

## Light wavelength-switchable photocatalytic reaction by gold nanoparticle-loaded titanium (IV) oxide

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### Experimental details

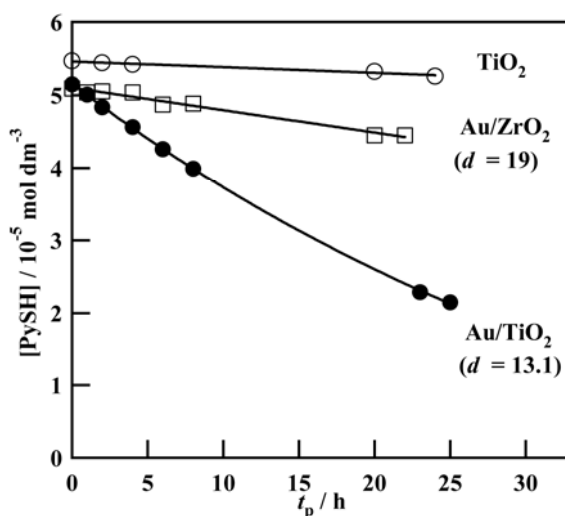
#### Photocatalytic reaction

The photoreaction solution of 2-mercaptopyridine (PySH) ( $5.4 \times 10^{-5} \text{ mol dm}^{-3}$ ) was prepared by diluting an acetonitrile solution with H<sub>2</sub>O (H<sub>2</sub>O:acetonitrile = 99:1 v/v). After the suspension (200 mL) of TiO<sub>2</sub>, Au/TiO<sub>2</sub>, or Au/ZrO<sub>2</sub> (200 mg) had been stirred at 298 K in dark, irradiation was started using a 300 W Xe lamp (HX-500, Wacom) with a cut off filter Y-45 (Toshiba) in a double jacket type reaction cell (31 mm in diameter and 175 mm in length, transparent to light with  $\lambda > 4300 \text{ nm}$ ). The light intensity integrated from 420 to 480 nm ( $I_{420-480}$ ) was measured to be  $3.7 \text{ mW cm}^{-2}$  by the use of a digital radiometer. Magnetic stirring of the suspension were continued throughout the irradiation. The temperature of the suspension was kept at 298 K by circulating thermostatted water through an outer jacket around the cell. The concentrations of PySH consumed and 2,2'-dipyridyl disulfide (PySSPy) generated were determined from the absorbances at 342 nm ( $\epsilon_{\text{max}} = 7.82 \times 10^3 \text{ mol}^{-1} \text{ dm}^3 \text{ cm}^{-1}$ ) and HPLC, respectively.

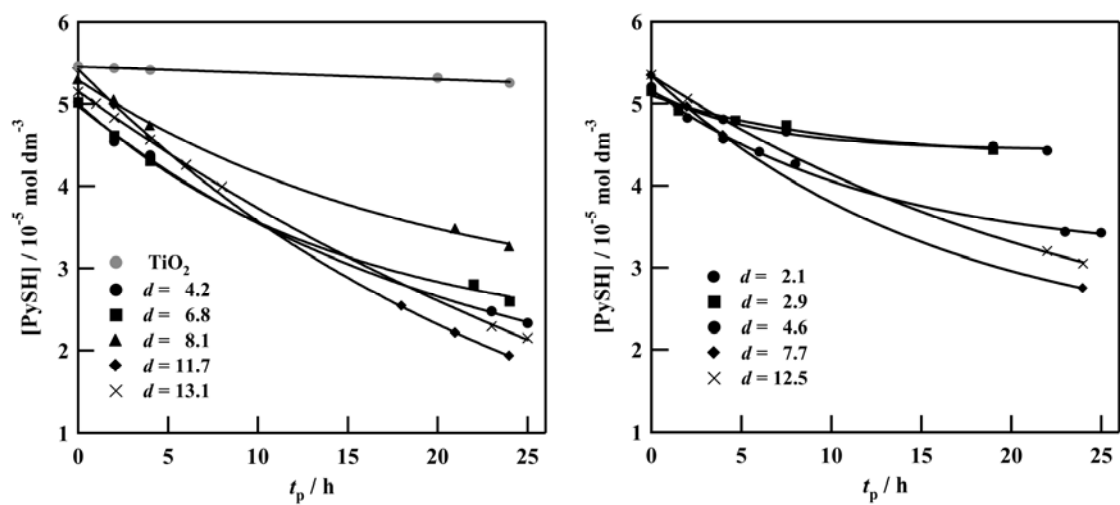
#### Photochronopotentiometry measurement

Photoelectrochemical measurements: slurry of Au/TiO<sub>2</sub> particles (Au/TiO<sub>2</sub> 0.5 g/H<sub>2</sub>O 1 mL) was

coated on SnO<sub>2</sub>-film coated glass substrates (12 Ω/□) by a squeegee method, and the sample was heated in air at 573 K for 1 h to form Au/TiO<sub>2</sub>/SnO<sub>2</sub> electrodes. The  $U$  was measured in a 0.1 mol dm<sup>-3</sup> Na<sub>2</sub>SO<sub>4</sub> electrolyte solution with PySH ( $5.4 \times 10^{-5}$  mol dm<sup>-3</sup>) in a regular three-electrode electrochemical cell using a galvanostat/potentiostat (HZ-5000, Hokuto Denko). Irradiation by using a xenon lamp with a monochromator (fwhm, 10 nm) (HM-5, JASCO) led to a shift of  $U$  in the cathodic direction.



**Fig. S1** Plots of concentrations of PySH under visible light irradiation in the presence of TiO<sub>2</sub>, Au/ZrO<sub>2</sub> ( $d = 19$ ,  $x = 0.57$  mass%) and Au/TiO<sub>2</sub> ( $d = 13.1$ ,  $x = 0.43$  mass%).



**Fig. S2** Plots of concentrations of PySH under Vis-irradiation in the presence of Au/TiO<sub>2</sub> with various size  $d$  as a function of  $t_p$ : Au/TiO<sub>2</sub> ( $x = 0.43$  mass%) and TiO<sub>2</sub> (A) and Au/TiO<sub>2</sub> ( $x = 0.25$  mass%) (B)