

Electronic Supplementary Material (ESI)

TiO₂-SiO₂ composite fibers with tunable interconnected porous hierarchy fabricated by single-spinneret electrospinning toward enhanced photocatalytic activity

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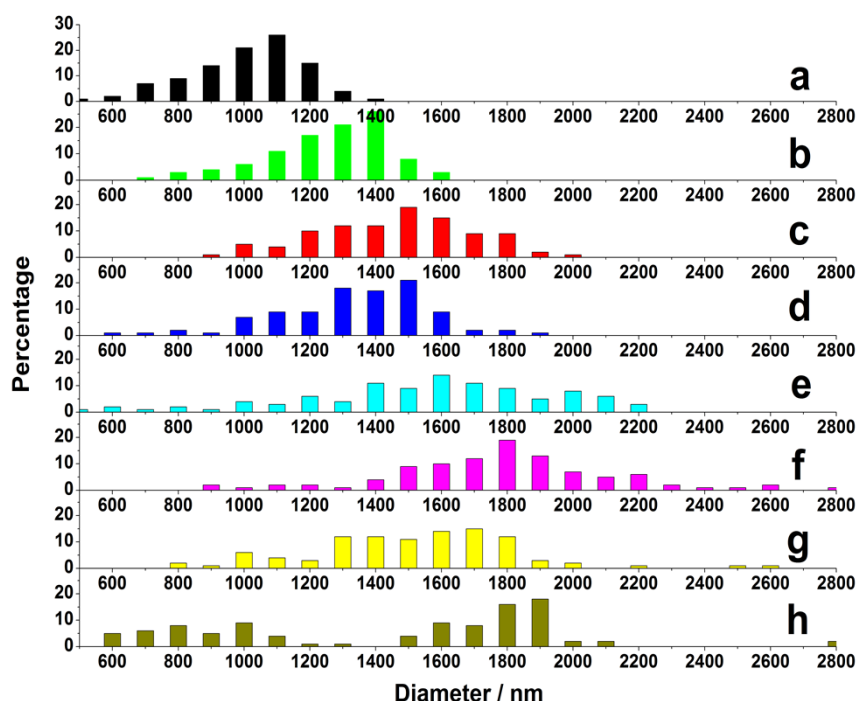


Fig. S1 Histogram of the diameter distributions of TS-n obtained from electrospinning solutions of varying Ti/Si ratios. (a) TS- ∞ , (b) TS-8.08, (c) TS-5.41, (d) TS-2.53, (e) TS-1.18, (f) TS-0.69, (g) TS-0.35 and (h) TS-0.13, showing that the diameter distribution of TS-n widens with decreasing Ti/Si ratios.

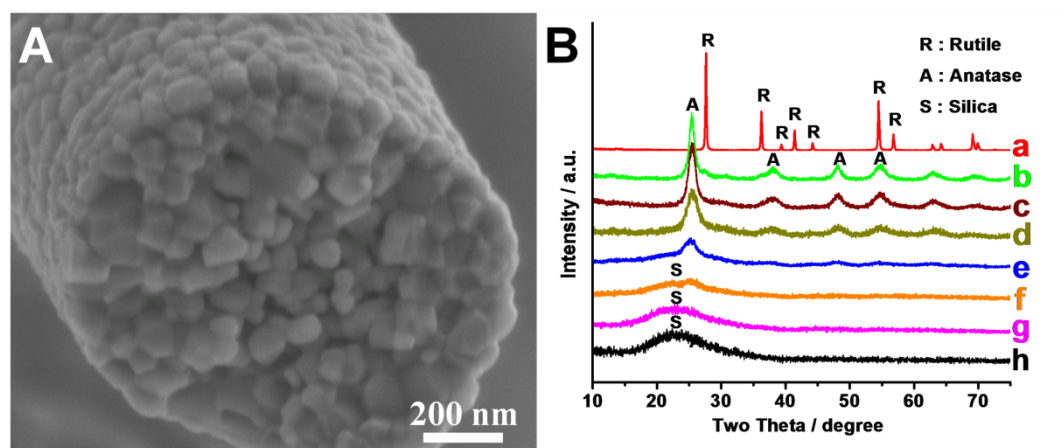


Fig. S2 (A) SEM of TS- ∞ showing aggregated polycrystals. (B) XRD patterns: (a) TS- ∞ , (b) TS-8.08, (c) TS-5.41, (d) TS-2.53, (e) TS-1.18, (f) TS-0.69, (g) TS-0.35 and (h) TS-0.13, showing that TS- ∞ has a rutile structure with high crystallinity, and TS-8.08, TS-5.41, TS-2.53 and TS-1.18 have a anatase structure with decreasing crystallinity. TS-0.69, TS-0.35 and TS-0.13 contain amorphous silica.

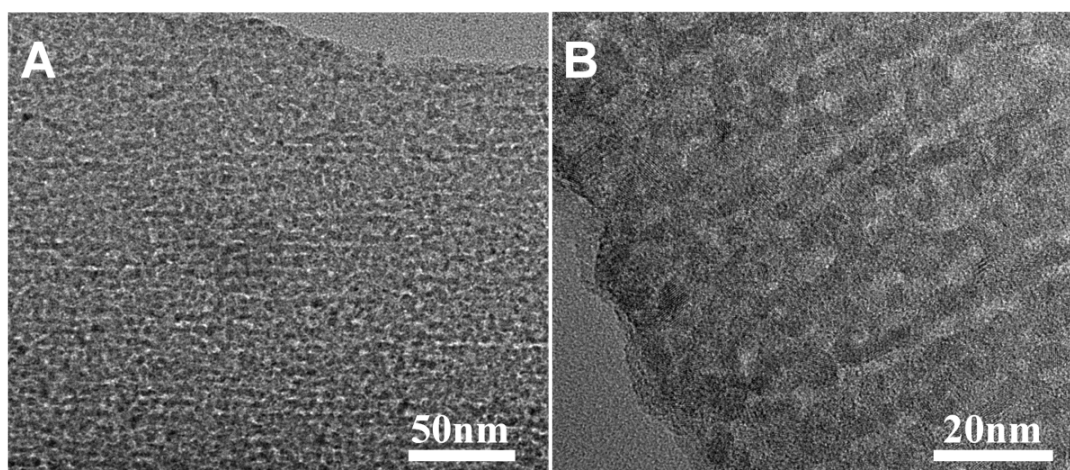


Fig. S3 TEM imaging analysis of TS-8.08 showing porous structure and permeable fiber wall.

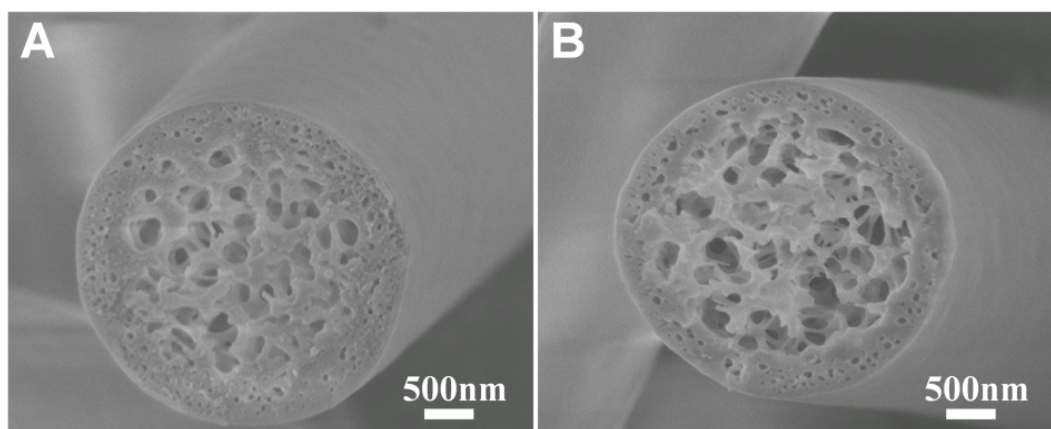


Fig. S4 SEM of (A) TS-0.35 and (B) TS-0.13 before calcination.

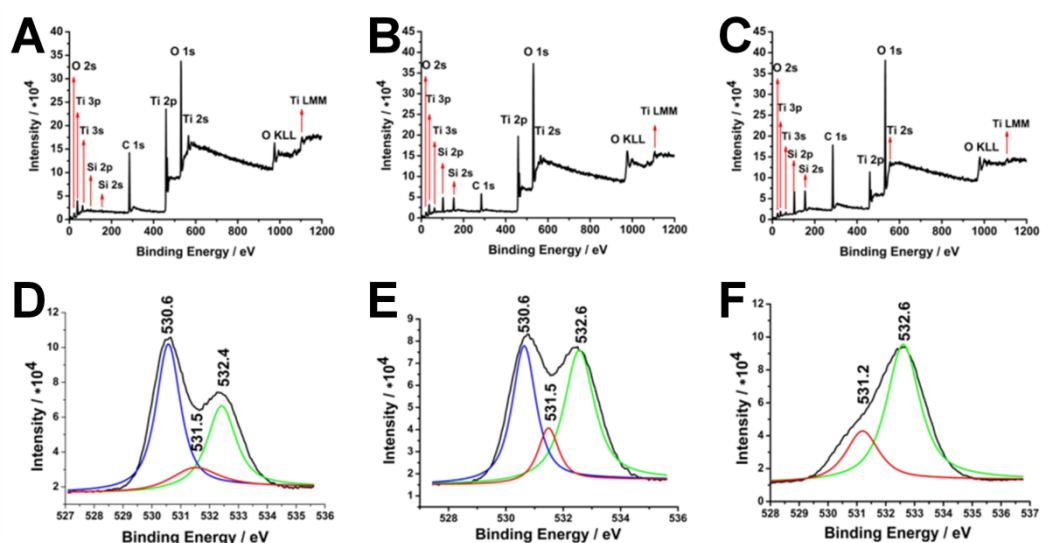


Fig. S5 XPS survey spectra: (A) TS-8.08. (B) TS-2.53 (C) TS-0.69. The deconvoluted peaks of O 1s: (D) TS-8.08. (E) TS-2.53. (F) TS-0.69. The binding energy at 530.6 eV, 531.5 eV and 532.4 eV is ascribable to the Ti-O-Ti, Ti-O-Si and Si-O-Si linkages, respectively. The percentage of Ti-O-Ti linkages decrease and that of the Si-O-Si linkages increase with increasing silica contents. The amount of Ti-O-Si linkages appears to level off at TS-2.53.

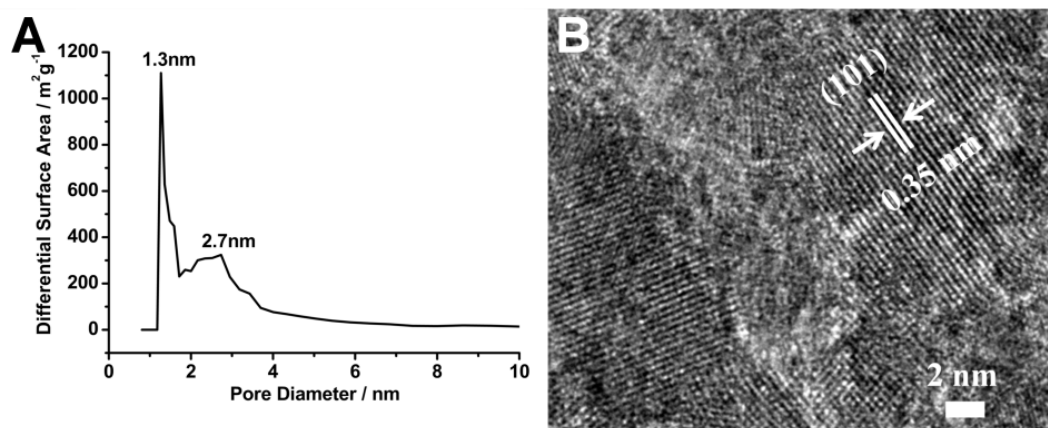


Fig. S6 (A) The micro-mesopore size distribution of TS-0.13 based on the DFT model. (B) High resolution TEM of TS-8.08 showing the presence of crystalline domains and amorphous domains and interfacial regions.

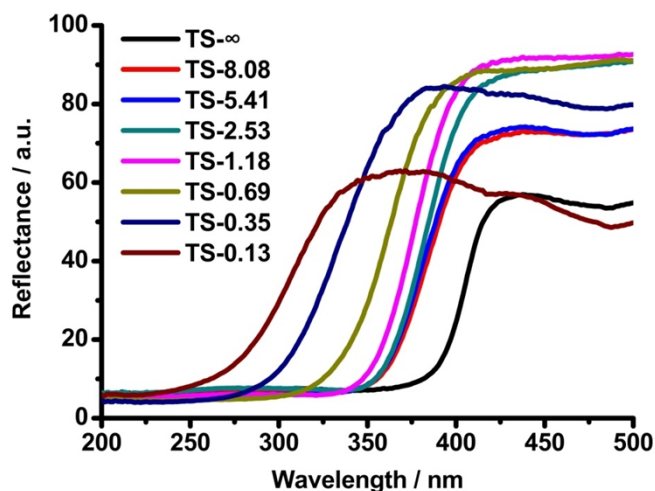


Fig. S7 UV-vis diffuse reflectance spectroscopy of TS-n.

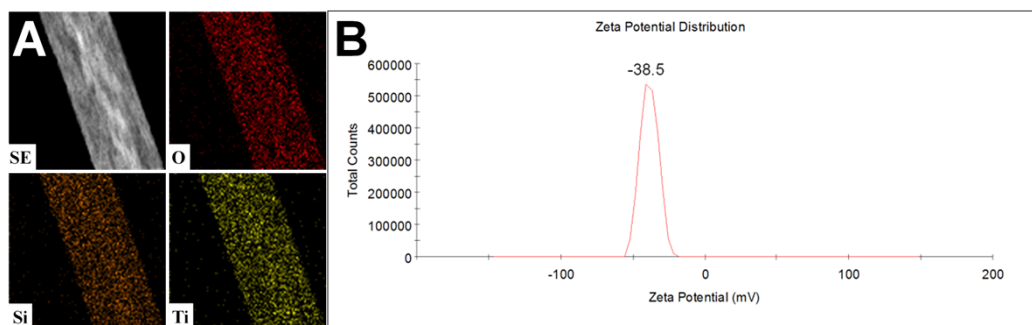


Fig. S8 (A) The elemental mapping of O, Si and Ti in TS-8.08 based on EDX analysis. (B) The zeta potential of TS-8.08 in water.

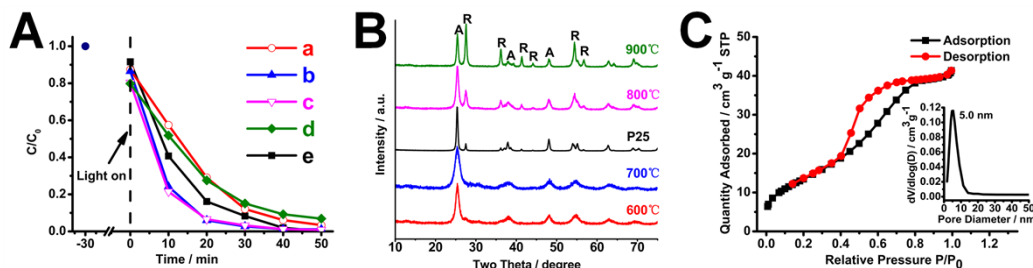


Fig. S9 (A) Photocatalytic degradation of RhB in the presence of TS-8.08 calcined for 6 h in air at (a) 600 °C, (b) 700 °C, (c) 800 °C, (d) 900 °C and (e) P25. (B) XRD patterns of P25, and TS-8.08 upon calcination at different temperatures for 6 h. TS-8.08 contains anatase upon calcination below 700 °C, and mixed anatase/rutile of 71/29 and 49/51 molar ratio upon calcination at 800 °C and 900 °C, respectively. (C) The nitrogen adsorption-desorption isotherm and pore size distribution curve (inset) of TS-8.08 calcined at 800 °C for 6h, the BET surface area of TS-8.08 calcined at 800 °C for 6h is 50.0 m² g⁻¹.

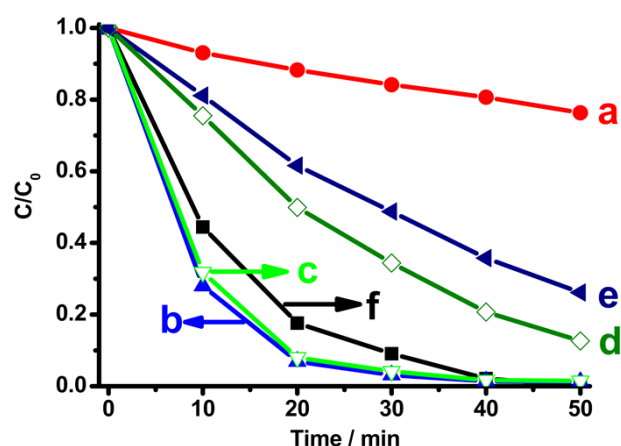


Fig. S10 Photocatalytic degradation of RhB monitored at normalized concentration change (C/C_0) vs irradiation time (t) in the presence of (a) TS-∞, (b) TS-8.08, (c) TS-5.41, (d) TS-2.53, (e) TS-1.18 and (f) P25. C_0 and C are the initial concentration after adsorption equilibrium and the concentration of RhB at any irradiation time, respectively.

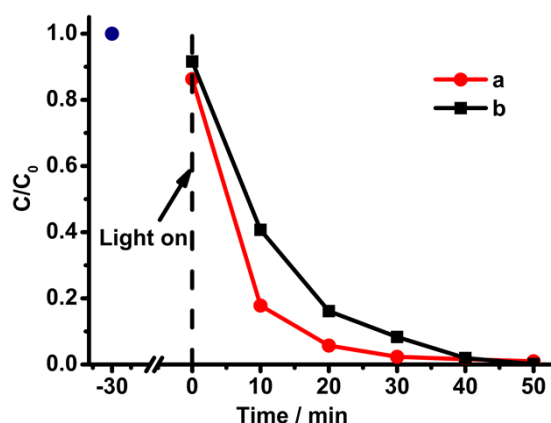


Fig. S11 Photocatalytic degradation of RhB based on 50 mg of TiO₂: (a) TS-8.08 and (b) P25.

Table S1 Comparing the photocatalytic activity of TS-8.08 with selected reported works.

TiO ₂ photocatalysts	C _{RHB} : W _{tCatalyst} (mol : g)	Light source	Degradation vs time	Rate constants / min ⁻¹	Ref
Macroporous Brookite	8×10 ⁻⁴ : 1	UV (352 nm)	92% (100min)	0.0303	1
P25	1×10 ⁻⁵ : 1	25W Hg	20% (60min)	0.0065	2
TiO ₂ (80%)-SiO ₂ (20%)			97% (60min)	0.109	
P25	2×10 ⁻⁶ : 1	300 W Xe	92% (60min)	Not available	3
TiO ₂ /AlOOH superstructures			95% (60min)	Not available	
P25	1×10 ⁻⁵ : 1	500W	Not available	0.0025	4
38% Brookite-62% Rutile			Not available	0.0150	
P25	4×10 ⁻⁵ : 1	300 W Xe	70% (60min)	Not available	5
Ag/TiO ₂			96% (60min)	Not available	
P25	2×10 ⁻⁵ : 1	300 W Xe	100% (30min)	0.1108	6
Au@TiO ₂ core-shell			80% (200min)	0.0087	
Pd@TiO ₂ core-shell			100% (120min)	0.0262	
Pt@TiO ₂ core-shell			100% (50min)	0.0795	
P25	4×10 ⁻⁵ : 1	800 W Xe	81.8% (60min)	Not available	7
TiO ₂ nanotube			98.9% (60min)	Not available	
TiO ₂ nanowire			91.9% (60min)	Not available	
P25	8×10 ⁻⁵ : 1	250 W Hg	89.6% (120min)	0.0187	8
Macro-mesoporousTiO ₂ film			92.1% (120min)	0.0206	
Mesoporous TiO ₂ microsphere	1×10 ⁻⁴ : 1	300 W Hg	100% (60min)	0.1090	9
P25	5×10 ⁻⁵ : 1	UV(365 nm)	85% (50min)	Not available	10
Anatase TiO ₂ nanowire			93% (50min)	Not available	
TiO ₂ nanoparticles	1×10 ⁻⁵ : 1	UV(254 nm)	100% (150min)	0.0230	11
P25	2×10 ⁻⁵ : 1	20W	100% (12h)	0.0057	12
Carbon/TiO ₂ nanotubes			95% (12h)	0.0048	
P25	1×10 ⁻⁵ : 1	300 W Hg	100% (50min)	0.0895	Current work
TS-8.08			100% (50min)	0.1071	

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