Electronic Supplementary Information

Efficient Light Harvesting over CdS/In₂O₃ Photonic Crystals Photocatalyst for Hydrogenation of 4-Nitroaniline to *p*-Phenylenediamine

Xiaofang Li, Changqian Wang, Bo Li, Yu Shao, Danzhen Li*

State Key Laboratory of Photocatalysis on Energy and Environment, Research

Institute of Photocatalysis, Fuzhou University, Fuzhou 350002, P. R. China.

Tel & Fax: (+86)591-83779256; E-mail: dzli@fzu.edu.cn

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Experimental section

Preparation of Polystyrene Spheres: Monodisperse polystyrene spheres with various sphere sizes were synthesized using a typical emulsion polymerization according to the literature. Typically, 100 mL of ultrapure water (18 M Ω /cm² @ 25 °C) and a certain amount of styrene were added into a three-necked, round-bottomed flask (250 mL). The mixture was stirred at 500 rpm, while being heated to 70 °C and purged with nitrogen gas with a flow rate of 100 mL/min. After the mixture was kept at 70 °C for 20 min, 0.1 g of K₂S₂O₈ was added and the reaction lasted for 12 or 24 h. The resulting polystyrene spheres were centrifuged at 8000 rpm to remove any large agglomerates in the bottom and then the remained polystyrene spheres were centrifuged at 12000 rpm to remove small spheres in the upper liquid. The obtained precipitates were redispersed in 100 mL of water to form a colloidal polystyrene spheres suspension until needed. In the present study, monodisperse polystyrene spheres with various sphere sizes were produced by changing the amount of styrene and the reaction time, keeping all other experimental conditions the same. The synthesis conditions of the as-prepared PS templates with various sphere diameters were shown in Table S1.

Diameter(nm)	Amount of styrene(mL)	Reaction time
220	3.0	12
270	3.6	24
340	5.4	12

Table S1 The synthesis conditions of the as-prepared PS templates.



Fig. S1 The SEM images of the as-prepared PS templates (a) PS220 nm, (b) PS270 nm, (c) PS340

nm and (d) PS_{mix}



Fig. S2 The SEM images of (a) porous In_2O_3 and (b) CdS/porous In_2O_3 .



Fig. S3 The electronic band gap value of In_2O_3 (a) and CdS (b) derived from the absorption of

In₂O₃ NCs and CdS/In₂O₃ NCs.



Fig. S4 Reflection spectra of the In_2O_3 PCs with different pore diameters in the present of water.



Fig. S5 (a) The UV-vis spectrum of standard PPD solution with different concentration, (b) the linear relationship between the concentration (C) and the absorbance (A) at 238 nm for PPD.



Fig. S6 GC-MS spectra of the reaction solution (a) before and (b) after the reaction.



Fig. S7 MS patterns for the compounds at different retention times (t): (a) t = 14.01 min; (b) t = 14.01 min; (b) t = 14.01 min; (b) t = 14.01 min; (c) t = 14.01 min

10.73 min.



Fig. S8 (a) Transient photocurrent response and (b) EIS Nynquist plots without any bias potential

of the as-prepared samples under visible light irradiation in wavelength of 400-800 nm.



Fig. S9 The relative location between the photonic band gaps of CdS/In₂O₃ PCs, the absorption of

CdS and the monochromatic light.



Fig. S10 The electronic band structure of In₂O₃ and CdS.

Notes:

The conduction band potential of semiconductor could be determined by the expression in the following according to the Xu et al.:

$$E_{\rm C} = -\chi + 0.5 E_{\rm g}$$

Where χ is the electronegativity of semiconductor, E_g is the electronic band gap. The conduction band and valence band potential of In₂O₃ were -0.75 and 2.55 V vs RHE. The conduction band and valence band potential of CdS were -0.47 and 2.07 V vs RHE.



Fig. S11 The photocatalytic activity of CdS/In₂O₃ PCs/216 with the addition of $K_2S_2O_8$ as a

scavenger.