TiO_2@h-CeO_2: a composite yolk-shell microsphere with enhanced photodegradation activity

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Supporting Information

Synthesis of anatase spheres and h-CeO_2 spheres

The anatase spheres and h-CeO_2 spheres were prepared for contrast test, and their synthesis routes were shown in Scheme 1.

Synthesis of anatase nanosphere

At first, the resulting TP spheres were dispersed in the ethanol water mixture (12 mL, 2:1 by volume) and $NH_3 \cdot H_2O$ (0.2 mL). Then, the mixture was sealed within a Teflon-lined autoclave (20 mL) and kept at 160℃ for 16 h. At last, anatase spheres were acquired by centrifugation, washing with ethanol, and calcination at 550℃ for 2 h.

Synthesis of h-CeO_2 nanosphere

Synthesis of SiO_2 template Monodisperse SiO_2 spheres were prepared by a slightly modified Stöber process. Briefly, TEOS (4.5 mL) was rapidly injected into a solution of ethanol (62 mL), H_2O (25 mL), and $NH_3 \cdot H_2O$ (1.5 mL), then kept stirring for 2 h. After centrifugation and washed with ethanol, the obtained spheres were dried at 50℃.

Synthesis of SiO_2@CeO_2@SiO_2 sphere and h-CeO_2 catalyst The synthesis procedure of SiO_2@CeO_2@SiO_2 spheres was same with the preparation procedure of TP@SiO_2@CeO_2@SiO_2, but with SiO_2 spheres in place of TP@SiO_2. After the acquirement of SiO_2@CeO_2@SiO_2, this light yellow powder was calcined at 900℃ for 2 h. Then, NaOH etching treatment described before was carried out again.

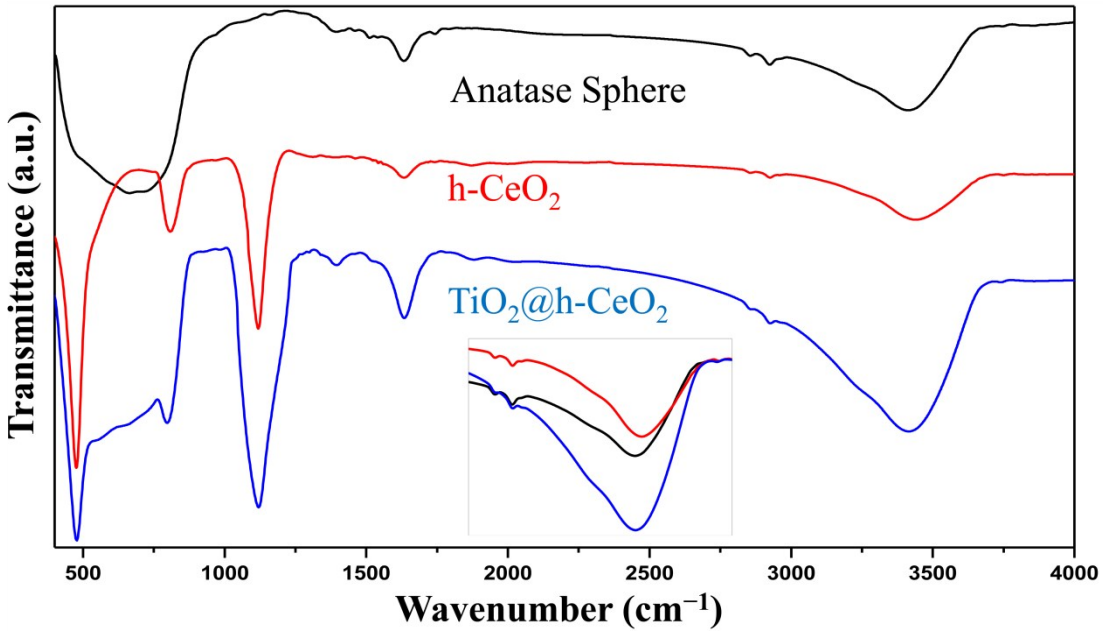

Fig. S1 FT-IR spectra of anatase sphere, h-CeO_2, and TiO_2@h-CeO_2. All three samples were dried at 80℃ overnight. The assignments of the stretching vibration bands of Ce-O-Ce and Si-O-Si were about 480 and 1120 cm^{-1}. And the Ti-O-Ti band was observed at a broad absorption from 500 to 800 cm^{-1}. The peaks around 3400 cm^{-1} were due to the -O-H stretching vibrations. The insert image was an enlargement of -O-H stretching vibrations.

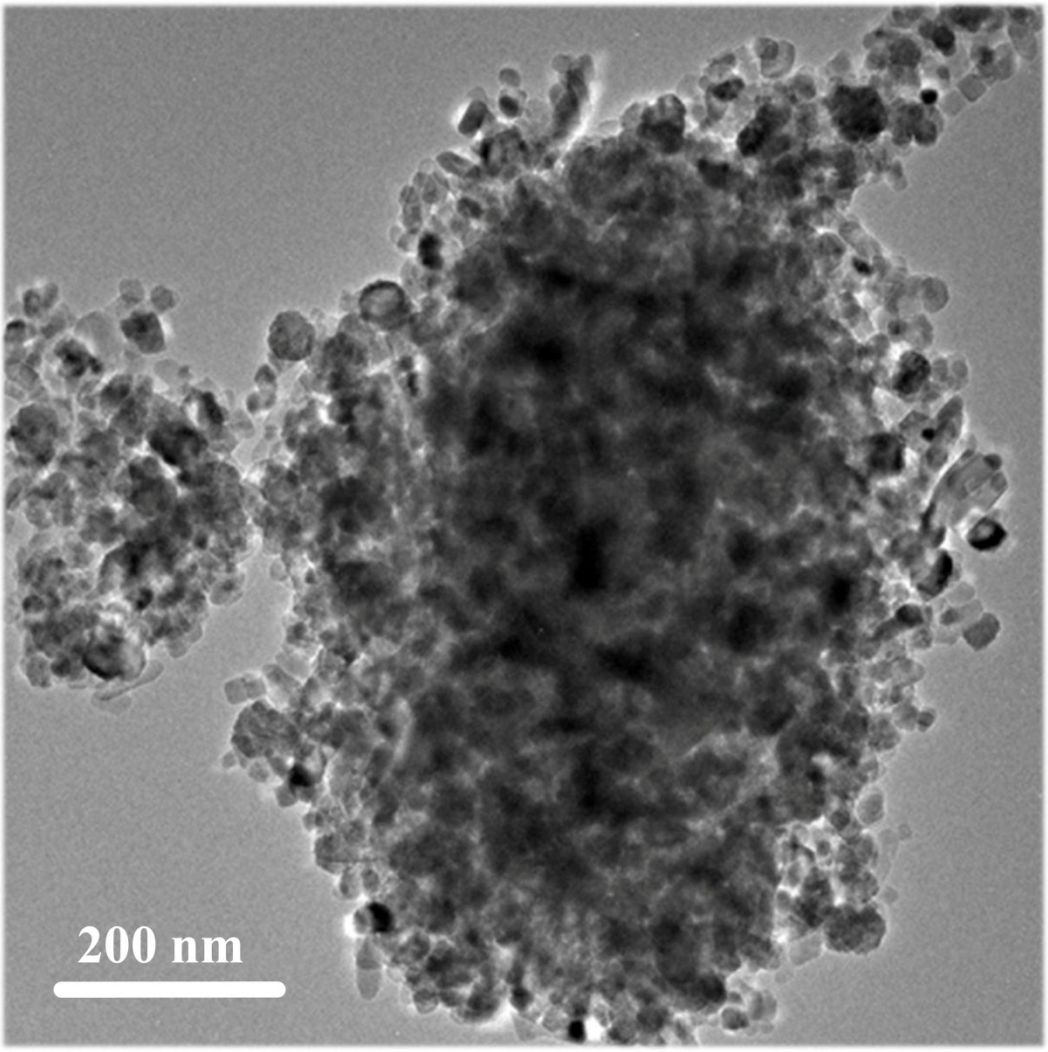

Fig. S2 TEM images of CeO_2 coated TP.

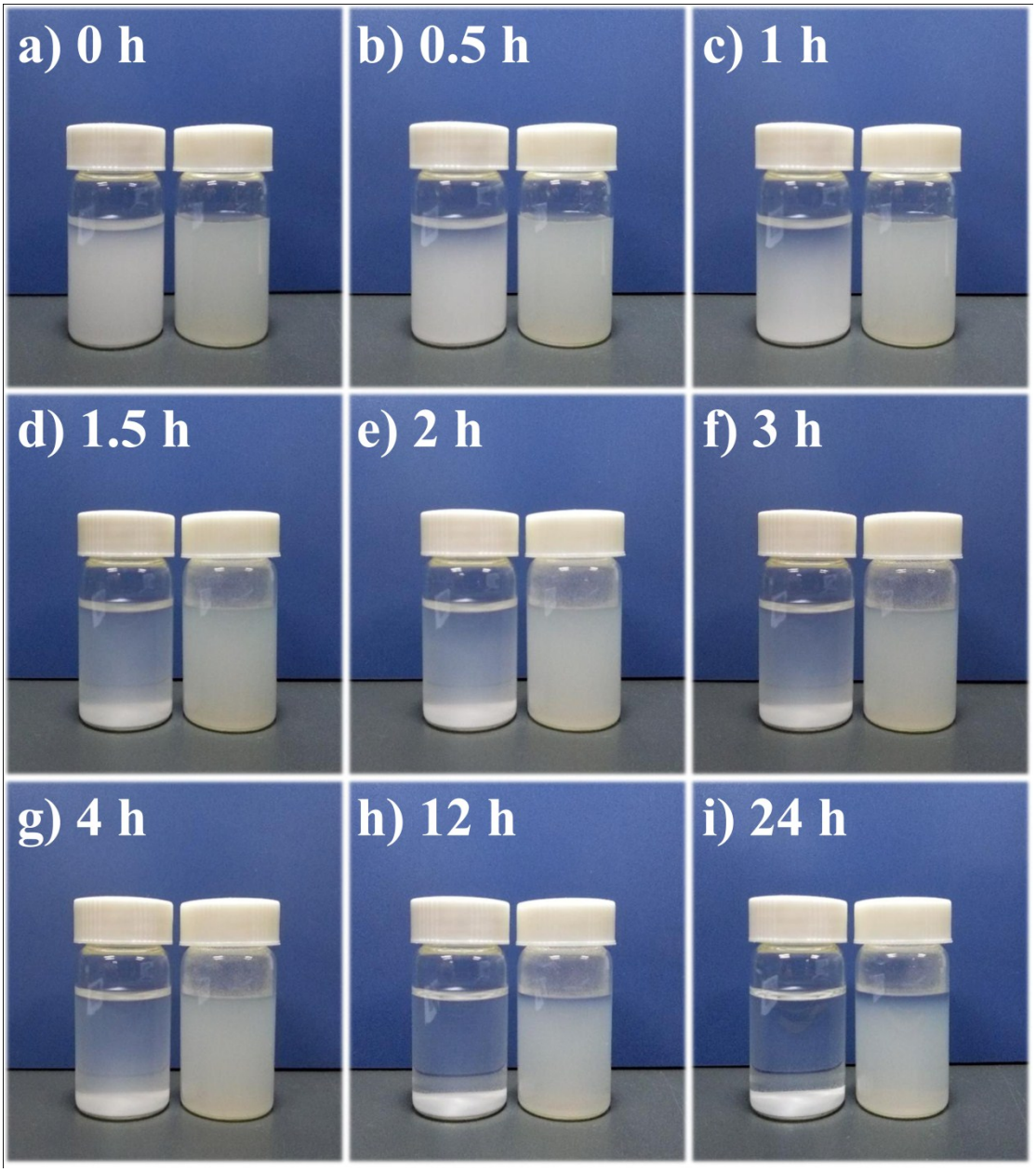

Fig. S3 Images of anatase sphere (left) and TiO_2@h-CeO_2 (right) suspensions kept steady for different times. The contents of both materials were 1 mg/ mL. And the suspensions were treated with ultrasonication for 30 min before kept steady.

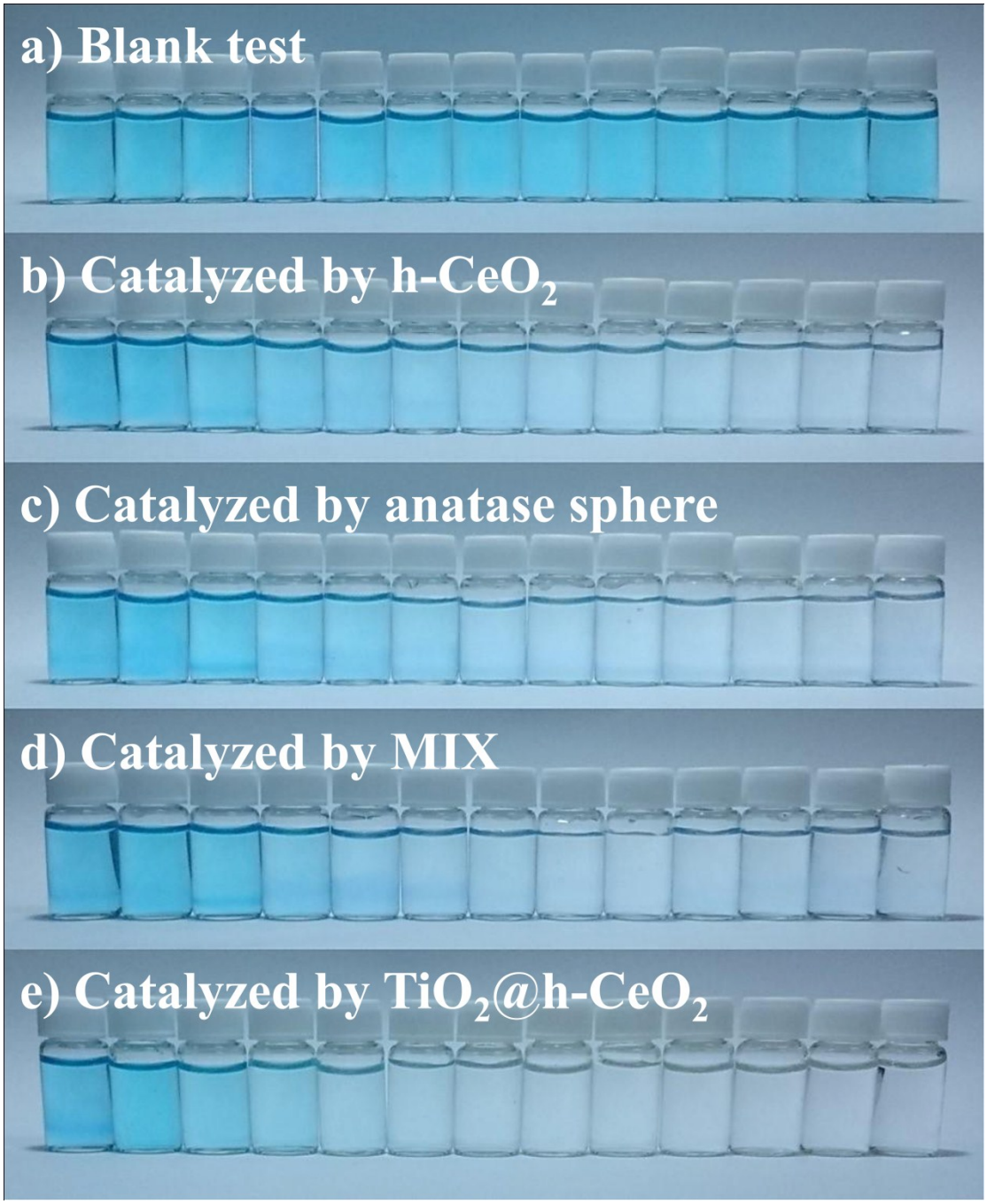

Fig. S4 The images of color variations during photodegradation of MB.

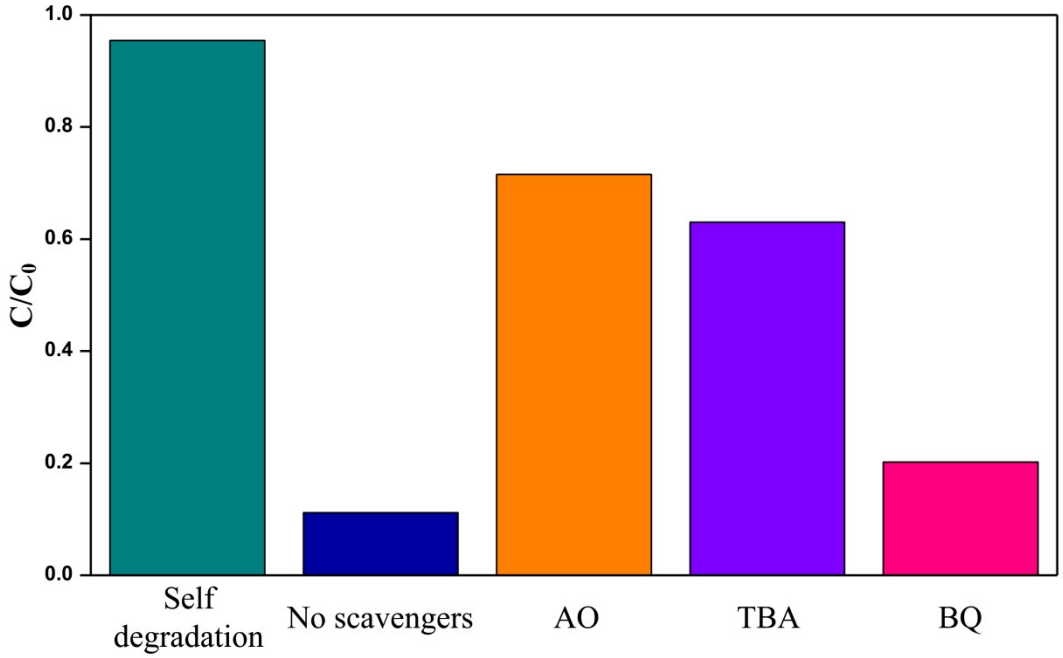

Fig. S5 Trapping experiment of active species during the photocatalytic degradation with 20 min high-pressure mercury lamp irradiation.