

Electronic Supplementary Information (ESI)

Monolithic 3D titania with ultrathin nanoshell structures for enhanced photocatalytic activity and recyclability

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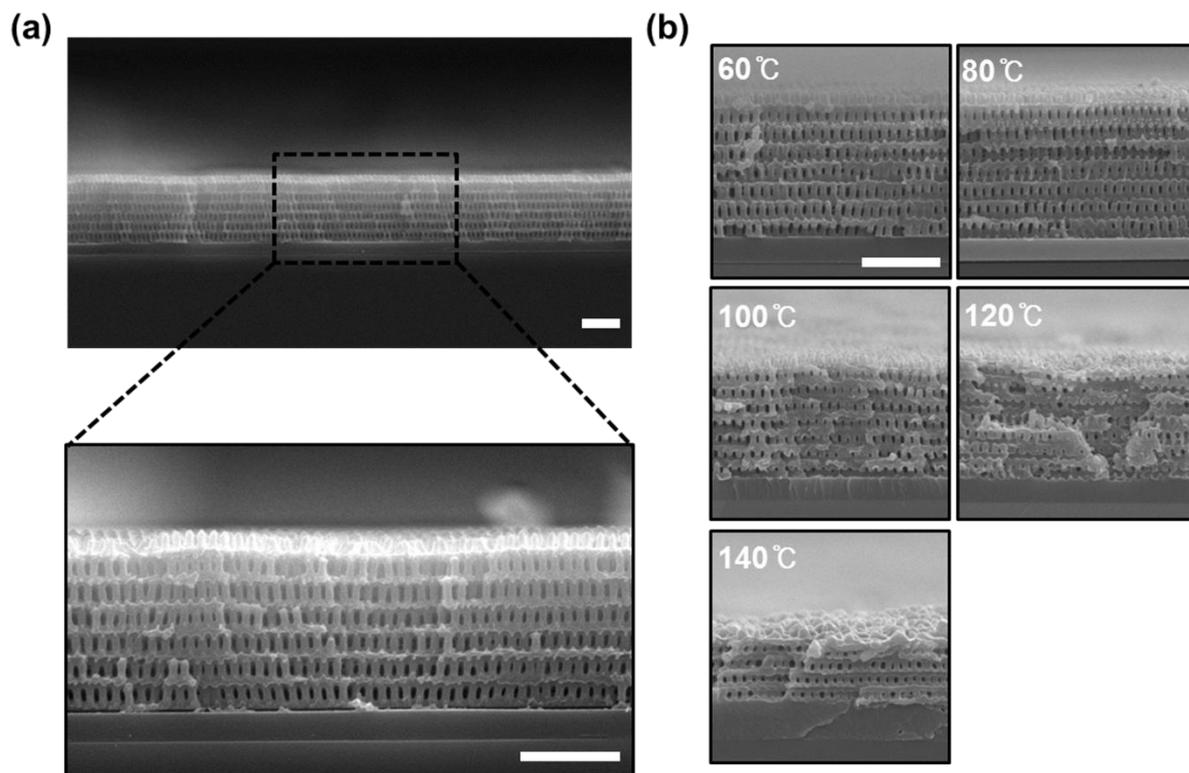


Fig. S1 (a) Cross sectional SEM images of 3D nanostructured polymer templates prepared by PnP. (b) Cross sectional SEM images of 3D polymer templates after heat-treatment at various temperatures (60 °C, 80 °C, 100 °C, 120 °C, 140 °C). Scale bar: 5 μm .

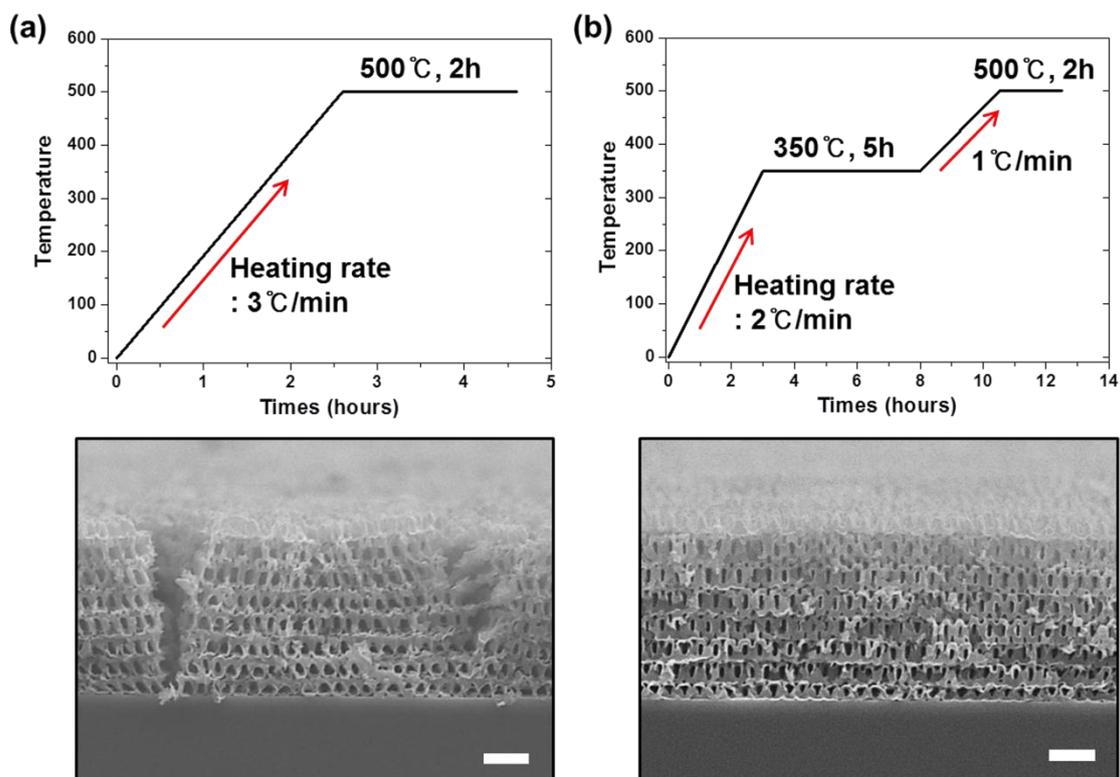


Fig. S2 Two different strategies for heat-treated template removal and resultant 3D structures after each process. (a) One-step process (3 °C/min up to 500 °C). (b) Two-step process (2 °C/min up to 350 °C and 1 °C/min up to 500 °C). Scale bar: 2 μm.

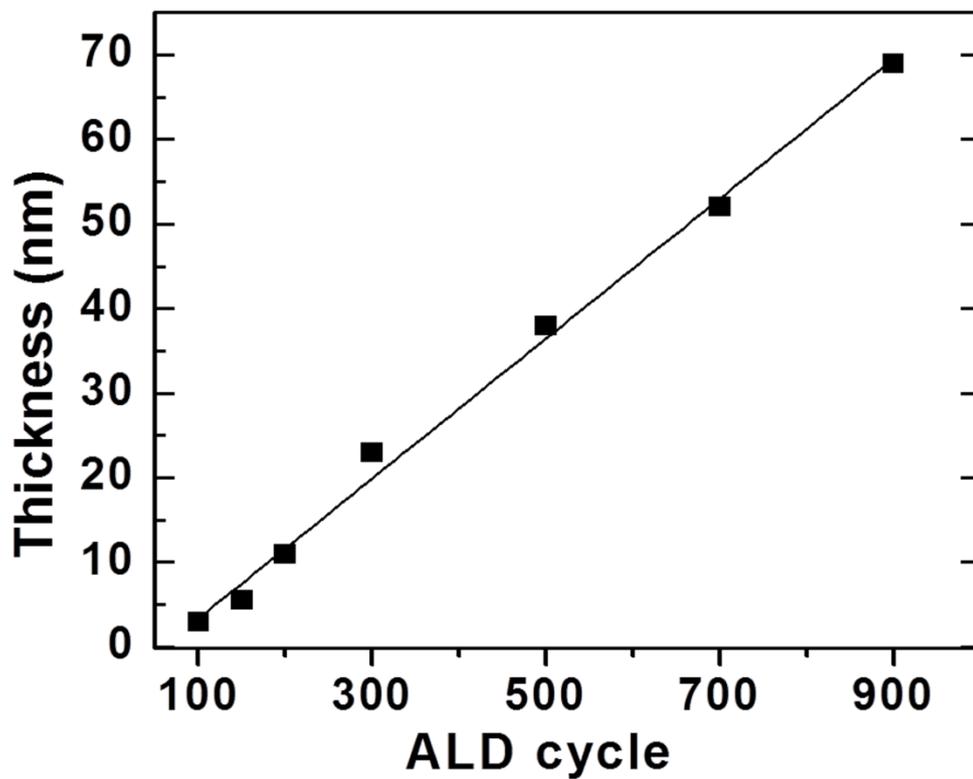


Fig. S3 A measured film thickness on a flat substrate as a function of the number of ALD cycles.

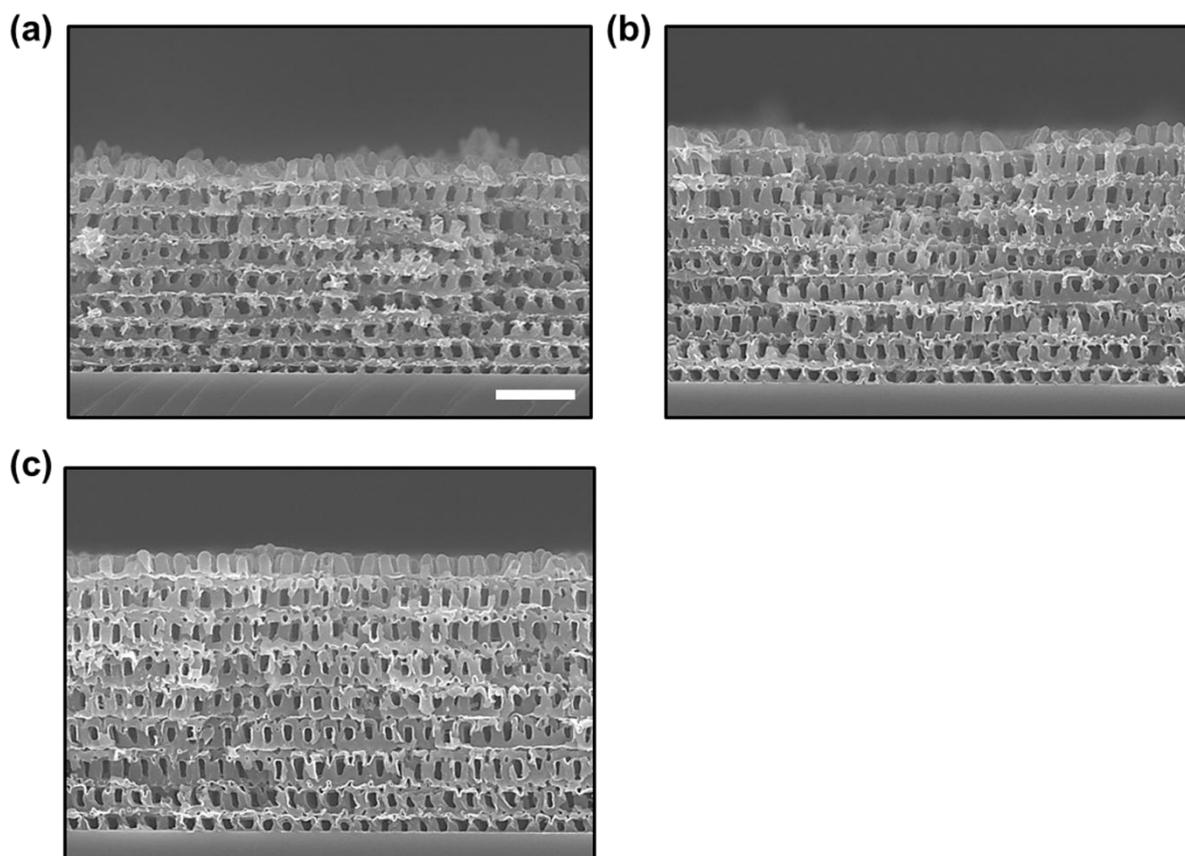


Fig. S4 Cross sectional SEM images of 3D nanoshell titania prepared by various ALD cycles (a) 150 cycle. (b) 200 cycle. (c) 250 cycle. Scale bar: 2 μm .

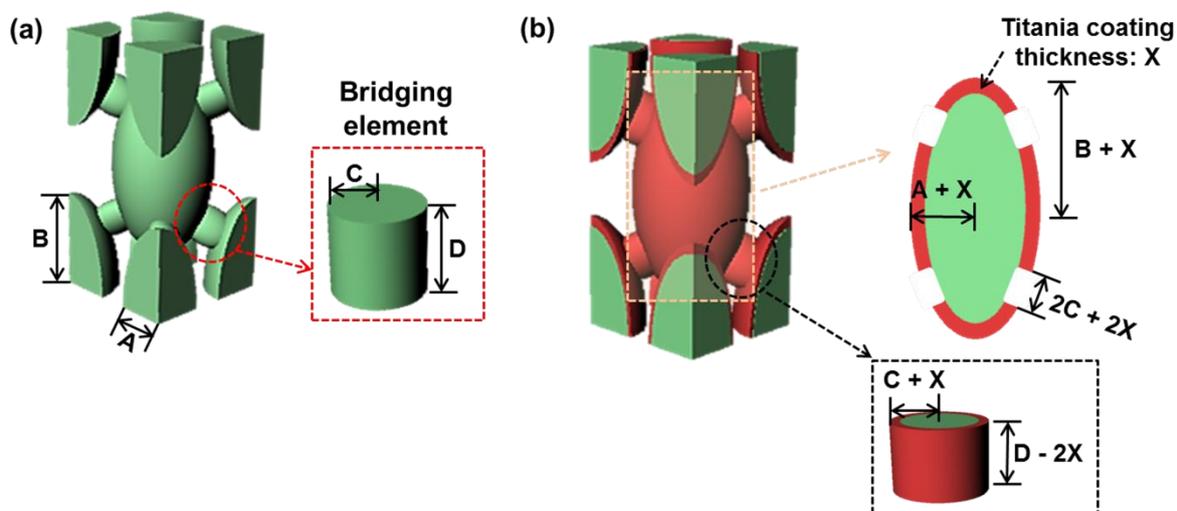


Fig. S5 Schematic images of ellipsoid body and bridging elements with detailed parameters for the calculation of surface area. (a) Original polymer templates. (b) Titania coated polymer templates. The unit cell consists of ellipsoids (prolate spheroid) with equatorial radius A and polar radius B , respectively. Each ellipsoid is interconnected through bridging elements in a cylindrical shape (radius C , height D). Parameters of 3D polymer template: $A = 200$ nm, $B = 500$ nm, $C = 150$ nm, $D = 150$ nm. Coating thickness (X) = 7.7 nm (100 cycle), 23.1 nm (300 cycle), 38.5 nm (500 cycle), 53.9 nm (700 cycle), 69.3 nm (900 cycle).

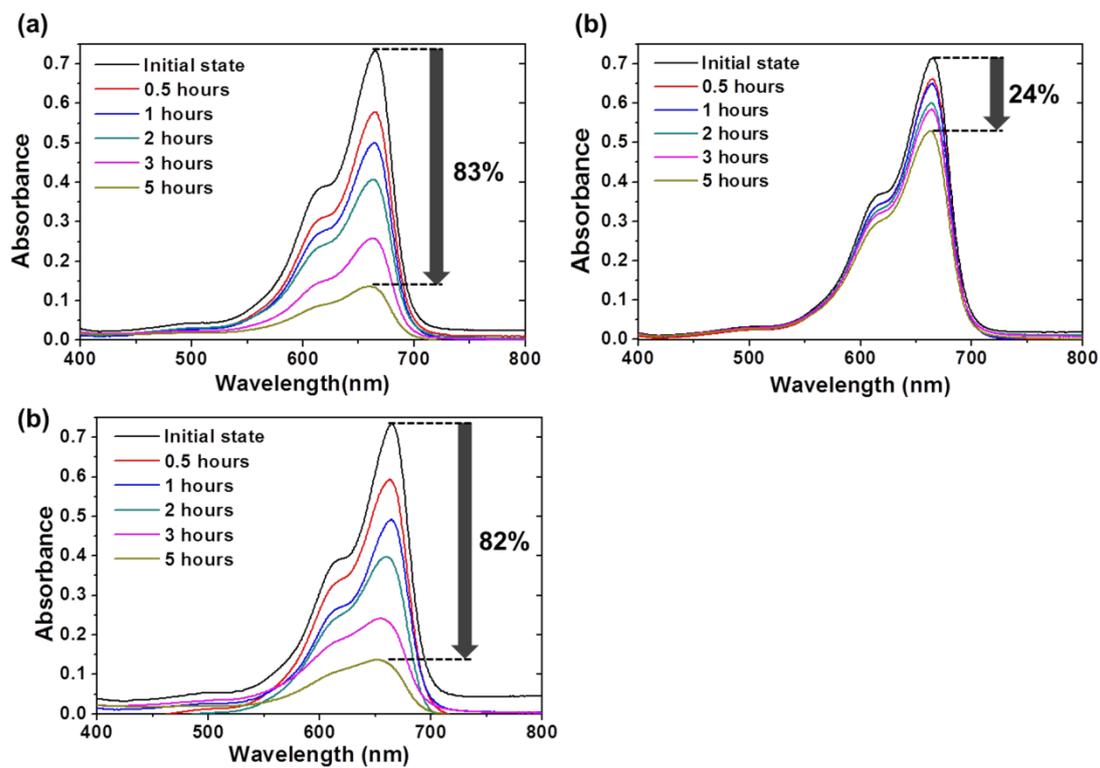


Fig. S6 Time profile of MB absorbance spectra under UV irradiation. (a) 3D nanoshell. (b) Thin film. (c) P25 film (commercially available nanoparticles).

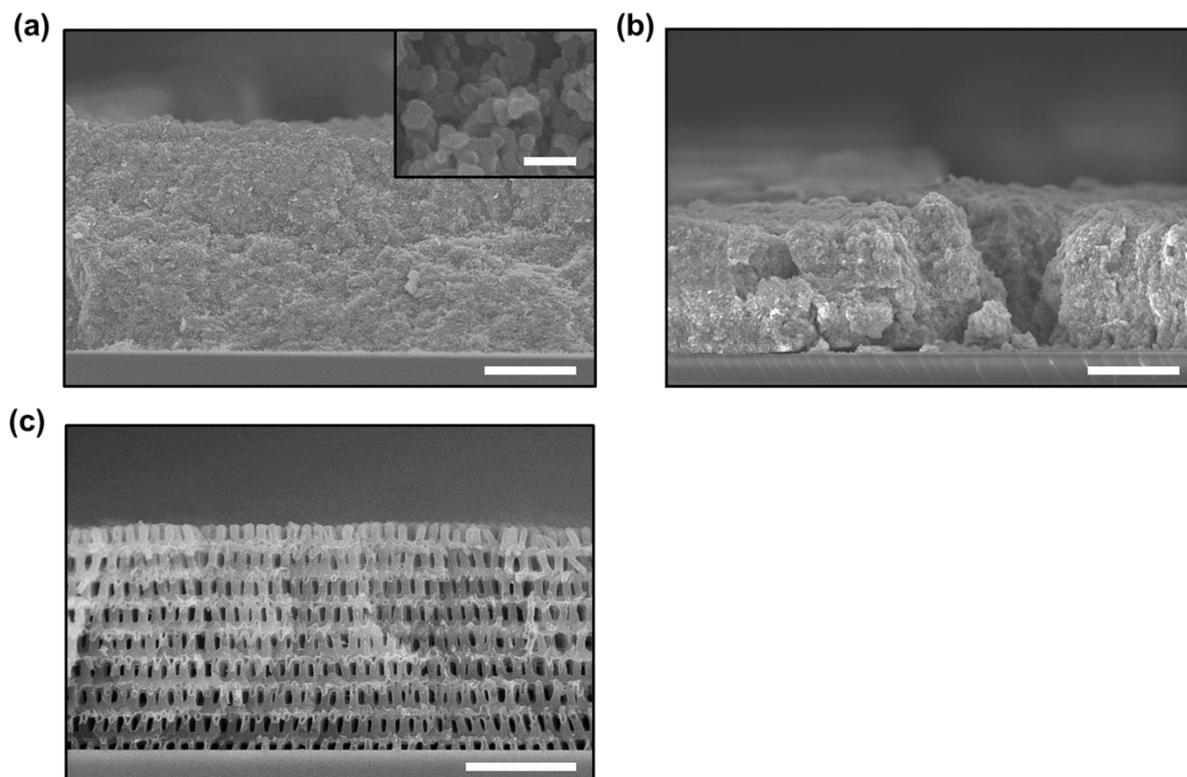


Fig. S7 (a) A cross sectional SEM image of a P25 film (inset: a top view SEM image). (b) A cross sectional SEM image of a P25 film after finishing 5 cycles for photocatalytic reaction. (c) A cross sectional SEM image of 3D nanoshell titania after finishing 5 cycles for photocatalytic reaction. Scale bar: 5 μm (a,b,c), 200 nm (inset)

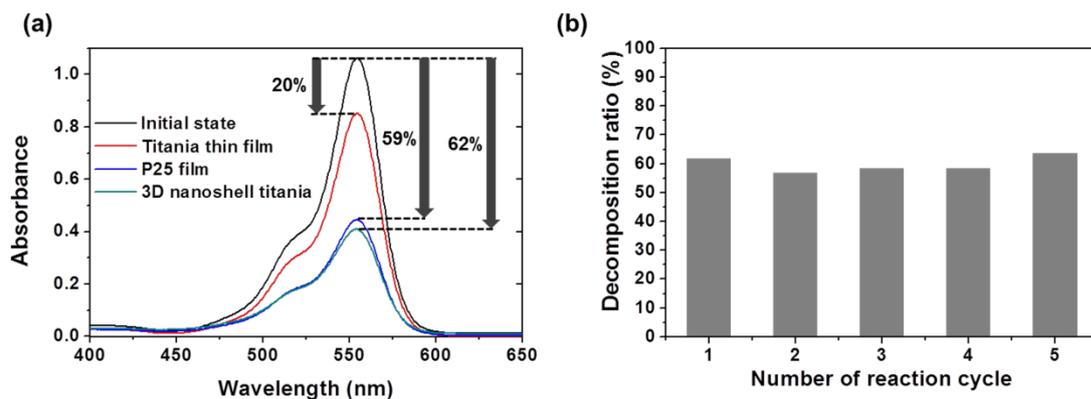


Fig. S8 Analysis of photocatalytic activity using rhodamine b solution under UV irradiation for 3 hours. (a) Comparison of photodegradation properties of a thin film, P25 film and a 3D nanoshell titania. (b) Recyclability of 3D nanoshell titania.