Supporting Information

In Situ Ion Exchange Grown Visible-light-driven Z-scheme $AgVO_3$/AgI Graphene Microtube for Enhanced Photocatalytic Performance

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1 Method

1.1 Synthesis of graphene oxide (GO)

GO is prepared by chemical delamination of graphite powder through applying the modified Hummers' method. [1] At the beginning, a 9:1 mixture of concentrated

H_2SO_4/H_3PO_4 (360:40 mL) was added to a mixture of graphite flakes (3.0 g, 1 wt equiv) and $KMnO_4$ (18.0 g, 6 wt equiv), producing a slight exotherm to 35-40 °C. The reaction was then heated to 50 °C and stirred for 12 h. The reaction was cooled to room temperature and poured onto ice (400 mL) with 30% H_2O_2 (3 mL). For workup, the mixture was washed with 200 mL of 30% HCl by centrifugation (8000 rpm). Subsequently, the mixture was washed with water to neutrality, then washed with 200 ml of ethanol and the supernatant decanted away. The solid obtained after centrifugation was vacuum-dried overnight at room temperature, obtaining 5.8 g of product.

1.2 Characterizations

The morphology and surface elements distribution of as-prepared samples were characterized by a scanning electron microscopy (SEM, JSM-7500F, Japan). The crystalline phases composition of all the samples was investigated using X-ray diffraction (XRD, DX-2600, China). In addition, the Fourier transform infrared (FTIR, Shimaduzu-8400S, Japan) was used to identify the chemical functional groups. The X-ray photoelectron spectroscopy (XPS, XSAM800, Britain) was also investigated. Raman spectra were performed on a Raman system (Thermo Scientific, DXR Smart, USA). The UV-vis diffuse reflectance spectra (UV-vis DRS) of the samples were obtained over a Lambda75 UV-vis spectrophotometer using $BaSO_4$ as reference. Photoluminescence (PL) emission and excitation spectra were recorded with FLS1000 Edinburgh Instrument. The electrochemical impedance spectroscopy (EIS) was measured by an electrochemical system (CHI-660c, China).

2 Supplementary Results and Discussion

2.1 FT-IR and Raman spectra of samples

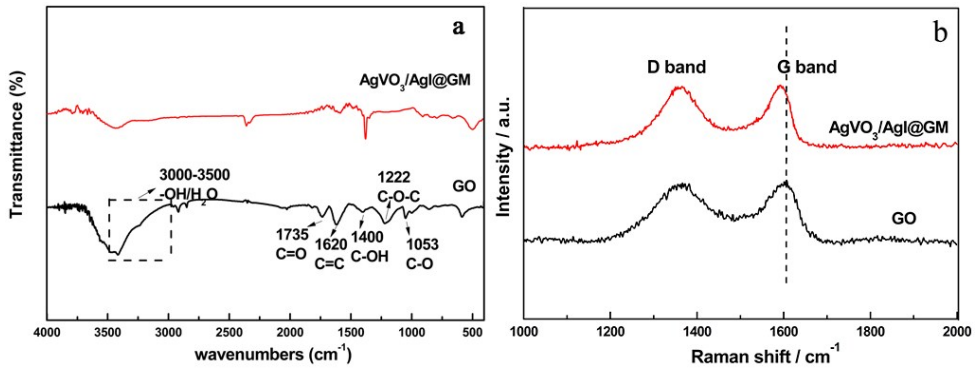

Fig. S1 (a) FT-IR spectra of GO and 0.25 $AgVO_3$/AgI@GM, (b) Raman spectra of GO and 0.25 $AgVO_3$/AgI@GM.

2.2 XPS analysis of samples

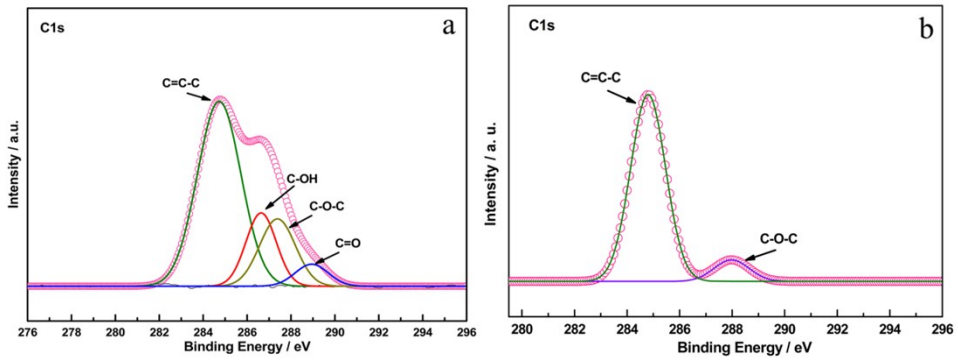

Fig. S2 (a, b) XPS spectra of C1s of GO and 0.25 $AgVO_3$/AgI@GM.

2.3 Band-gap estimation

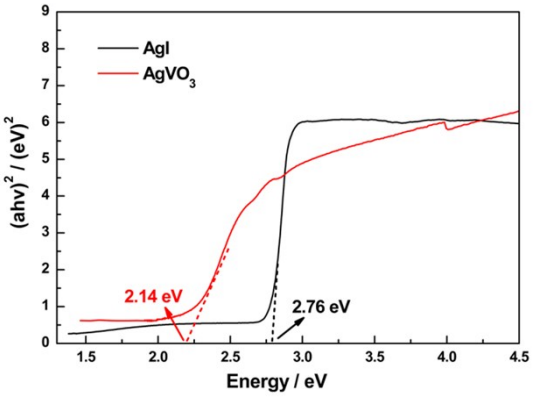

Fig. S3 Plots of $(ahv)^2$ vs. the energy of samples.

The energy band structures of the $AgVO_3$ and AgI were discussed to better

understand the photocatalytic mechanism of the composites. Calculate the conduction band (CB) and valence band (VB) positions of $AgVO_3$ and AgI according to equations (1) and (2) below.

$$E_{CB} = X - E_C - 0.5E_g \quad (1)$$

$$E_{VB} = E_g + E_{CB} \quad (2)$$

Where, E_{CB} and E_{VB} are CB edge potential and VB edge potential, respectively. X is the electronegativity of the semiconductor, in which $AgVO_3$ [1] and AgI [2] are 5.86 eV and 5.48 eV, respectively. Ec is the energy of free electrons with a hydrogen scale of approximately 4.5 eV, and Eg is the band-gap energy of the semiconductors. Based on the equations (1) and (2), the CB and VB edge potentials of $AgVO_3$ are 0.29 eV and 2.43 eV, and those of AgI are -0.40 eV and 2.36 eV, respectively.

2.4 The trapping experiments

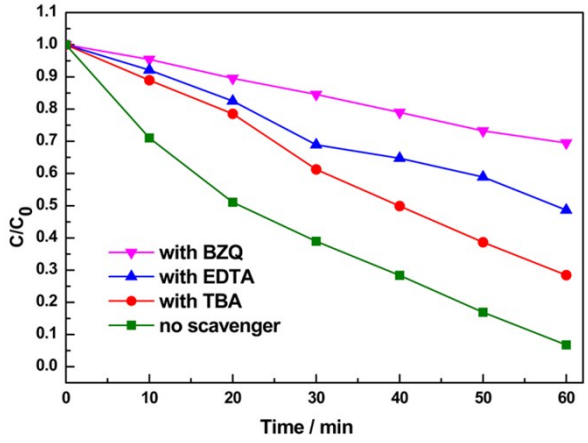

Fig. S4 The trapping experiments of the 0.25 $AgVO_3$/AgI@GM.

Reference

1. W. Zhao, Z. Wei, H. He, J. Xu, J. Li, S. Yang and C. Sun, *Appl Catal A Gen*, 2015, **501**, 74-82.
2. X. Wang, J. Yang, S. Ma, D. Zhao, J. Dai and D. Zhang, *Catal Sci Technol*, **6**, 10.1039.C1035CY00787A.