Supplementary Information

Novel heterostructured Bi_2S_3/BiOI photocatalyst: facile preparation, characterization and visible light photocatalytic performance

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Experimental Section

(1) The synthetic processes of 40% Bi_2S_3/BiOI at room temperature for 5 h and 24 h were shown as follows: the aqueous solution containing thioacetamide (0.077 g) was introduced to the suspension of BiOI (0.300 g) that dispersed in 40 mL deionized water with constant stirring for 5 h and 24 h at room temperature, respectively. Then the products were collected, washed, and then dried at 80 °C for 8 h.

(2) The Bi_2S_3/BiOI with different theoretical molar percentage of Bi_2S_3 to initial BiOI (8%, 15%, 30% and 40%) were prepared by a hydrothermal process at 140 ^oC for 24 h. Firstly, a stoichiometric amount of thioacetamide was added dropwise into the suspension of BiOI (0.300 g) that dispersed in 40 mL deionized water. Then the mixture was stirred for 5 h at room temperature and transferred into a stainless steel autoclave with a Teflon liner of 50 mL capability and heated at 140 °C for 24 h. After the autoclave was cooled down to room temperature, the product was collected, washed, and then dried at 80 °C for 8 h.

The effect of pH on the photodegradation of MO over Bi_2S_3/BiOI

The surface properties of the catalysts and the effect of pH on the photodegradation of methyl orange (MO) over Bi_2S_3/BiOI were further studied. The initial pH value of MO solution was adjusted with dilute sulfuric acid and sodium hydroxide solution before irradiation. As seen from Fig. S6, the pH value shows a significant influence on the MO photodegradation. The photodegradation efficiency reduced with increasing pH from 4.00 to 9.70. The removed MO after 5 h of visible light irradiation were 90.9% (pH=4.00), 81.9% (pH=6.02) and 27.1% (pH=9.70). The corresponding reaction rates (constant *k*) were 0.47029, 0.29145 and 0.05645 h^{-1}, respectively. According to the reported study,[1] the pH-dependent photodegradation can mainly be attributed to the variations of surface charge properties of the photocatalyst, which could change the absorption behavior of a dye on a catalyst surface. Thus the zeta potential of Bi_2S_3/BiOI under different pH conditions were respectively measured to be -10.2 mV (pH=1.96), -13.9 mV (pH=4.00), -14.2 mV (pH=6.02), -29.8 mV (pH=9.07) and -51.8 mV (pH=11.02) using Zetasizer Nano-ZS90 (Malvern Co., United Kingdom), implying the overall charges of Bi_2S_3/BiOI became more negative with increase of pH value. Since MO has an anionic configuration, its adsorption can be favored in the acidic solution. As shown in Fig. S6, the corresponding adsorption values were 0.2% (pH=9.70), 0.5% (pH=6.02) and 19.8% (pH=4.00). The increasing MO in close contact with the Bi_2S_3/BiOI catalyst facilitates the MO photodegradation.

References:

1 X. P. Lin, F. Q. Huang, W. D. Wang, Y. M. Wang, Y. J. Xia and J. L. Shi, *Applied Catalysis A: General*, 2006, **313**, 218.

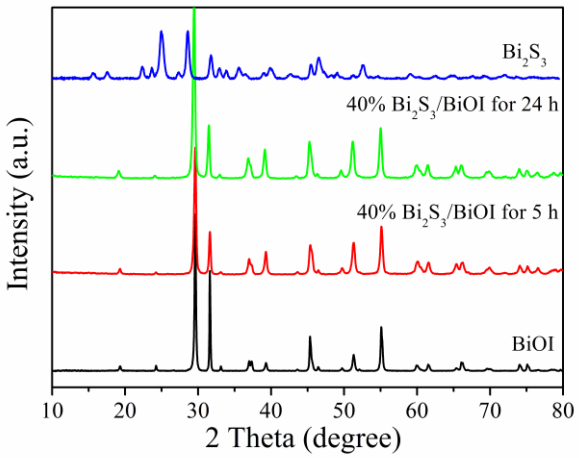

Fig. S1. XRD patterns of 40% Bi_2S_3/BiOI prepared at room temperature for 5 h and 24 h.

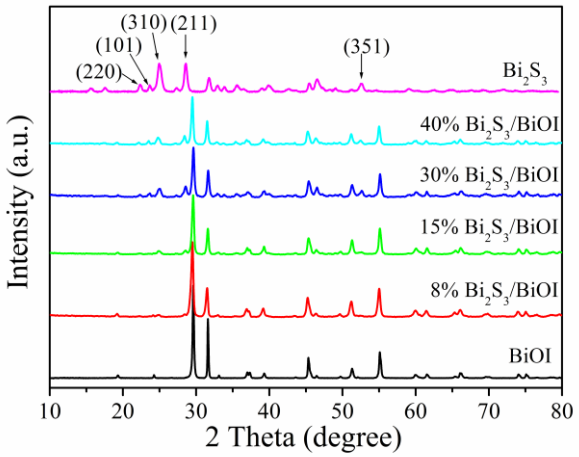

Fig. S2. XRD patterns of Bi_2S_3/BiOI with different ratios prepared by a hydrothermal process at 140 ^{o}C for 24 h.

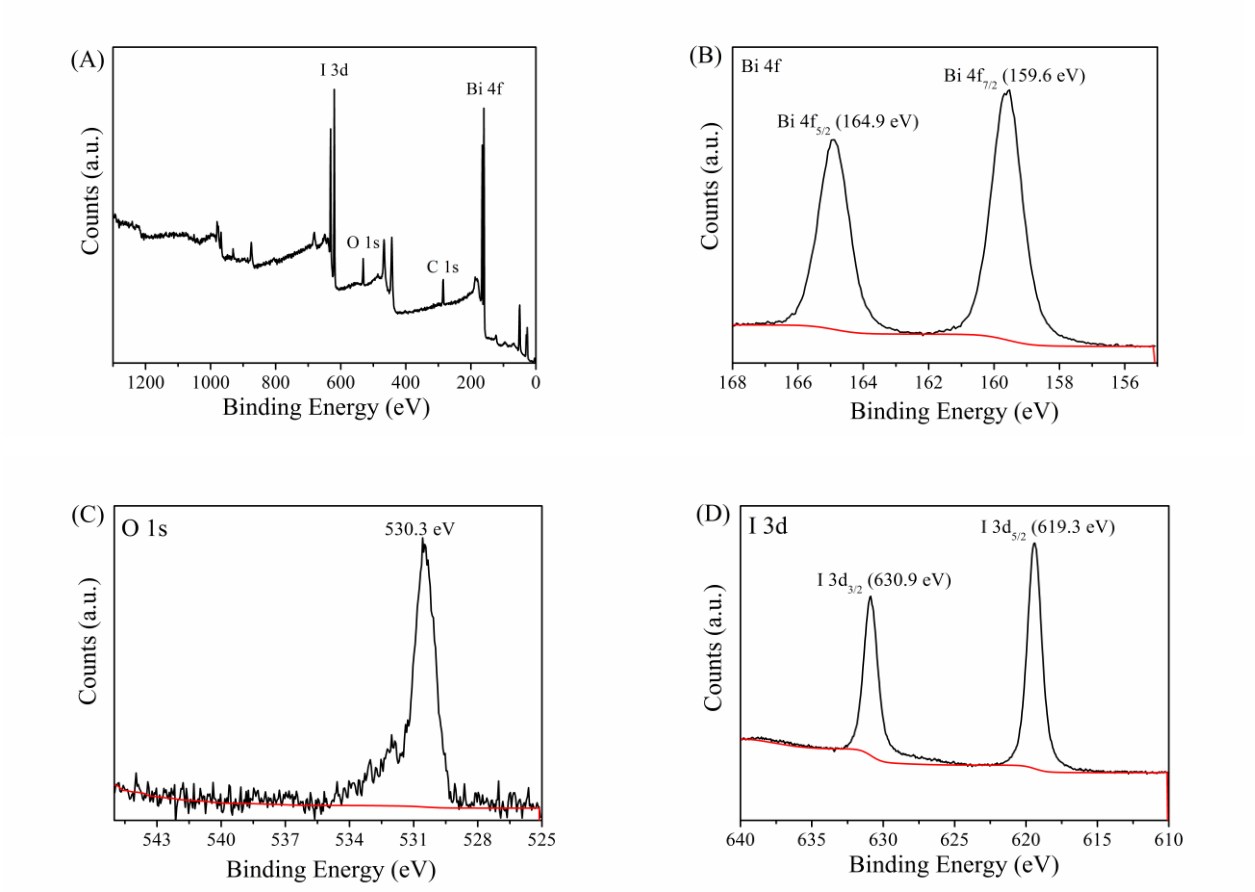

Fig. S3. XPS spectra of BiOI sample: (A) survey spectrum, (B) Bi 4f, (C) O 1s and (D) I 3d.

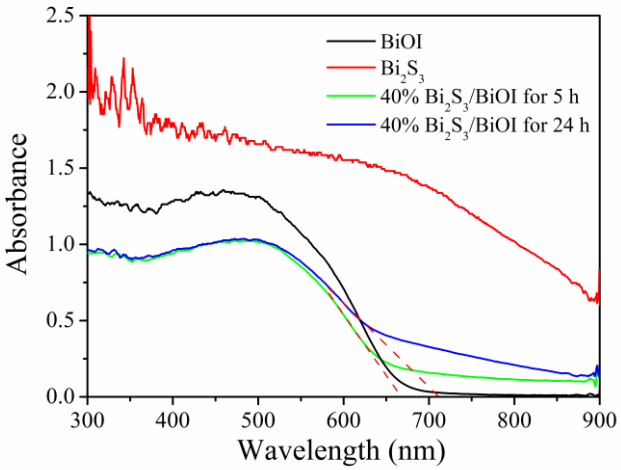

Fig. S4. UV–Vis diffuse reflectance spectra of 40% Bi_2S_3/BiOI, BiOI and Bi_2S_3.

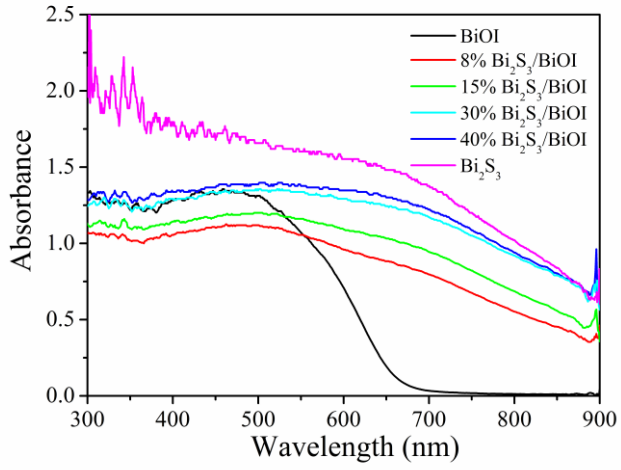

Fig. S5. UV–Vis diffuse reflectance spectra of Bi_2S_3/BiOI with different ratios prepared by a hydrothermal process at 140 ^{o}C for 24 h.

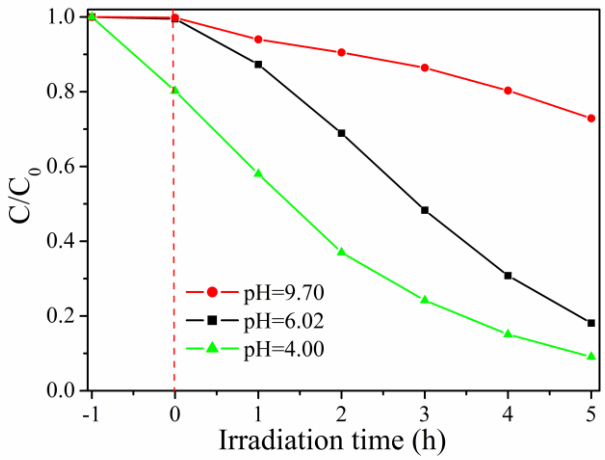

Fig. S6. The effect of pH values on photocatalytic activity of 4% Bi_2S_3/BiOI photocatalyst under visible light.

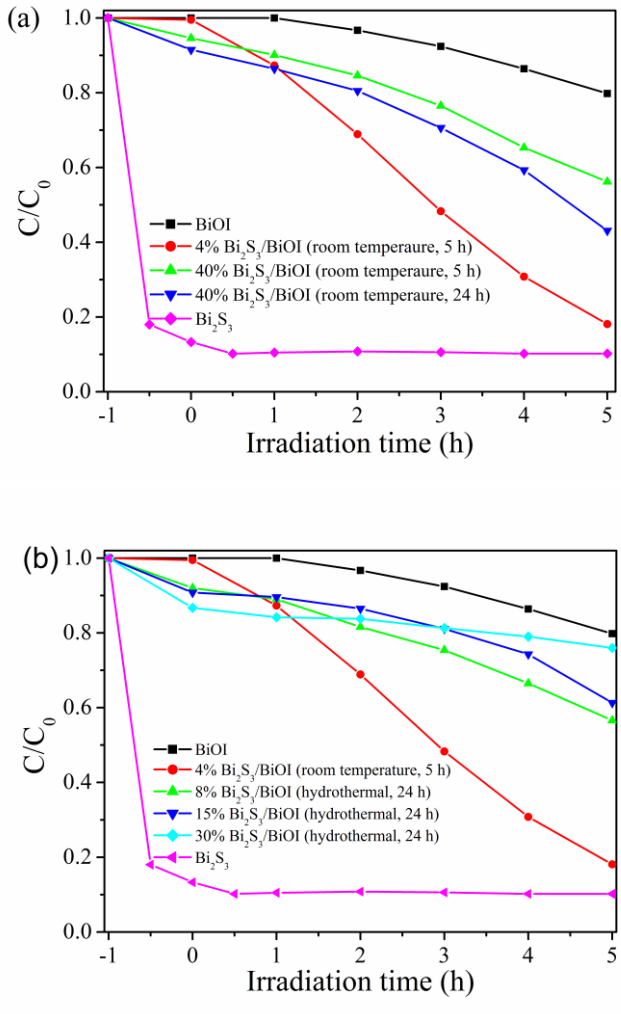

Fig. S7. Photocatalytic activities of (a) Bi_2S_3/BiOI with different ratios prepared at room temperature and (b) Bi_2S_3/BiOI prepared by a hydrothermal process at 140 ^{o}C for 24 h.