Electronic Supplementary Information for

UV-induced formation of activated Bi_2O_3 nanoflake: an enhanced visible light driven photocatalyst by platinum loading

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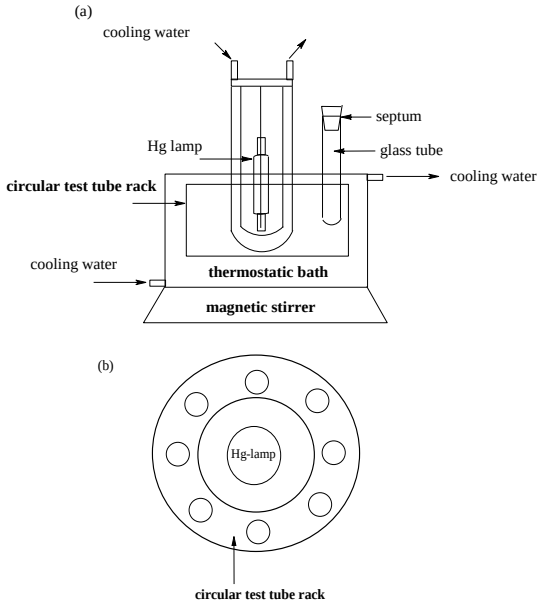
[1] Experimental details:

Preparation of Pt-loaded bismuth oxide nanoflakes:
$Bi(NO_3)_3 \cdot 5H_2O$ (0.485 g, 1 mmol) and urea (0.3 g, 5 mmol) were added to 40 ml of absolute ethanol. The mixture was sonicated for 10min and transferred into a 100 mL of Teflon-lined autoclave, which was then sealed, maintained at 180 ^oC for 4 h, and then allowed to cool to room temperature. The resulting khaki precipitate was collected and washed several times with distilled water and absolute ethanol. It was then dried at 60 ^oC for 12 h in vaccum. The products were heated at 500 ^oC for 1h whose color turned yellow. The yellow samples were subsequently suspended in distilled water for UV irradiation with a 500 W high pressure mercury lamp for 1 h. After irradiation the colour of the powder changed from yellow to brown. After that, an aqueous suspension containing Bi_2O_3 samples and $H_2PtCl_6 \cdot 6H_2O$ with different concentrations was exposed to visible light (λ>400 nm) provided by the 500 W mercury lamp fitted with a cutoff filter. After 2 h of irradiation, methanol (5 vol%) was added and the suspension was further irradiated for 2 h. Nitrogen-doped TiO_2 were purchased from Sumitomo Chemical Co. Ltd. (Type: TP-S201).
Characterization: A Hitachi S-4800 field emission scanning electron microscope (FESEM, Hitachi CO. Ltd. S-4800) was utilized to the morphology investigation. TEM images were collected by using a JEOL JEM 2010F microscope working at 200 kV. X-ray diffraction (XRD, Rigaku D/Max-2550pc) measurements were carried out using filtered Cu *Kα* radiation. Energy dispersive X-ray analysis (EDXA, Inca Energy-200) is used to investigate the sample composition. The nitrogen adsorption and desorption isotherms at 77K were obtained using a Micrometrics ASAP 2010 system after the sample was degassed in vacuum at 120^oC overnight. A Shimadzu UV-1601PC spectrophotometer was used to record the UV-vis spectra of the sample.
Photocatalytic activity measurement: The overall photocatalytic activity was tested as the amounts of CO_2 gas that originated from the oxidation decomposition of aqueous acetaldehyde solution (0.5 vol%, ca.175 μmol) and isopropyl alcohol (20 μmol) containing a suspension of the photocatalyst powder (40 mg) under the irradiation of UV lamp with the cutoff filter (λ > 400 nm) at 25^oC. The reaction stoichiometry of acetic acid has been ascertained to be following:

$$CH_3CHO + 5/2O_2 \rightarrow 2CO_2 + 2H_2O$$

The CO_2 concentrations were measured using a gas chromatography (Align model GC-6890N) equipped with a 2 m Porapak-Q column, a methanizer, and a flame ionization detector, using N_2 as the carrier gas.
Photocatalytic reactor: A photocatalytic reactor (Nanjing Xujiang Co., Ltd) was used in this study and the schematic details are depicted in Scheme S1. An ultrahigh-pressure Hg lamp (500 W) was located in the center of the reactor along the axis and protected by a water-cooled quartz jacket. At the bottom of the reactor a magnetic stirrer was used to achieve effective dispersion agitating mechanically. A circular test tube rack was inserted on the thermostatic bath to hold up the Pyrex glass tubes. Thus the UV light was collected into the glass tube and ensured the photocatalytic reaction performed uniformly and completely. The reactor was fitted with a magnetic stirrer for stirring at 700 rpm to keep the catalyst in suspension.



Scheme S1. The schematic illustration of the cylindrical photocatalytic reactor: (a) cross-sectional view, (b) top view.

[2] EDXA data

Energy dispersive X-ray analysis (EDXA, Inca Energy-200) was used to investigate the sample composition. The analysis showed that the elements of Bi, O and C are found in bismuth carbonate (Figure S1a). After calcination at 500 ºC for 1 hour, no carbon peak could be observed in the EDXA spectrum of samples, indicating that the carbon previously is efficiently removed by calcination (Figure S1b). The bismuth carbonate is decomposed into bismuth oxide.

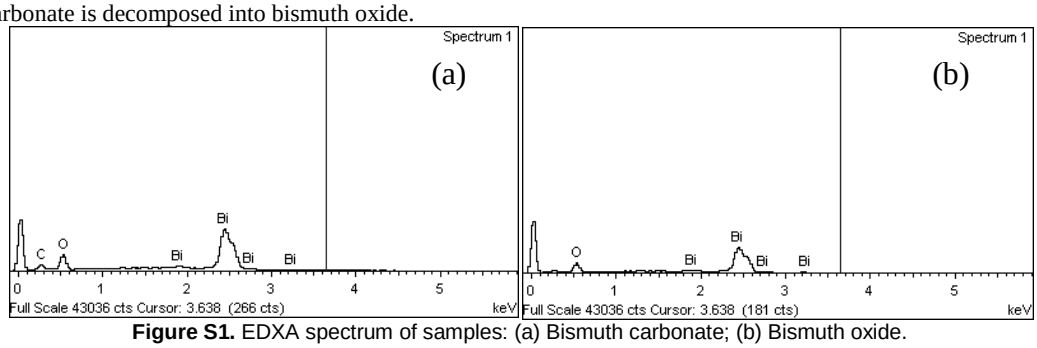


Figure S1. EDXA spectrum of samples: (a) Bismuth carbonate; (b) Bismuth oxide.

[3] Nitrogen adsorption-desorption isotherms and the corresponding BJH pore size distributions

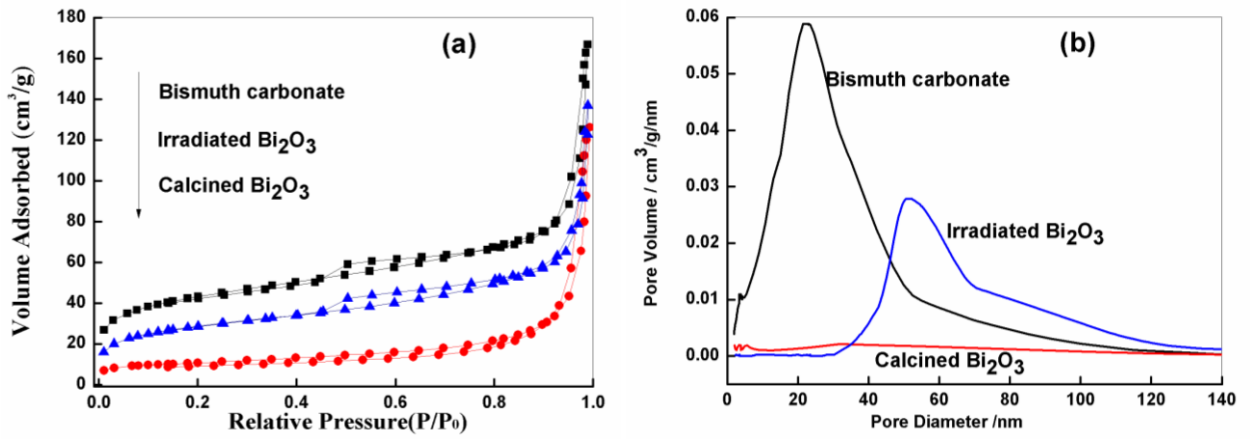


Figure S2. Nitrogen adsorption-desorption isotherms (a) and Pore size distributions (b) of samples.

[4] UV-vis spectra of Bi_2O_3 samples with different treatment

The estimated band gap value for irradiated Bi_2O_3 was ca. 2.4 eV, comparable with that of the calcined Bi_2O_3 (ca. 2.7 eV).

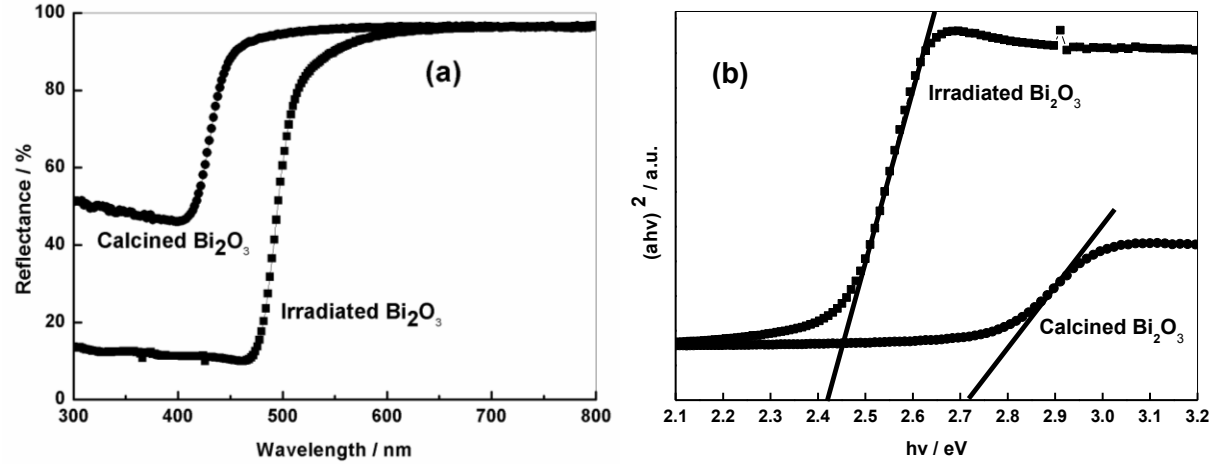


Figure S3. (a) UV-vis spectrum for NTs analyzed by the diffuse reflectance method. Adsorption coefficient (α) was obtained by the Kubelka-Munk method; (b) the square of adsorption coefficient α vs. photon energy.

[5] The effect of UV light irradiation time:

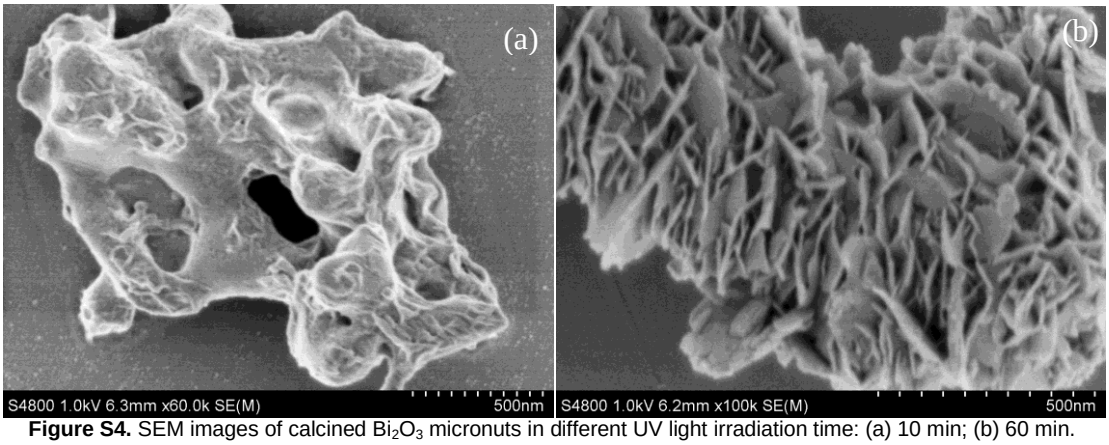


Figure S4. SEM images of calcined Bi_2O_3 micronuts in different UV light irradiation time: (a) 10 min; (b) 60 min.

[6] The effect of Pt-loading concentration:

The photocatalytic reaction was carried out under visible light irradiation (400<λ<500 nm) in order to clarify the photocatalytic activity of products. Acetaldehyde (AcH) was selected as a model pollutant. To enable a quantitative comparison, the decomposition rates for the first 60 min were proposed to represent the photocatalytic activities because this region is most likely to be dominated by pure light-intensity-limited conditions.

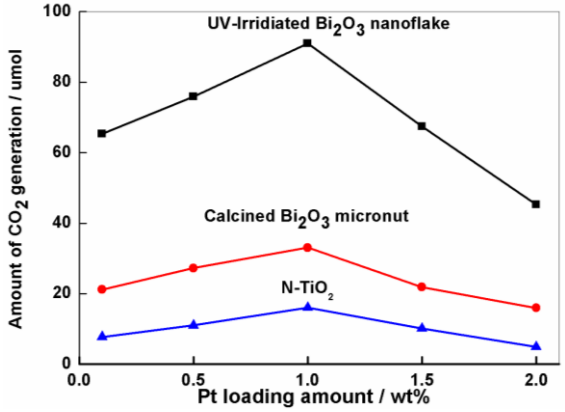


Figure S5. Initial decomposition rates vs. Pt-loading concentration.

[7] The repeated photocatalytic experiment of Pt-loaded Bi_2O_3 nanoflakes:

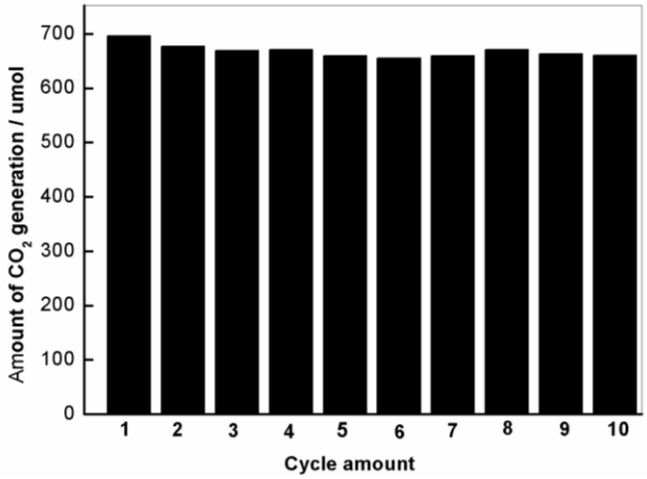


Figure S6. decomposition curves of AcH solution over 1wt% Pt/Bi_2O_3 nanoflakes under visible-light irradiation for 3 h in repeated experiments.

[7] The TEM characterization of Pt-loaded Bi_2O_3 nanoflakes:

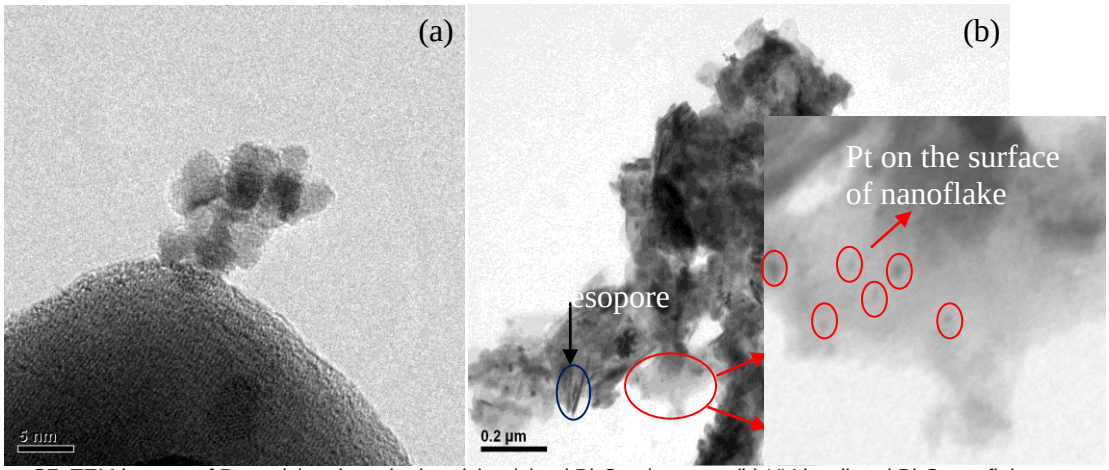


Figure S7. TEM images of Pt particles deposited on (a) calcined Bi_2O_3 micronuts; (b) UV-irradiated Bi_2O_3 nanflakes.