Supplementary Material (ESI) for Chemical Communications
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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 × 10^{-5} mol dm^{-3}) was prepared by diluting an acetonitrile solution with H2O (H2O:acetonitrile = 99:1 v/v). After the suspension (200 mL) of TiO2, Au/TiO2, or Au/ZrO2 (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 λ > 4300 nm). The light intensity integrated from 420 to 480 nm (I_{420-480}) was measured to be 3.7 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 (ε_{max} = 7.82 × 10^{3} mol^{-1} dm^{3} cm^{-1}) and HPLC, respectively.

Photochronopotentiometry measurement

Photoelectrochemical measurements: slurry of Au/TiO2 particles (Au/TiO2 0.5 g/H2O 1 mL) was
coated on SnO$_2$-film coated glass substrates (12 $\Omega$/$\square$) by a squeegee method, and the sample was heated in air at 573 K for 1 h to form Au/TiO$_2$/SnO$_2$ electrodes. The $U$ was measured in a 0.1 mol dm$^{-3}$ Na$_2$SO$_4$ electrolyte solution with PySH ($5.4 \times 10^{-5}$ mol dm$^{-3}$) 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$_2$, Au/ZrO$_2$ ($d = 19$, $x = 0.57$ mass%) and Au/TiO$_2$ ($d = 13.1$, $x = 0.43$ mass%).
Fig. S2 Plots of concentrations of PySH under Vis-irradiation in the presence of Au/TiO$_2$ with various size $d$ as a function of $t_p$. Au/TiO$_2$ ($x = 0.43$ mass%) and TiO$_2$ (A) and Au/TiO$_2$ ($x = 0.25$ mass%) (B)