Supporting Information

Polyacrylamide exotemplate-assisted synthesis of hierarchically porous nanostructured TiO$_2$ macrobeads for efficient photodegradation of organic dyes and microbes

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Figure S1. (A) UV-vis diffuse reflectance spectra and (B) plot of Kubelka-Munk function \((F(R)h\nu)^{0.5}\) versus photon energy \((E_g)\) for the bandgap measurement of (a) PAM–TiO\(_2\) NC, and (b) porous NS TiO\(_2\) macrobeads.
Figure S2. SEM images (cross-sectional view) of (A–C) PAM showing greater macroporosity, (D–F) PAM–TiO$_2$ NC macrobeads showing (D,E) blocked pores and (F) TiO$_2$ particles.
Figure S3. Pore size distribution of (A) PAM, (B) PAM–TiO₂ NC and (C) porous NS TiO₂ macrobeads. (D) Particle size distribution of TiO₂ nanobuilding blocks. ImageJ software was used to measure the average pore size distribution of beads and particle size of TiO₂ nanobuilding units (NBUs).
Figure S4. Removal efficiency (mg/g) of porous NS TiO$_2$ macrobeads (A) without H$_2$O$_2$, and (B) with H$_2$O$_2$. 
Figure S5. Time-wise bactericidal efficiencies (%) of 0.2 mg/mL dosage of PAM, PAM–TiO$_2$ NC and porous NS TiO$_2$ macrobeads against *S. aureus* under (A) UV light and in the (B) dark, and against *E. coli* under (C) UV light and in the (D) dark.
Figure S6. Fluorescence spectra of the irradiated (a) TA (without TiO$_2$) and TA with TiO$_2$ samples.
Figure S7. SEM image of a single NS TiO$_2$ macrobead. (B) Digital photograph of the NS TiO$_2$ macrobeads (zoomed-in view in the inset) showing their integrity in MB aqueous solution.
### Table S1. A comparison for the removal of methylene blue by different TiO$_2$-based materials.

| Material                               | Removal Efficiency | $k$ (min$^{-1}$) | Operational Parameters | Ref. |
|----------------------------------------|--------------------|------------------|------------------------|------|
| commercial TiO$_2$ powders            | 48.2%              | —                | 15 mg of Catalyst, 20 ppm MB Conc., 50 mL of MB, 70 min | 1    |
| CdSe-TiO$_2$ nanocrystals             | 67%                | 0.004            | 9 mg of Catalyst, 10 ppm MB Conc., 100 mL of MB, 60 min | 2    |
| TiO$_2$–polymer nanofibers             | 70%                | —                | 1×10$^{-8}$ M MB Conc., 200 mL of MB, 180 min | 3    |
| TiO$_2$-based coatings                 | 71.5%              | —                | 2×10$^{-8}$ M MB Conc., 10 mL of MB, 180 min | 4    |
| Ag NPs loaded TiO$_2$ NTs             | 81.2%              | —                | 20 mg of Catalyst, 20 ppm MB Conc., 60 mL of MB, 150 min | 5    |
| PoPD/TiO$_2$ NCs                      | 85.9%              | 0.010            | 30 mg of Catalyst, 10 ppm MB Conc., 30 mL of MB, 180 min | 6    |
| commercial TiO$_2$ NPs                | 90%                | 0.025            | 150 mg of Catalyst, 150 ppm MB Conc., 300 mL of MB, 360 min | 7    |
| anatase nano-TiO$_2$                  | 90.3%              | 0.035            | 50 mg of Catalyst, 4×10$^{-8}$ M MB Conc., 100 mL of MB, 60 min | 8    |
| TiO$_2$ hollow microspheres            | 92%                | —                | 100 mg of Catalyst, 15 ppm MB Conc., 500 mL of MB, 360 min | 9    |
| TiO$_2$@rGO NCs                       | 92%                | 0.018            | 200 mg of Catalyst, — MB Conc., 5 mL of MB, 120 min | 10   |
| Ag@Fe$_3$O$_4$@SiO$_2$@TiO$_2$        | 95%                | 51 mg/g          | 10 mg of Catalyst, 50 ppm MB Conc., 20 mL of MB, 240 min | 11   |
| JHP-TiO$_2$–Au microswimmer           | 97%                | —                | 100 mg of Catalyst, 10 ppm MB Conc., — mL of MB, 60 min | 12   |
| chargeable TiO$_2$ NPs                | 97%                | 0.018            | 100 mg of Catalyst, 10 ppm MB Conc., 600 mL of MB, 180 min | 13   |
| electrospun fiber embedding TiO$_2$   | 97% (total)        | 0.045            | 100 mg of Catalyst, 20 μM MB Conc., — mL of MB, 330 min | 14   |
| TiO$_2$[(EPF(2/1)=TiO$_2$]            | 97% (total)        | 0.050            | 100 mg of Catalyst, 20 μM MB Conc., — mL of MB, 330 min | 14   |
| porous TiO$_2$ nanowires              | 97.98%             | —                | 15 mg of Catalyst, 20 ppm MB Conc., 50 mL of MB, 56 min | 15   |
| aerochitin-TiO$_2$ composite          | 98%                | 0.018            | 10 mg of Catalyst, 10 ppm MB Conc., 10 mL of MB, 200 min | 16   |
| NS TiO$_2$ macrobeads (without H$_2$O) | 86.87% (total)     | 0.030            | 5 mg of Catalyst, 25 ppm MB Conc., 10 mL of MB, 60 min | This study |
| NS TiO$_2$ macrobeads (with H$_2$O)   | 98.53% (total)     | 0.050            | 5 mg of Catalyst, 25 ppm MB Conc., 10 mL of MB, 60 min | This study |

Total means the cumulative efficiency achieved under both the dark and UV light conditions; $K$ is the reaction rate constant; MB stands for methylene blue; conc. stands for concentration; ref. stands for references; NTs, NPs, NCs and NS stand for nanotubes, nanoparticles, nanocomposites and nanostructured, respectively.

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