Supporting Information for

Hierarchical Ag/Bi$_2$MoO$_6$ hollow nanoboxes with high photocatalytic performance

Ying Ma, a, * Yulong Jia, a, * Yinhe Lin, a Wenbing Shi a

a School of Chemistry and Chemical Engineering, Yangtze Normal University
Chongqing, 408000 (China)
Email: yma2017@126.com

Experimental section

The Ag$_3$PO$_4$ nanocubes were obtained by a simple co-precipitation method using silver-ammino complex as precursor. To get silver-ammino complex, ammonia aqueous solution (0.1 M) was added into the AgNO$_3$ (0.2 g) aqueous solution (30 mL) to form a transparent solution. Subsequently, Na$_2$HPO$_4$ aqueous solution (0.167 g, 0.15 M) was dropped into the above solution. Finally, olivine powder was obtained by filtration and washing with deionized water and ethanol. In order to grow Bi$_2$MoO$_6$ nanosheets, 0.21 g Bi(NO$_3$)$_3$•5H$_2$O and 0.27 g (NH$_4$)$_6$Mo$_7$O$_{24}$•4H$_2$O were separately dissolved in 5 mL ethylene, forming the homogeneous solution. Then, (NH$_4$)$_6$Mo$_7$O$_{24}$ solution was added dropwise into the Bi(NO$_3$)$_3$ solution. With stirred for 10 min, the precursor solution was added with 25 mL ethanol and poured into a 80 mL Teflon-lined stainless steel autoclave, which was heated at 160 ºC for 12 h. After cooling down to room temperature, the obtained samples were collected and dried in vacuum for 4 h. In order to reveal the growth process of samples, the hydrothermal reaction was controlled at 4 h, 8 h, 12 h and 16 h, respectively. In addition, Ag nanoparticles were obtained by the same procedure except adding of precursors for Bi$_2$MoO$_6$. For comparison, the microbox was prepared as referred to [1].

Characterizations

The morphologies of samples can be characterized by scanning electron microscopy (SEM) (JSM-6701, JEOL) and transmission electron microscopy (TEM) (FEI Tecnai TF20). X-ray diffraction (XRD) patterns of samples can be investigated by Rigaku RINT-2000 instrument using Cu Kα radiation at 40 kV. Moreover, the UV-vis absorption spectra were measured on the UV-2550 (Shimadzu) spectrometer. The valence states of elements were characterized by Thermo ESCALAB 250 Xi system at room temperature using Al Kα with monochromic radiation.

Photocatalytic reactions

The photocatalytic activity of samples was evaluated by the CO$_2$ production produced by decomposition of 2-propanol in gas phase. More specifically, the photocatalyst (200 mg) was dispersed on a glass dish (4 cm$^2$), which was located in a Tedlar bag with a volume of 125 mL mixed air (79% N$_2$, 21% O$_2$, <0.1 ppm of CO$_2$, 500 ppm of 2-propanol). Adsorption-desorption equilibrium can be reached by leaving the photocatalytic system in dark for 1 h. After that, the samples were irradiated by visible light with 100 mW cm$^{-2}$, which was obtained by a Xenon lamp equipped with a Yellow-44 filter. In addition, the CO$_2$ evolution was measured by gas chromatography (Agilent/Inficon 3000 Micro GC) with a PLOT U column and OV-1 column.

Additional Figures and Discussions
Fig. S1. Mapping images of (B) Bi (C) Mo (D) O and (E) Ag based on the TEM image (A) of samples.

Fig. S2. (A) UV-vis diffuse reflectance spectra and (B) absorption edge of Ag nanoparticles, Bi₂MoO₆ microbox and Ag/Bi₂MoO₆ nanobox.

Reference