Supporting Information of

Fabrication of $Y_xBi_{1-x}VO_4$ Solid Solutions for Efficient C_2H_4 Photodegradation

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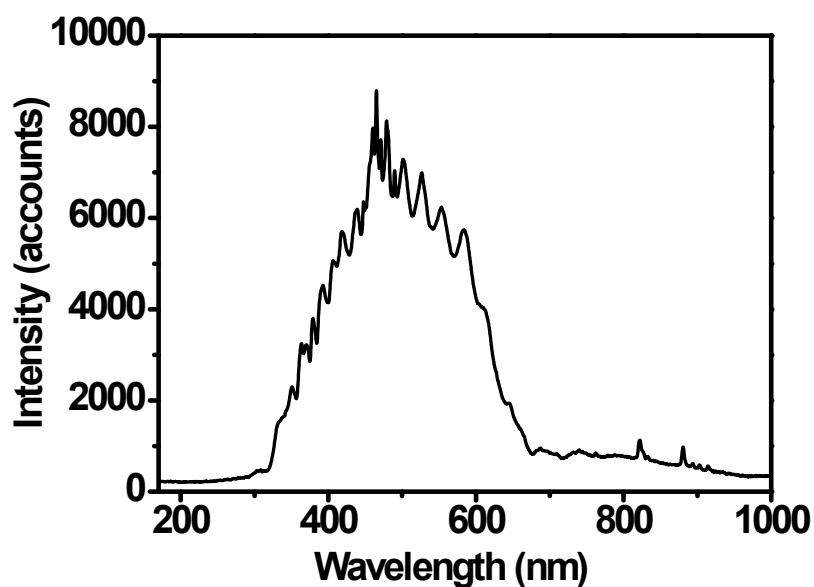
S1 Xe lamp spectrum

Fig. S1. The spectrum of the Xe lamp.
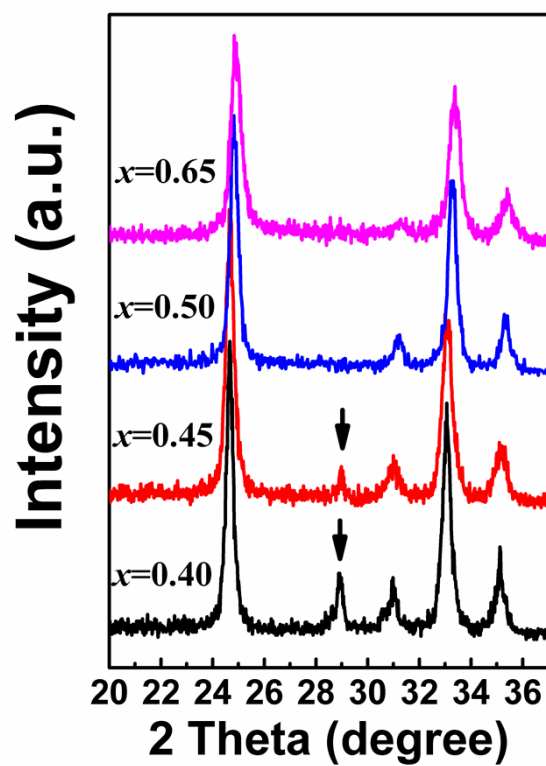
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S2 XRD patterns:

Fig. S2 Room temperature XRD patterns of $Y_xBi_{1-x}VO_4$ powders close to the monoclinic/tetragonal phase boundary. The arrows indicate (121) plane of the monoclinic phase.
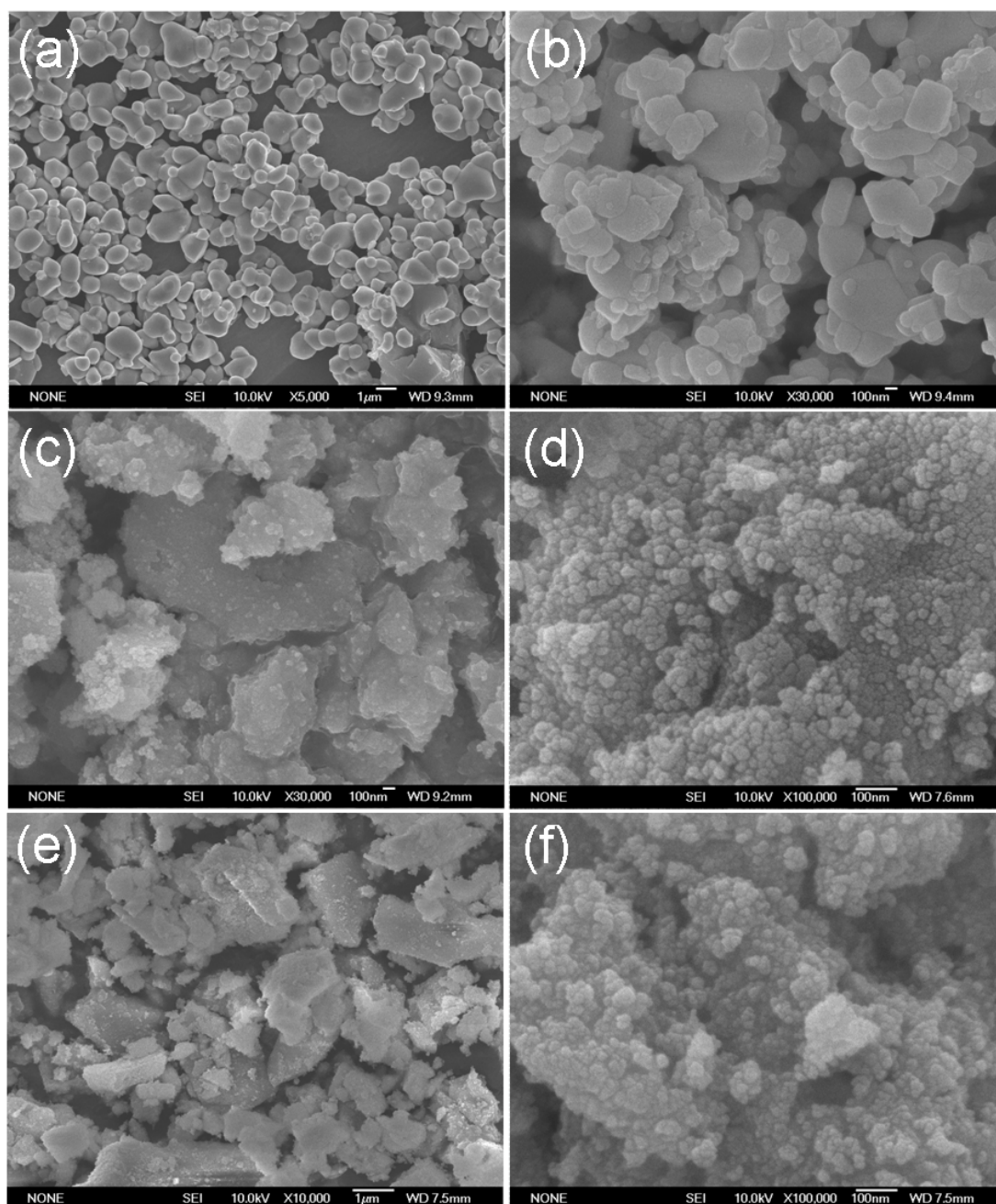
S3 SEM images:

Fig. S3 SEM images of the as prepared samples: (a) $BiVO_4$, (b) $Y_{0.25}Bi_{0.75}VO_4$, (c-d) $Y_{0.85}Bi_{0.15}VO_4$, (e-f) YVO_4.
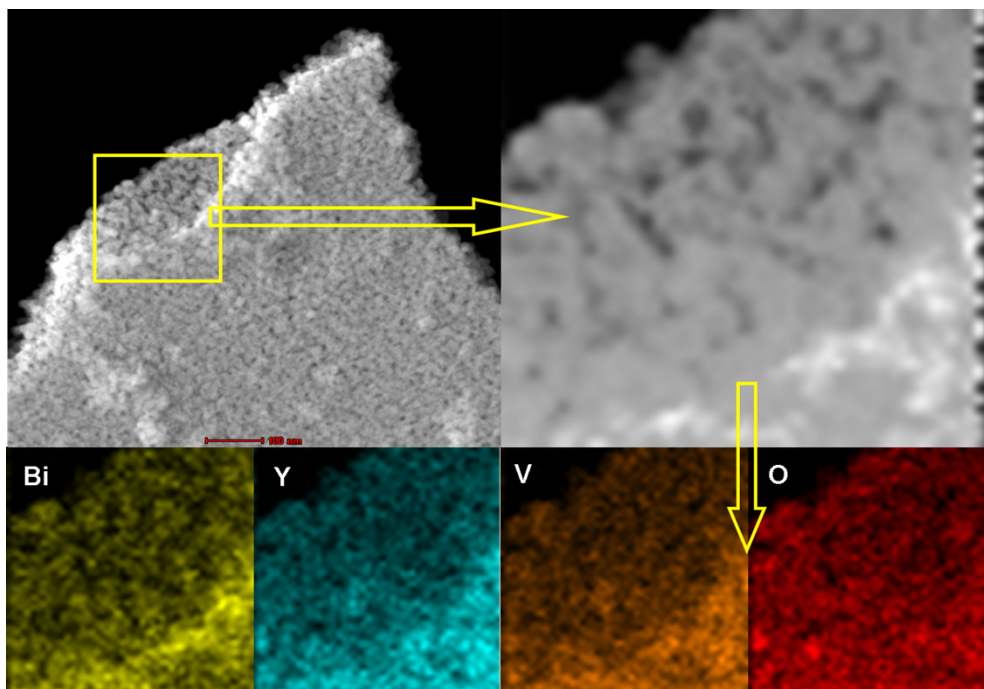
S4-5 element mapping analysis

Fig. S4 The high angle annular dark field-scanning transmission electron microscopy (HAADF-STEM) image of $Y_{0.85}Bi_{0.15}VO_4$ (top panels) and elemental mapping patterns (bottom panels) for the boxed area.
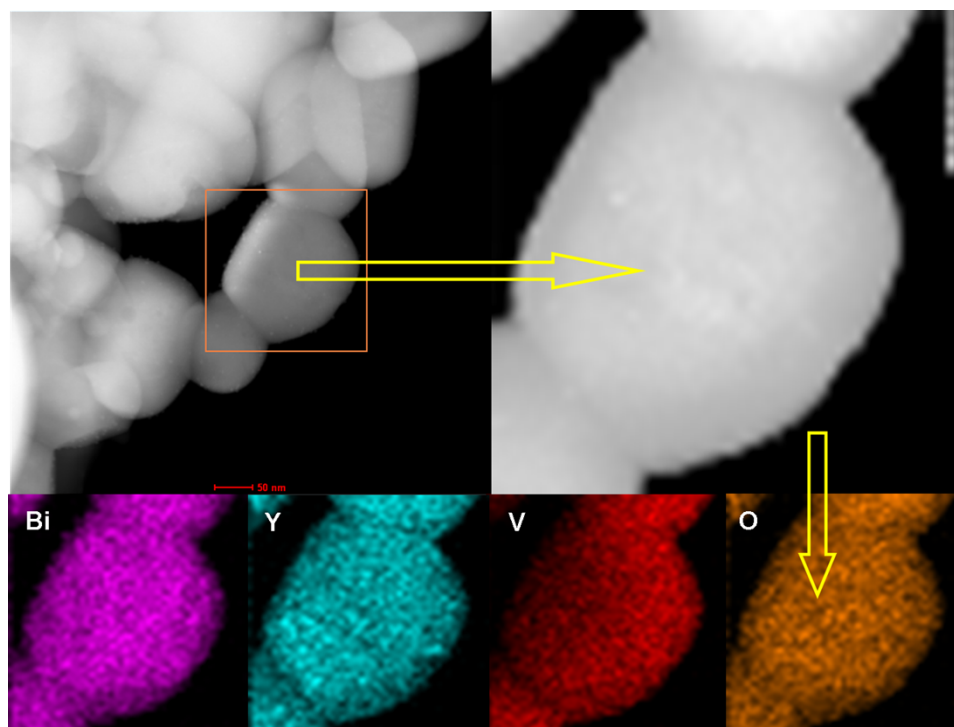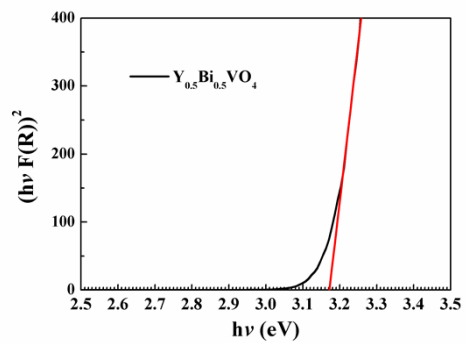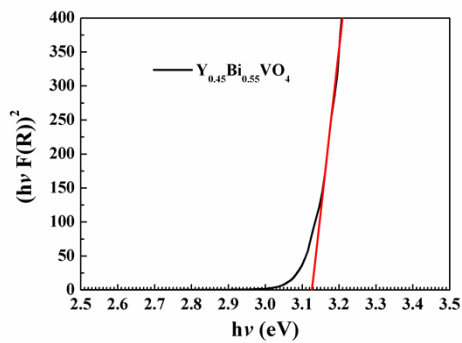

Fig. S5 The high angle annular dark field-scanning transmission electron microscopy (HAADF-STEM) image of $Y_{0.25}Bi_{0.75}VO_4$ (top panels) and elemental mapping patterns (bottom panels) for the boxed area.
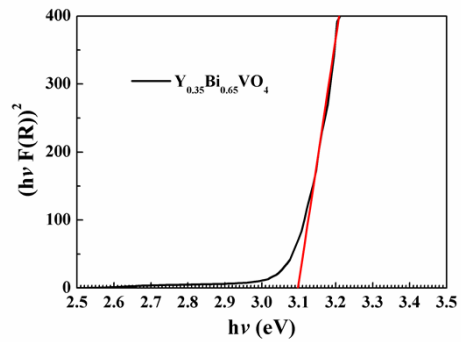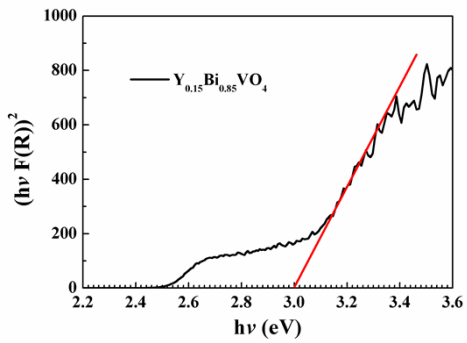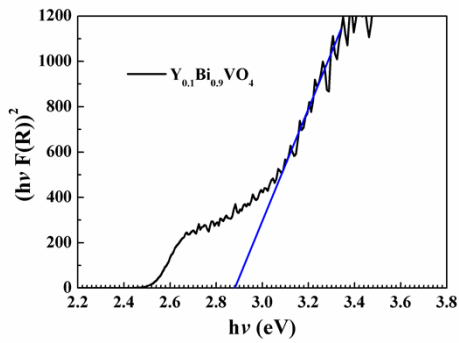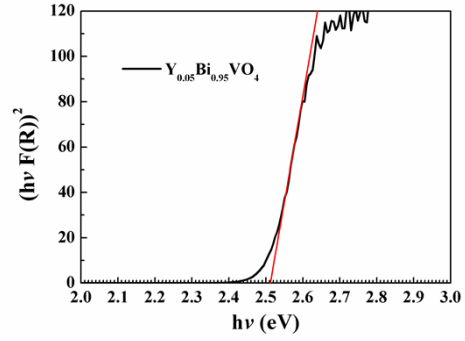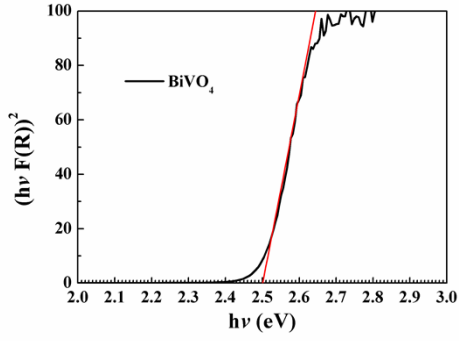
S6Tauc plots:
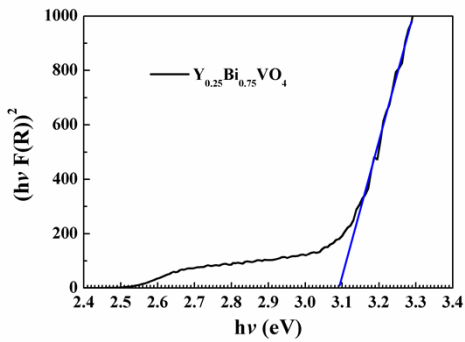
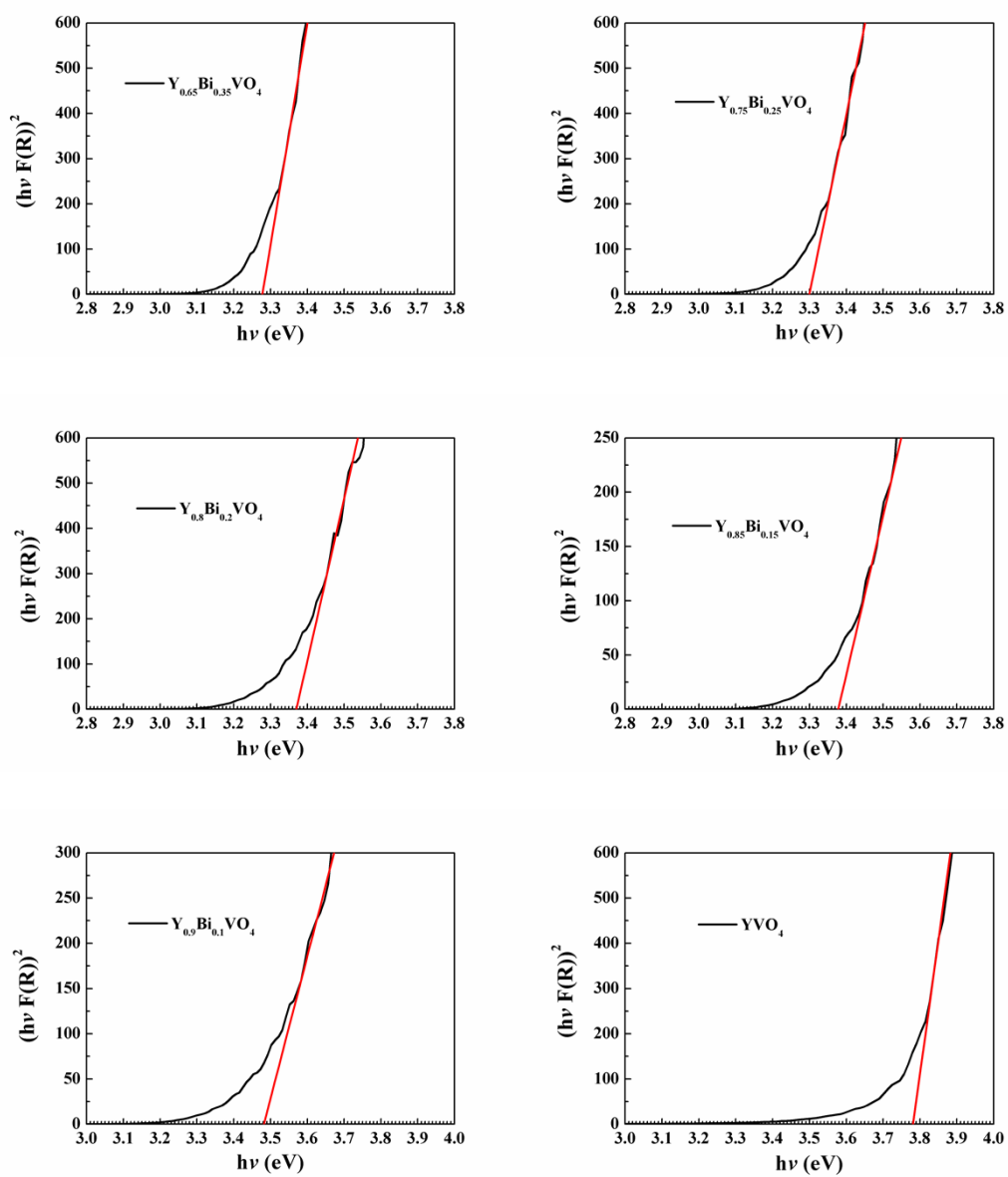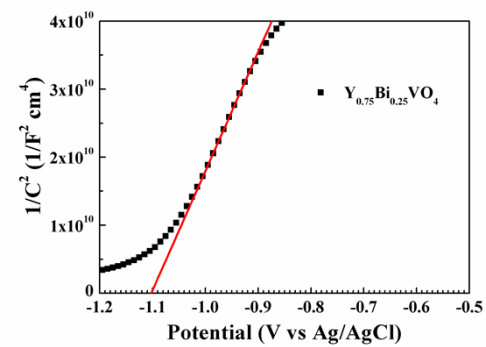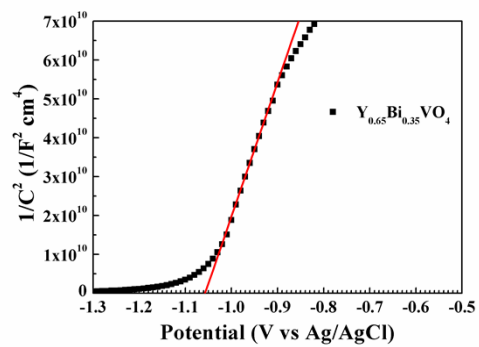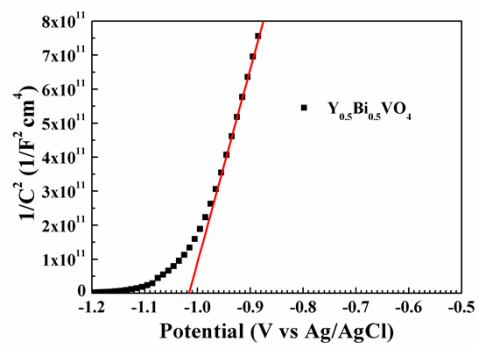Fig. S6 Tauc plots of the $Y_xBi_{1-x}VO_4$ photocatalysts.

S7 Mott-Schottky analysis:
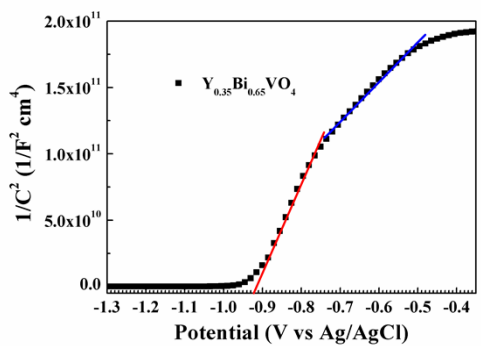
Fig. S7 Mott-Schottky plots of the $Y_xBi_{1-x}VO_4$ photocatalysts.

S8 C_2H_4 degradation kinetics:
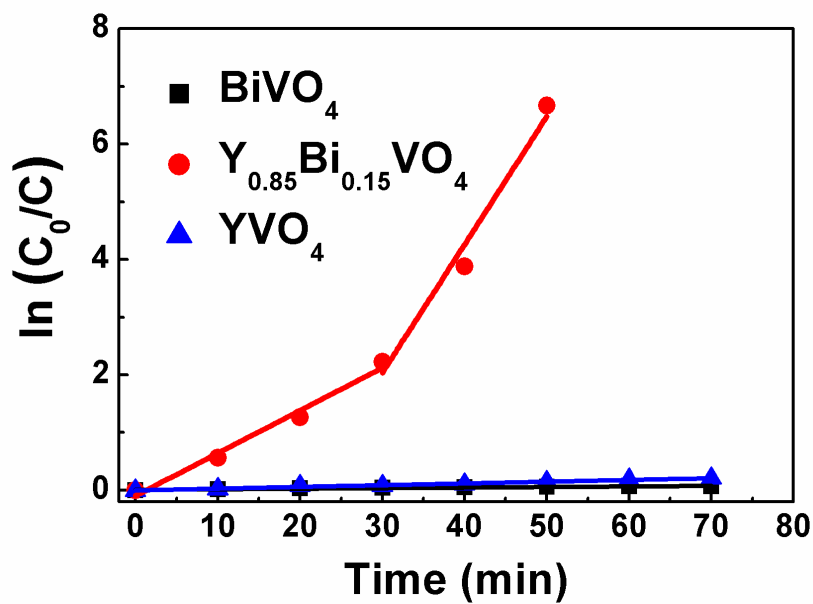
Fig. S8 C_2H_4 photodegradation kinetics of different samples.

S9. Turnover number calculations:

Fig. S9 C_2H_4 photodegradation test upon $Y_{0.85}Bi_{0.15}VO_4$ powder under fixed-bed flow gas mode (catalyst: 0.15 g; reaction gas: a mixture of 5 mL C_2H_4 and 5mL O_2 with N_2 atmosphere).

Note:

Reaction formula: $C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$

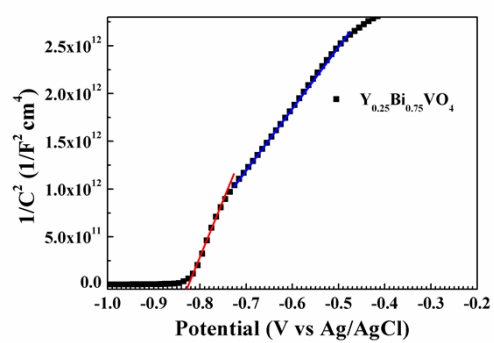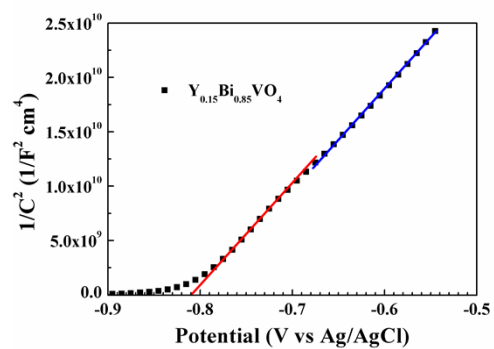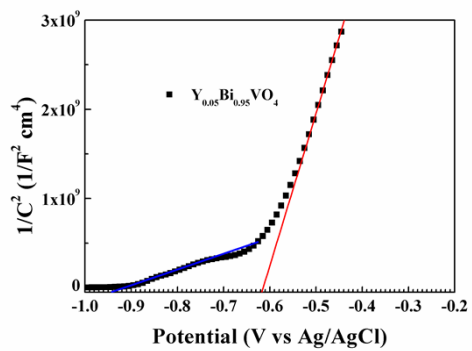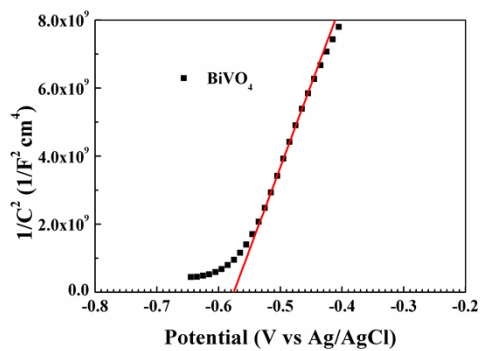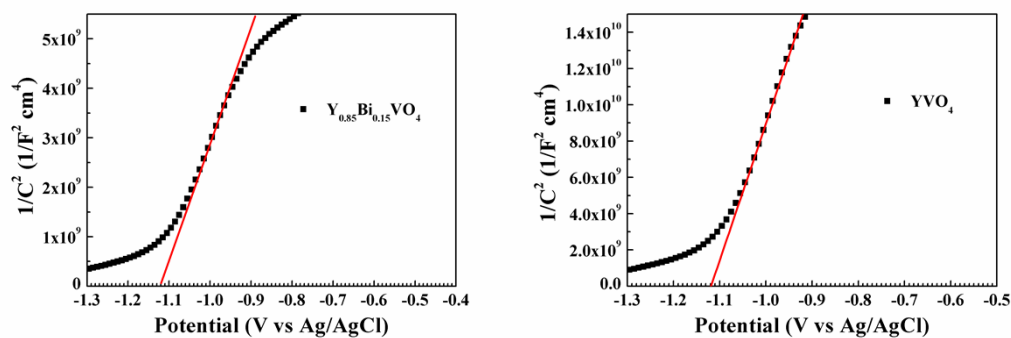The number of electrons gain and loss in the reaction: **12 · e^{-1}**

The amount of substance 5 mL C_2H_4: n_1=0.015/22.4 mol=2.2321×10^{-4} *mol*

The total amount of substance of electrons gain and loss in the photo-degradation of 5 mL C_2H_4:

$$n_2 = 12 \times 2.2321 \times 10^{-4} \, mol = 2.6786 \times 10^{-3} \, mol$$

For the $Y_{0.85}Bi_{0.15}VO_4$:

The amount of substance: n_3=6.7568×10^{-4} *mol*

The Turnover number: **n** = 2.6786×10^{-3} / 6.7568×10^{-4}= 3.9643

S10: Flow mode degradation of C$_2$H$_4$:

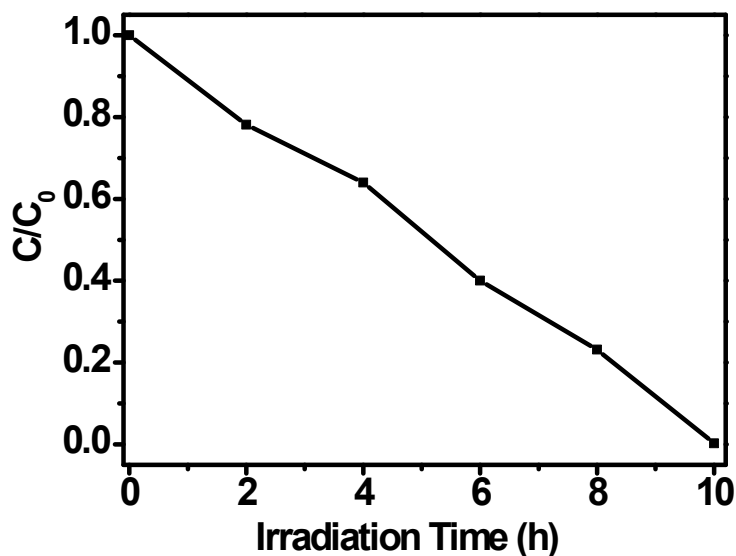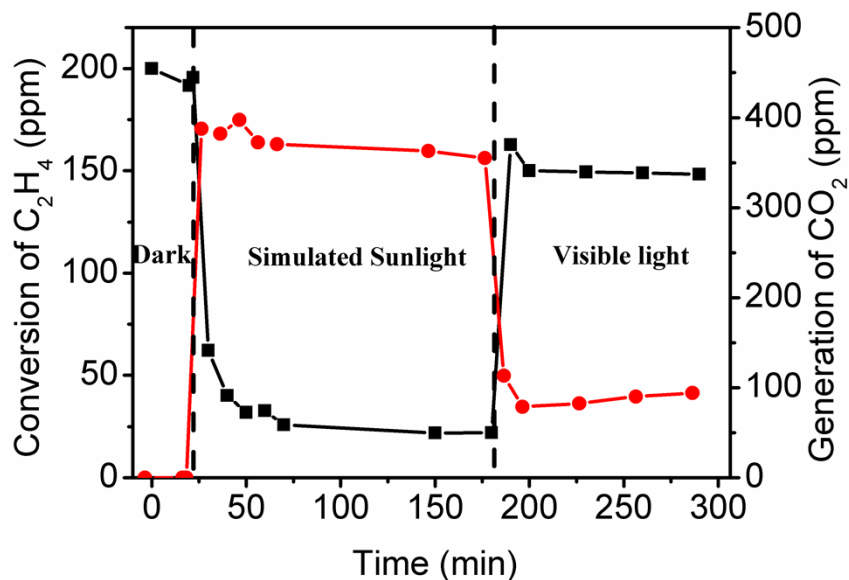Fig. S10 C$_2$H$_4$ photodegradation test upon Y$_{0.85}$Bi$_{0.15}$VO$_4$ powder under fixed-bed flow gas mode (catalyst: 0.8 g; reaction gas: a mixture of 200 ppm C$_2$H$_4$ and O$_2$ with N$_2$ carrier; Flow speed: 10 mL/min).
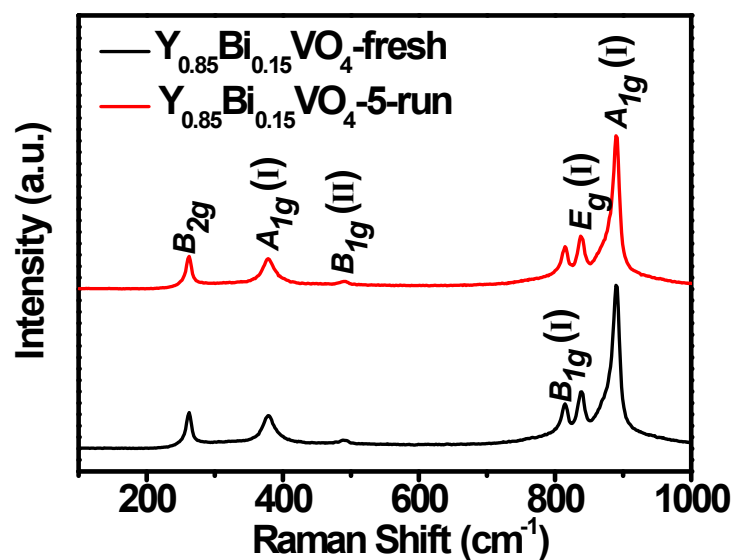
S11 Raman spectra of photocatalyst

Fig. S11 The Raman spectra of the Y$_{0.85}$Bi$_{0.15}$VO$_4$ samples before (Y$_{0.85}$Bi$_{0.15}$VO$_4$-fresh) and after (Y$_{0.85}$Bi$_{0.15}$VO$_4$-5 run) five cycles of C$_2$H$_4$ photo-degradation.
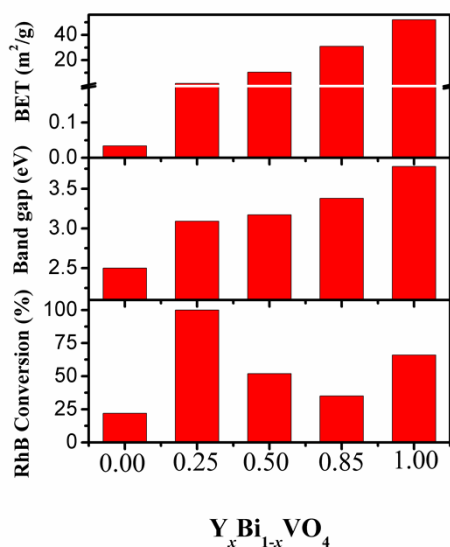
S12 Photocatalytic degradation of RhB

Fig. S12 Composion of BET surfaces, band gaps and RhB photodegradation efficiencies of the $Y_xBi_{1-x}VO_4$ photocatalysts. The Photocatalytic degradation of rhodamine B (RhB) were carried out as follows: First, 0.1 g of the $Y_xBi_{1-x}VO_4$ powder was mixed with RhB (2 mL, with a concentration of 40 mg L^{-1}) in a 198 mL H_2O solution. Then, the suspension was magnetically stirred for 1 h to reach a complete adsorption-desorption equilibrium in the dark and subsequently exposed to the sunlight simulator irradiation with maximum illumination time up to 180 min. The excitation source is a 300 W xenon lamp located at ca. 12.2 cm away from the suspension surface. During the irradiation, the suspension was continuously stirred and the reaction system was kept in ice-bath. Before irradiation and at certain time intervals, about 7 mL suspensions were sampled and centrifuged for three times to remove the residual before characterization. The concentration of RhB was determined by measuring the absorbance in step time using the UV-vis-NR spectrophotometers (Lambda-900, PerkinElmer).