Electronic Supplementary Information

In-situ synthesis of hierarchical In_2S_3-graphene nanocomposite photocatalyst for selective oxidation

Xiuzhen Li,[ab] Bo Weng,[ab] Nan Zhang,[ab] and Yi-Jun Xu*[ab]

[a] *State Key Laboratory of Photocatalysis on Energy and Environment, College of Chemistry, Fuzhou University, Fuzhou, 350002, P. R. China*
[b] *College of Chemistry, New Campus, Fuzhou University, Fuzhou, 350108, P. R. China*
* *Corresponding Author. Tel./Fax: +86 591 83779326; E-mail: yjxu@fzu.edu.cn*

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Experimental section for preparation of graphene oxide (GO).

In detail, 2 g of graphite powder was put into a mixture of 12 mL of concentrated H_2SO_4, 2.5 g of $K_2S_2O_8$, and 2.5 g of P_2O_5. The solution was heated to 80 °C in an oil bath kept stirring for 24 h. The mixture was then carefully diluted with 500 mL of deionized (DI) water, filtered, and washed until the pH of rinse water became neutral. The product was dried under ambient condition overnight. This preoxidized graphite was then subjected to oxidation described as follows. In a typical procedure, preoxidized graphite powder was added to a mixture of 120 mL of concentrated H_2SO_4 and 30 mL of HNO_3 under vigorous stirring, and the solution was cold to 0 °C. Then, 15 g of $KMnO_4$ was added gradually under stirring, and the temperature of the mixture was kept to be below 20 °C by cooling. Successively, the mixture was stirred at room temperature for 96 h and then diluted with 1 L of DI water in an ice bath to keep the temperature below 50 °C for 2 h. Shortly after the further dilution with 1 L of DI water, 20 mL of 30% H_2O_2 was then added to the mixture, and a brilliant yellow product was formed along with bubbling. The mixture was filtered and washed with 1:10 HCl aqueous solution to remove metal ions followed by DI water to remove the acid. The filter cake was then dispersed in water by a mechanical agitation. Low-speed centrifugation was done at 1000 rpm for 2 min. The supernatant then underwent two more high-speed centrifugation steps at 8000 rpm for 15 min to remove small GO pieces and water-soluble byproduct. The final sediment was redispersed in water with mechanical agitation or mild sonication using a table-top ultrasonic cleaner, giving a solution of exfoliated GO. The GO separated and dried is in the form of a brown powder. It is well documented to utilize GO as the precursor of graphene (GR) to synthesize the reduced graphene oxide (RGO)-semiconductor composite photocatalysts.[S1-S5]

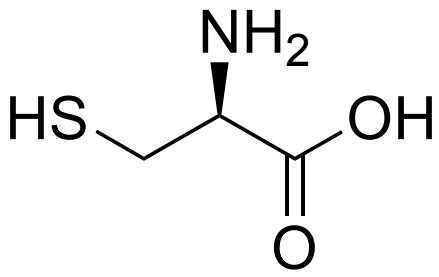

Fig. S1 The chemical structure of L-cysteine.

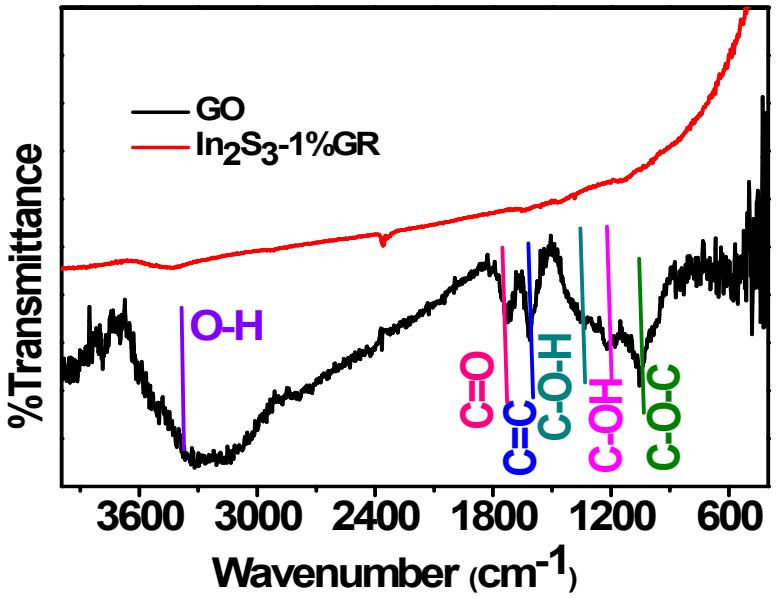

Fig. S2 The Fourier transformed infrared spectra (FTIR) of In_2S_3-1%GR nanocomposite and the original GO.

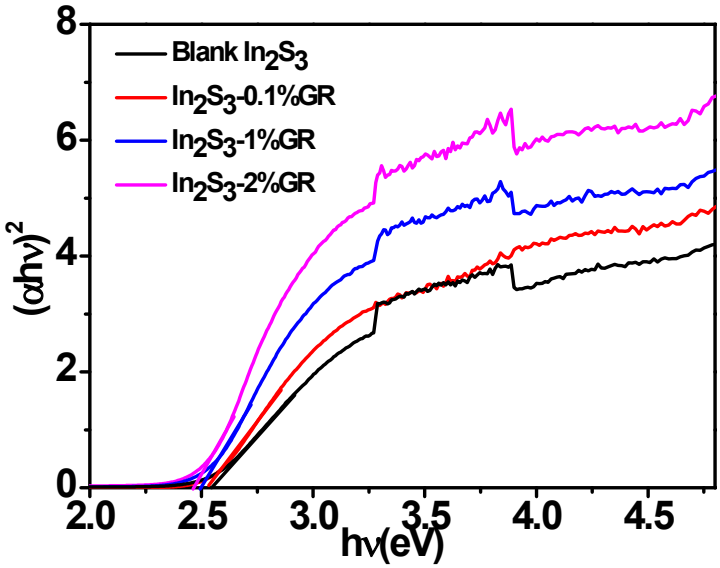

Fig. S3 The plot of transformed Kubelka-Munk function *versus* the energy of light for blank In_2S_3 and In_2S_3-GR nanocomposites with different weight addition ratios of GR.

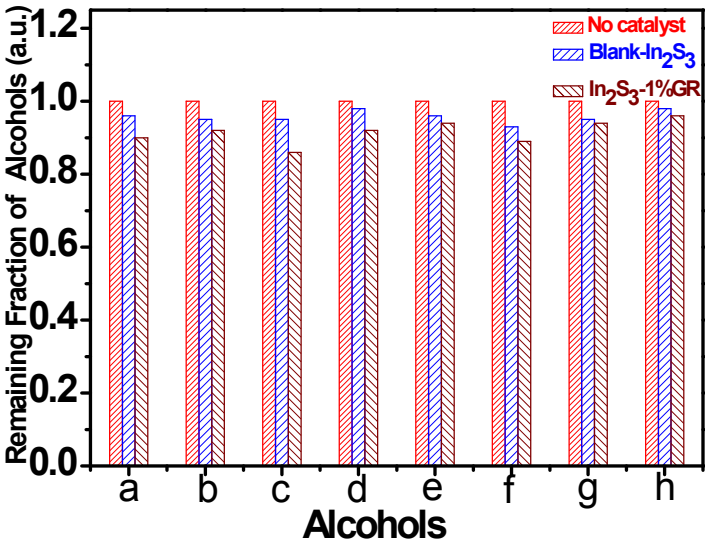

Fig. S4 Remaining fraction of various alcohols after the adsorption-desorption equilibrium is achieved over blank In_2S_3 and In_2S_3-1%GR nanocomposite: (a) benzyl alcohol, (b) 4-methylbenzyl alcohol, (c) 4-methoxybenzyl alcohol, (d) 4-nitrobenzyl alcohol, (e) 4-fluorobenzyl alcohol, (f) 4-chlorobenzyl alcohol, (g) cinnamyl alcohol, and (h) 3-methyl-2-buten-1-ol.

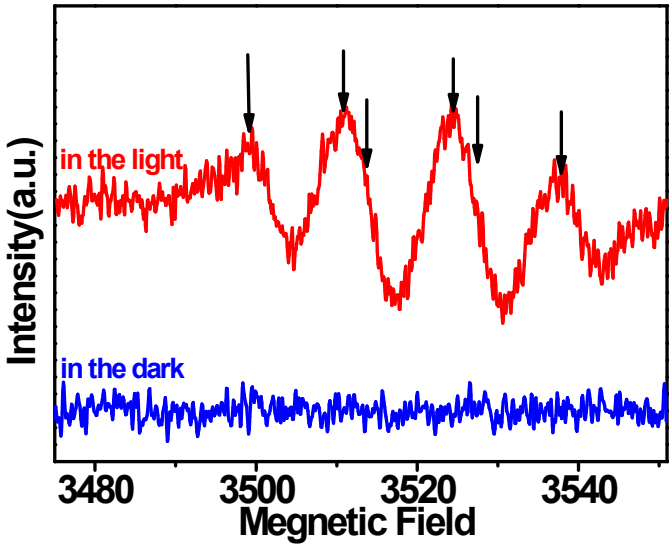

Fig. S5 ESR spectra of radical adduct trapped by DMPO (DMPO-$O_2^{\bullet-}$) over the In_2S_3-1%GR nanocomposite suspension in the solvent of BTF without or with the visible light irradiation.

Table S1 Summary of BET surface area and pore volume of blank In_2S_3 and In_2S_3-1%GR.

Samples	S_{BET} (m^2/g)	Total pore volume (cm^3/g)
In_2S_3-1%GR	37	0.23
Blank In_2S_3	18	0.11

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S3. N. Zhang, M.-Q. Yang, Z.-R. Tang and Y.-J. Xu, *ACS Nano*, 2014, **8**, 623.

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S5. J. Zhou, G. Tian, Y. Chen, X. Meng, Y. Shi, X. Cao, K. Pan and H. Fu, *Chem. Commun.*, 2013, **49**, 2237.