Supporting Information

Synergistic surface charge channels and oxygen vacancies engineering in Sillén–Aurivillius $Bi_7Fe_2Ti_2O_{17}Cl$ oxyhalides for boosting photocatalytic activities by in-situ Ag-clusters

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1. Characterization and photoelectrochemical measurements Captions

1.1 Characterization

The surface topographies of all samples in this experiment were determined by scanning electron microscopy (SEM). A Philips X-ray diffraction (XRD) with Cu K_α radiation as the radiation source was conducted to determine the crystal structure of the prepared samples. The X-ray photoelectron spectroscopy (XPS) with Al Kα was employed to collect the information of chemical elements on $Ag/Bi_7Fe_2Ti_2O_{17}Cl$ material (Ag, Bi, Fe, Ti, Nb, O, Cl and C elements). Transmission electron microscopy (TEM) with energy dispersive spectrometer (EDS) patterns were obtained by using a JEOL JEM-2100F microscope. The UV-Vis diffuse reflectance spectra (DRS) was used to character the reflection (*R*) data of different $Bi_7Fe_2Ti_2O_{17}Cl$ samples. A Hitachi F-4600 fluorescence spectrophotometer was applied to measuring the photoluminescence (PL) spectra with the excitation lamp of a 150W Xe lamp at 400 V. Electrochemical impedance spectroscopy (EIS) and transient photocurrent were measured by an electrochemical workstation of CHI-660D from Chenhua Instruments Co., Ltd.

1.2 Electrochemical and photoelectrochemical measurements

In this experiment, an electrochemical workstation was used to determine the electrochemical and photoelectrochemical measurements, which was equipped with a systematic three-electrode cell, including the working electrode of the as-prepared samples (1 × 1 cm^2), the reference electrode of Ag/AgCl (3 M KCl), and the counter electrode of Pt net (1.5 × 1.5 cm^2). The $BaBi_4TiNbO_{11}Cl$ powder of 5 mg was mixed with 0.5 % nafion of 1mL, and then the mixed solution was sonicated for 1 h at room temperature. Afterwards, the obtained solution was coated on a fluorine-doped tin oxide (FTO) substrate by using a squeezing method and dried at 60 ^oC for 4 h. The working electrode was prepared as follows: To measure the flat-band potential of instrument, impedance measurements were evaluated with the same electrodes in $NaSO_4$ electrolytic solution of 0.5 M (pH = 2).

Figure Captions

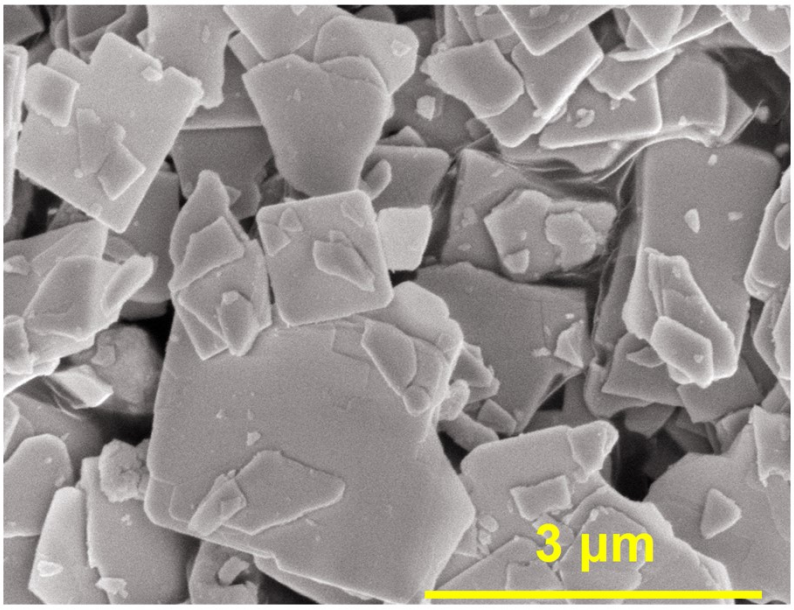

Figure S1. SEM image of $Bi_7Fe_2Ti_2O_{17}Cl$.

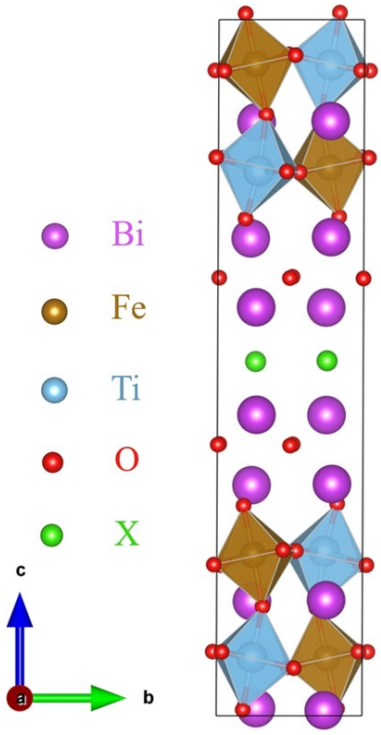

Figure S2. The crystal structure of $Bi_7Fe_2Ti_2O_{17}Cl$.

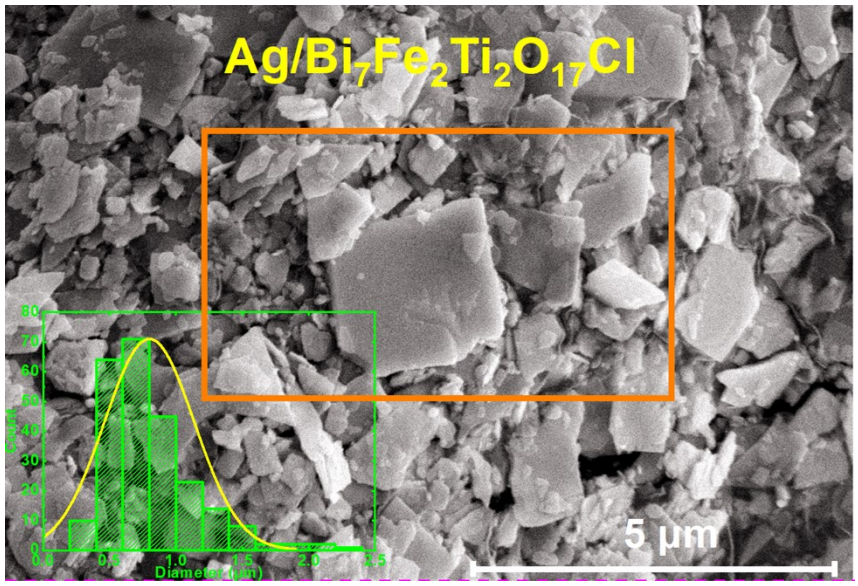

Figure S3. SEM images of $Ag/Bi_7Fe_2Ti_2O_{17}Cl$.

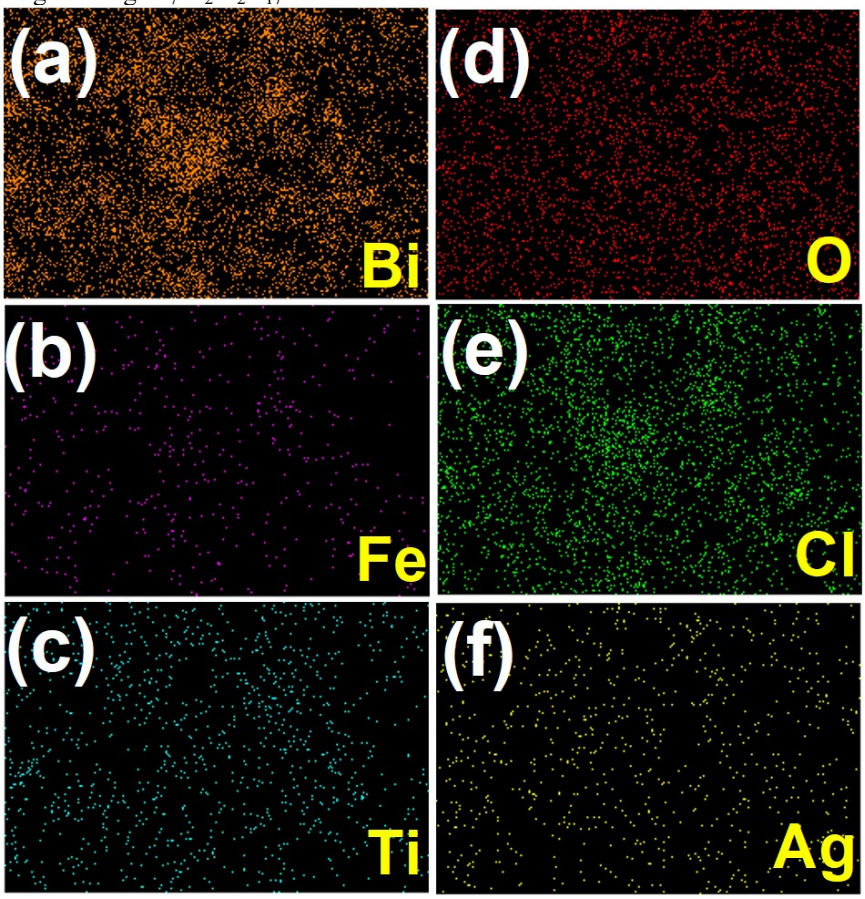

Figure S4. The corresponding SEM-EDS elemental mappings of (a) Bi, (b) Fe, (c) Ti, (d) O, (e) Cl, and (f) Ag.

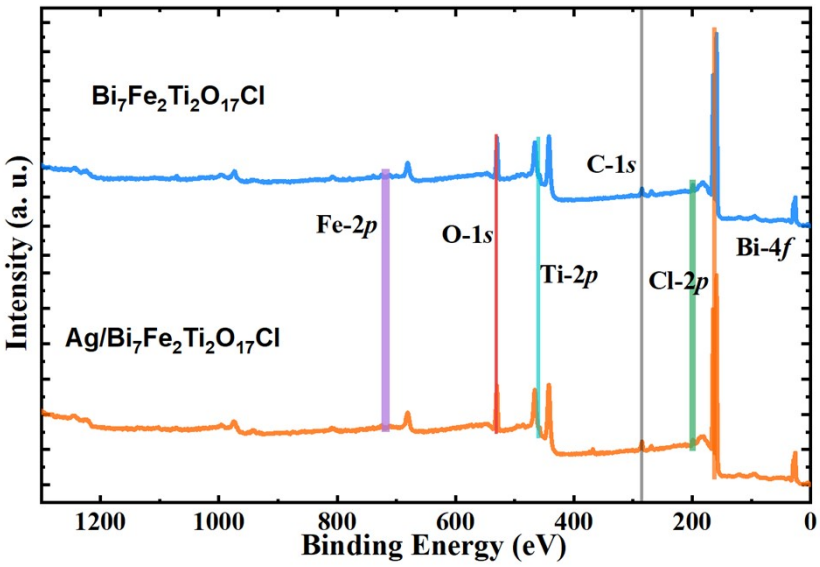

Figure S5. XPS spectra of $Bi_7Fe_2Ti_2O_{17}Cl$ and $Ag/Bi_7Fe_2Ti_2O_{17}Cl$.

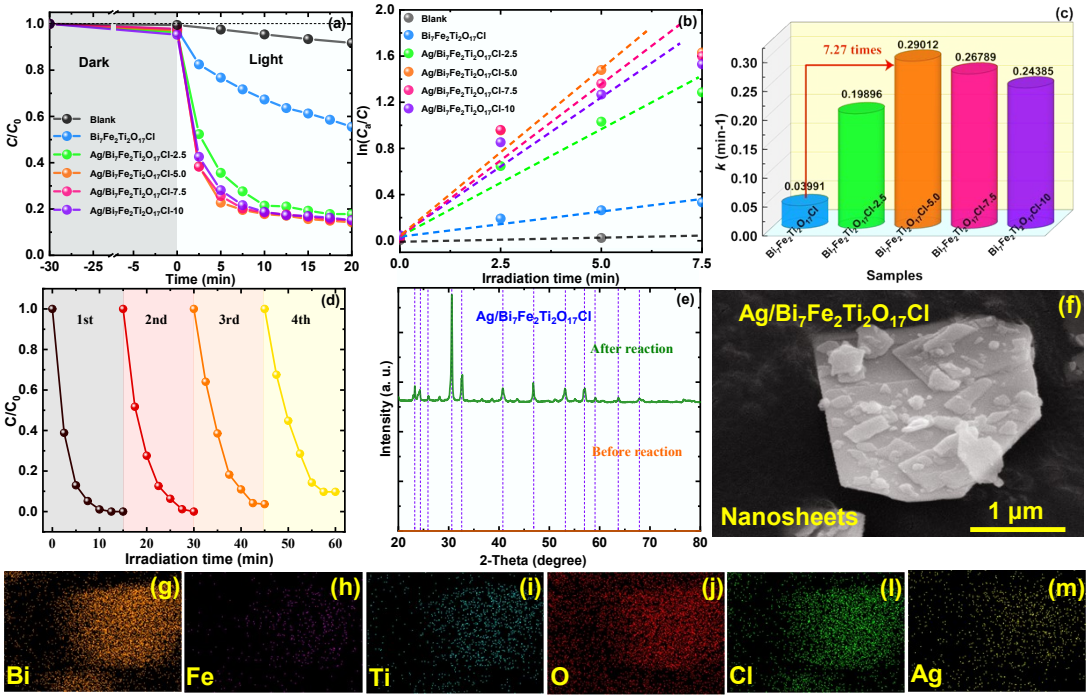

Fig. S6. (a) Time profiles of photocatalytic degradation of TCH by $Bi_7Fe_2Ti_2O_{17}Cl$, $Ag/Bi_7Fe_2Ti_2O_{17}Cl$-2.5, $Ag/Bi_7Fe_2Ti_2O_{17}Cl$-5.0, $Ag/Bi_7Fe_2Ti_2O_{17}Cl$-7.5, and $Ag/Bi_7Fe_2Ti_2O_{17}Cl$-10 (10 mg/L). (b) The corresponding linear transform of the first-order reaction kinetics for TCH degradation. (c) The *k* values of $Bi_7Fe_2Ti_2O_{17}Cl$ with different Ag contents. (d) Time plots for the degradation of TCH for four successive cycles. The corresponding XRD patterns (e) and SEM images (f) of photocatalysts before and after four cycles. The SEM-EDS mappings of (g) Bi, (h) Fe, (i) Ti, (j) O, (k) Cl, and (l) Ag of $Ag/Bi_7Fe_2Ti_2O_{17}Cl$-5.0 after four cycles.

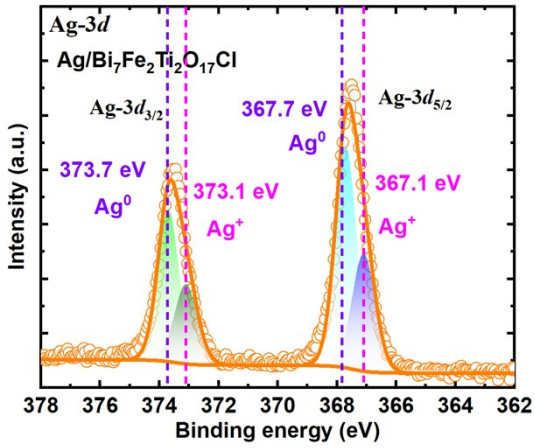

Figure S7. High-resolution XPS patterns of Ag-3*d* for the used composite material.

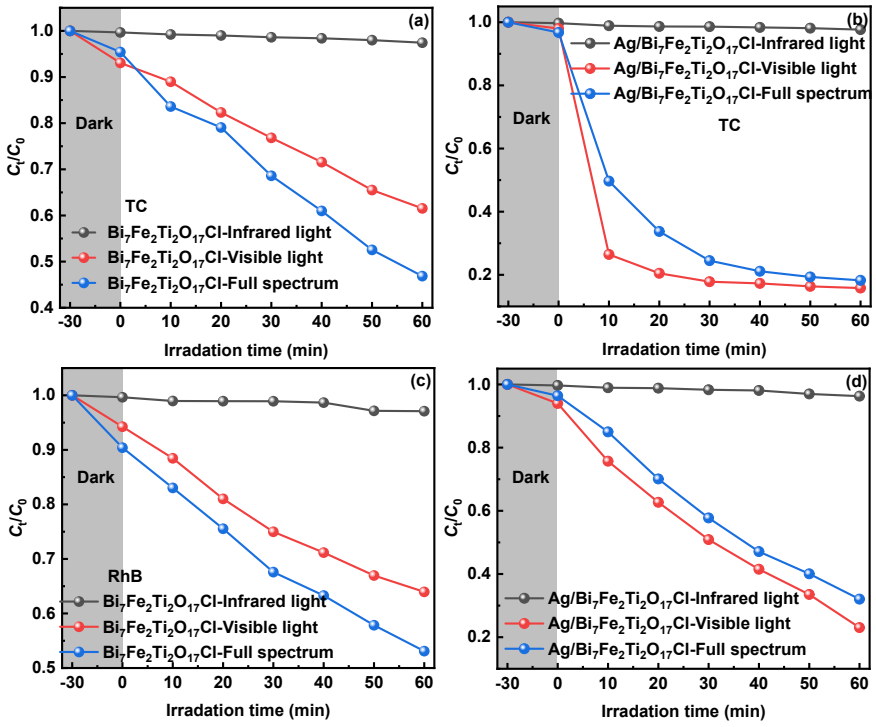

Fig. S8. Time profiles of photocatalytic degradation of TC by (a) $Bi_7Fe_2Ti_2O_{17}Cl$, (b) $Ag/Bi_7Fe_2Ti_2O_{17}Cl$. Time profiles of photocatalytic degradation of RhB by (c) $Bi_7Fe_2Ti_2O_{17}Cl$, (d) $Ag/Bi_7Fe_2Ti_2O_{17}Cl$.