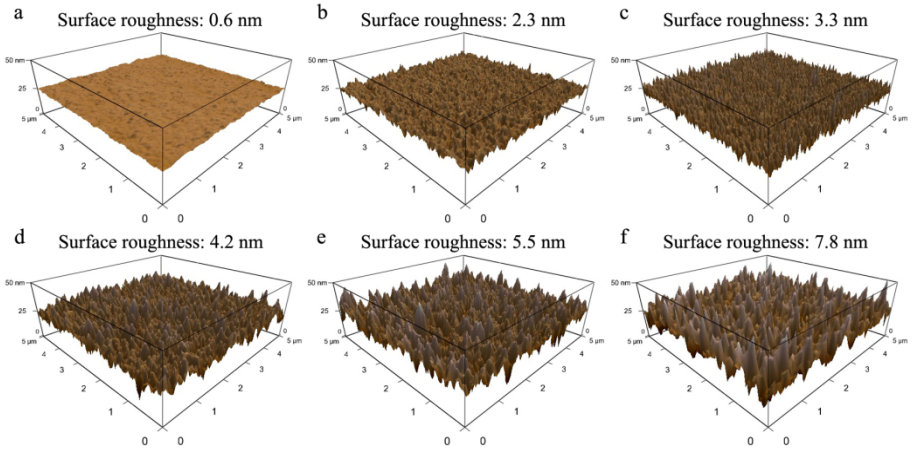

Fig. S1 AFM micrographs of (a) TI-0, (b) TI-0.5 (c) TI-1, (d) TI-3, (e) TI-5 and (f) TI-10 films.

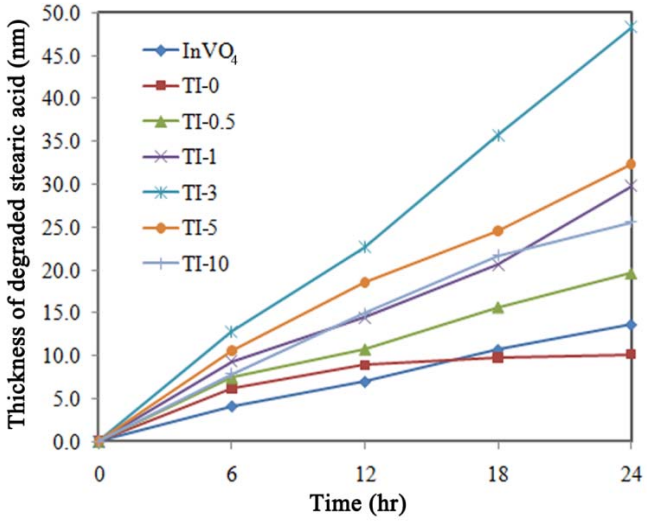

Fig. S2 Decomposition of stearic acid on as-prepared films under ambient light illumination.

The decomposition of stearic acid on the as-prepared films exposed to ambient light is shown in Fig. S2. $InVO_4$ exhibited lower stearic acid photo-degradation rate compared to that of other films.[2] Unmodified TiO_2 thin film also exhibited a small amount of photocatalytic activity, which may be attributed to the presence of carbon impurities (derived from TIP) that can act as photosensitizers.[3, 4] Due to the sensitization effect of $InVO_4$, the photocatalytic efficiency of TiO_2-$InVO_4$ films under visible light was significantly higher than that of TiO_2. TI-3 sample showed the highest efficiency among the nanocomposite films. After 24 h of illumination, the thickness of stearic acid degraded on TiO_2-$InVO_4$ film was 48.35 nm, 4.8 times higher than that on TiO_2 film (10.17 nm). If we assume a zero-order reaction kinetic of stearic acid photo-decomposition with respect to the thickness of stearic acid layer,[4] then the rate constant K for TI-3 film was calculated to be 2.0 nm h^{-1}. Further increase of

$InVO_4$ loading to 5.0 wt.% and 10.0 wt.% in the composite films resulted in the decrease of photocatalytic activity. This may be due to higher amount of $InVO_4$, which could act as charge recombination sites, and the negative influence of the particle aggregation in composite films.

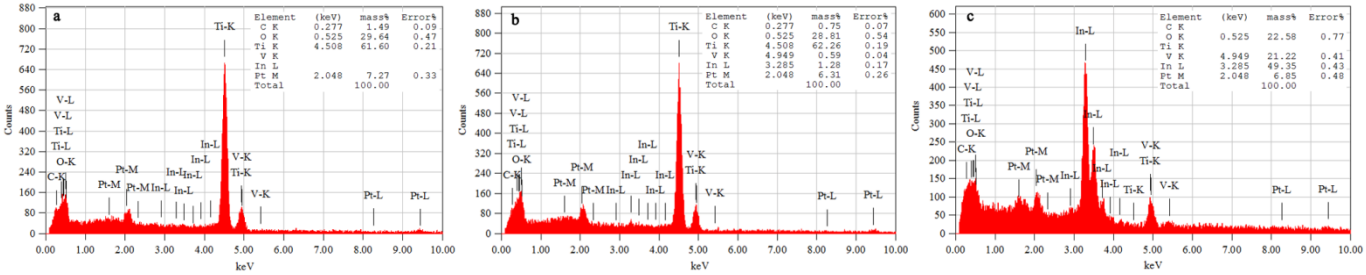

Fig. S3 EDX spectra of (a) TI-0, (b) TI-3 and (c) $InVO_4$. The insets show the concentrations of elements.

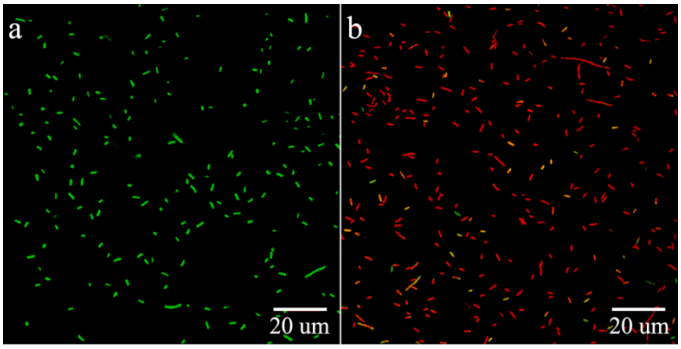

Fig. S4 LSCM image of *E. coli* on (a) bare glass and (b) TI-3 film exposed to visible light for 1 h.

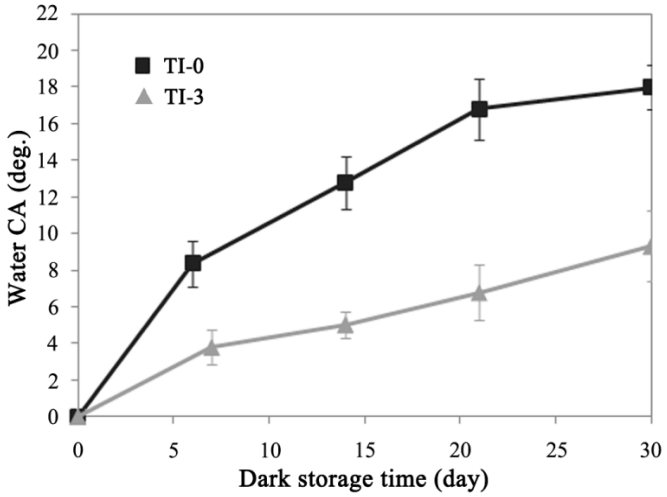

Fig. S5 Water CA of TI-0 and TI-3 films over dark storage time.

References

1. V. Pore, M. Ritala, M. Leskela, S. Areva, M. Jarn and J. Jarnstrom, *J. Mater. Chem.*, 2007, **17**, 1361-1371.
2. L. W. Zhang, H. B. Fu, C. Zhang and Y. F. Zhu, *J. Solid State Chem.*, 2006, **179**, 804-811.
3. X. X. Yang, C. D. Cao, L. Erickson, K. Hohn, R. Maghirang and K. Klabunde, *J. Catal.*, 2008, **260**, 128-133.
4. Q. C. Xu, D. V. Wellia, M. A. Sk, K. H. Lim, J. S. C. Loo, D. W. Liao, R. Amal and T. T. Y. Tan, *J. Photochem. Photobiol., A*, 2010, **210**, 181-187.