Supporting information for
One nanometer polydopamine layer assisted anatase TiO₂
with highly active visible-light photocatalysis

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**Materials:** Average diameter 30 nm anatase TiO$_2$ (Alfa Aesar), dopamine hydrochloride (DA, Alfa Aesar), Hexamethylenetetramine (HMTA, Alfa Aesar), Rhodamine B (RhB, Alfa Aesar), commercial P25 TiO$_2$ (Alfa Aesar), ethanol (Alfa Aesar). All chemicals were used without further purification and all solutions were prepared using ultrapure water (resistance $>18$ MΩ cm$^{-1}$).

**Preparation of TiO$_2$@PDA Core–Shell particles:** First, a calculated amount of TiO$_2$ and dopamine hydrochloride (1 mmol TiO$_2$ and 0.05 mmol DA) was added to 50 ml ultrapure water. Such a small molar ration of TiO$_2$: DA (20:1) is targeted to make sure that each TiO$_2$ particle is able to be coated with a uniform PDA layer with an exact thickness of 1 nm. Then, 0.71 mmol HMTA was then added to cause the PDA formation. Because HMTA can hydrolyze in water to give NH$_3$, so that the basicity of the solution was changed slowly, which is able to ensure the reacting environment suitable for controlled hydrolysis and this is critical in the synthesis process. After sealing and vortexing for 30 s, the reaction mixture was incubated at 90 °C for 3 h. To isolate the TiO$_2$@PDA core-shell particles, the reaction mixture was centrifuged at 10000 rpm for 2 min, the supernatant was removed, and the concentrated particles were washed by water and ethanol 2 times each, then were collected at the bottom of the Eppendorf tubes.

**Preparation of TiO$_2$-DA particles:** First, a calculated amount of TiO$_2$ and dopamine hydrochloride (1 mmol TiO$_2$ and 0.1 mmol DA) was added to 50 ml ultrapure water, and then the mixture was kept in dark place in case of dopamine getting polymerization for 3 h with stirring. The isolating procedure was performed as that of TiO$_2$@PDA.

**Characterization:** Transmission electron microscopy (TEM) and high-resolution transmission electron microscopy (HRTEM) images were collected on a JEM-2100F (JEOL) operated at 200kV. X-ray diffraction (XRD) measurement was carried out using a Rigaku D/max2500 diffractometer with filtered Cu K$_\alpha$ radiation, and the data were collected from 10° to 80°. The UV-visible absorption spectra of catalysts were obtained by using a UV-visible spectrophotometer (UV-2550, Shimadzu, Japan). BaSO$_4$ was used as a reflectance standard. The FTIR spectra of catalysts were performed by a TENSOR-27, Bruker, Germany.

**Photodegradation performance measurements:** The photocatalytic activity of the samples was evaluated in terms of the photodegradation of RhB under visible light irradiation at ambient temperature. 10 mg of catalyst was added into a 30 mL of 10 mg/L dye aqueous solution to undergo a stirring in the dark for 1 h. After reaching a complete adsorption–desorption
equilibrium, it was exposed to visible light irradiation offered by 50 W Xe lamp with a 420 nm cut-off filter under continuous stirring. A small quantity of liquid was sampled at the interval of 15 min to measure variation of the concentration of RhB in the solution. The concentrations of RhB was determined from the absorbance at the wavelength of 554 nm by an UV-visible spectrophotometer (UV-2550, Shimadzu, Japan). The same procedure was also done to P25, p-TiO₂, and TiO₂-DA for comparison. Catalysts were centrifuged out and washed for the recyclable catalysis.

**Controlling Experiments:** To change the thickness of the PDA layer, we can achieve this by simply adjusting the concentrations of reactants. The details of difference in the utilization of regents were list in Table S1.

![Figure S1](image)

*Fig. S1* X-ray diffraction (XRD) patterns of (a) p-TiO₂, (b) TiO₂-DA, TiO₂@PDA with (C) 1 nm PDA shell, (d) 2 nm PDA shell, (e) 4.5 nm PDA shell
Fig. S2 (a) Evaluation of RhB concentration versus reaction time of PDA nanospheres (black line) and TiO$_2$@PDA with 1 nm PDA shell (red line), and (b) TEM image of PDA nanospheres.

Fig. S3 FTIR spectra of (a) TiO$_2$@PDA and (b) TiO$_2$-DA
### Tab. S1 Details of controlling experiments

<table>
<thead>
<tr>
<th></th>
<th>TIO₂</th>
<th>DA</th>
<th>HMTA</th>
<th>H₂O</th>
</tr>
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<tbody>
<tr>
<td>TIO₂@PDA-1NM</td>
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<td>0.05mmol</td>
<td>0.71 mmol</td>
<td>50 ml</td>
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<td>0.1 mmol</td>
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<td>50 ml</td>
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<td>0.2 mmol</td>
<td>0.71 mmol</td>
<td>50 ml</td>
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</table>

**Reference**