

## Supplementary information

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Fig S1 (a) shows the infrared spectra of BWO, TiO<sub>2</sub> and TB6. The absorption peaks at 3452 cm<sup>-1</sup> and 1626 cm<sup>-1</sup> are attributed to the O-H bending vibration and tensile vibration of the adsorbed water on the catalyst surface<sup>[1,2]</sup>. The absorption peak of BWO and TB6 at 740 cm<sup>-1</sup> is ascribed to O-W-O stretching vibration. The absorption peak at 570 cm<sup>-1</sup> is assigned to the stretching vibration of Bi-O<sup>[3]</sup>. The strong and wide vibration band of TiO<sub>2</sub> below 1000 cm<sup>-1</sup> is related to the stretching vibration of Ti-O-Ti.

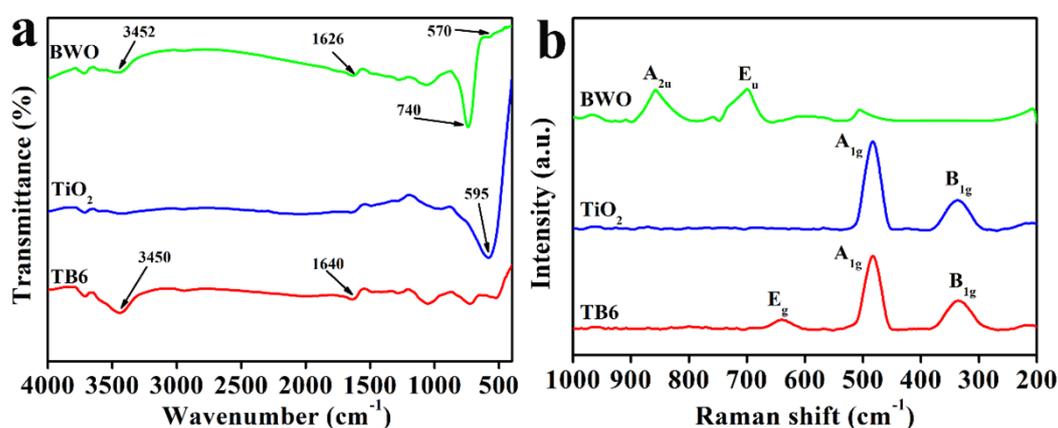


Fig. S1. FT-IR (a) and Raman (b) spectra of BWO, TiO<sub>2</sub> and TB6

The Raman spectra of BWO, TiO<sub>2</sub> and TB6 are shown in Fig S1 (b). The vibration peak of BWO within 600-1000 cm<sup>-1</sup> is the stretching vibration of W-O bond. The vibration peak at 857 cm<sup>-1</sup> is the vibration mode of A<sub>2u</sub>. A weaker peak appears at 754 cm<sup>-1</sup>, which corresponds to the antisymmetric stretching vibration mode of the WO<sub>6</sub> chain bridge. The vibration peak at 698 cm<sup>-1</sup> corresponds to the E<sub>u</sub> vibration mode. The vibration peak of TiO<sub>2</sub> at 483 cm<sup>-1</sup> is attributed to the A<sub>1g</sub> vibration mode. The vibration peak at 335 cm<sup>-1</sup> is attributed to the B<sub>1g</sub> vibration mode. The vibration peaks of TB6 at 637 cm<sup>-1</sup>, 481 cm<sup>-1</sup> and 335 cm<sup>-1</sup> belong to the E<sub>g</sub>, A<sub>1g</sub> and B<sub>1g</sub> vibration modes, respectively.

In order to explore the optimal usage of TB6, 50 mL and 2.5 mg L<sup>-1</sup> RhB solutions were degraded. Fig S2 (a) shows the degradation performance curve of RhB when the usage of TB6 is 30 mg, 40 mg, and 50 mg, respectively. When exposed to visible light for 20 min, the degradation rate of 30 mg of TB6 is the lowest. The degradation performance gradually increases as the usage of TB6 increases. Both 40 mg and 50 mg of TB6 can degrade RhB up to 97%. The possible reason is that the active sites provided

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by the 40 mg photocatalyst are sufficient for the oxidation-reduction reaction during the degradation process. From point of economic, the subsequent RhB degradation experiments used 40 mg of TB6.

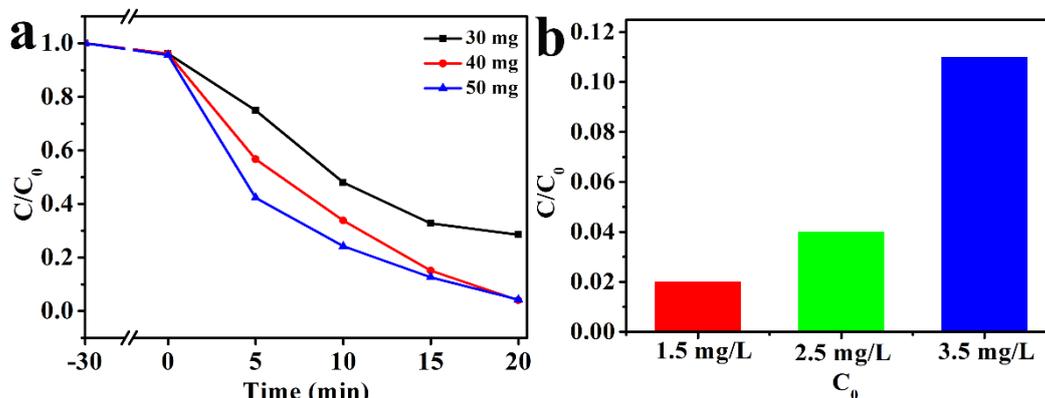


Fig. S2. Effect of different TB6 dosage (a) and different initial RhB concentration (b) on degradation performance

In order to analyze the effect of different initial concentrations of RhB on the degradation performance, 40 mg of TB6 was used as a catalyst to degrade RhB at different concentrations. It can be seen from Fig S2 (b) that the degradation rate gradually decreases as the initial concentration of RhB increases. When the initial concentration of RhB increased from 1.5 mg L<sup>-1</sup> to 3.5 mg L<sup>-1</sup>, the degradation rate of RhB decreased from 98% to 89%, indicating that the initial concentration of RhB had a greater impact on the degradation performance of TB6. The reason may be that the number of active species of TB6 is limited. Therefore, the degradation performance of TB6 gradually decreases as the initial concentration of RhB increases.

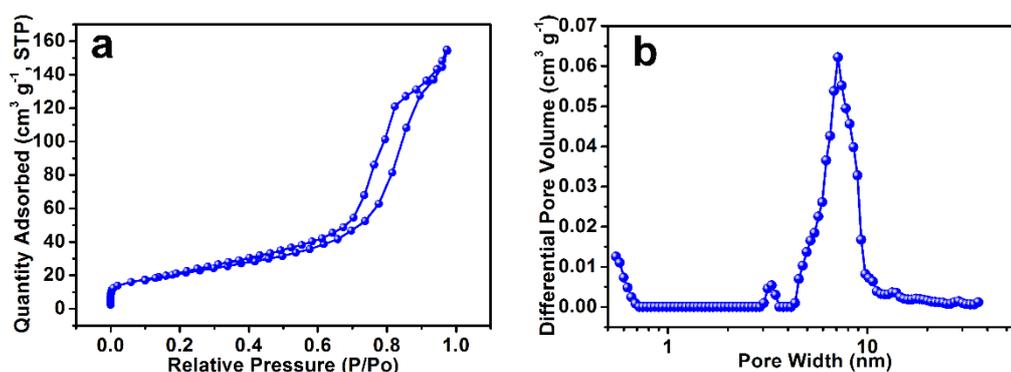


Fig. S3. The nitrogen adsorption-desorption isotherms curves

## References

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