Electronic Supplementary Material (ESI) for Photochemical & Photobiological Sciences.

Electronic Supplementary Information

Complementary Behavior of Doping and Loading in Ag/C-$ZnTa_2O_6$ for Efficient Visible-light Photocatalytic Redox towards Broad Wastewater Remediation

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1. Experimental

1.1. Synthesis of the contrast catalysts

Synthesis of C-$ZnTa_2O_6$ loaded with Au or Pt (Au/C-$ZnTa_2O_6$ and Pt/C-$ZnTa_2O_6$): 0.10 g of pre-prepared C-$ZnTa_2O_6$ powder was introduced into a quartz tube containing 20 mL deionized water and mixed with $HAuCl_4 \cdot 4H_2O$ (or $H_2PtCl_6 \cdot 6H_2O$, the mass ratio of Au/Pt is 10 wt.%) for 30 min to form a suspension in the dark. And the mixture is continued to be agitated for 2 h under the xenon lamp (500 W) irradiation. The product was filtered and washed by water for three times. The final products were dried in an oven at 60 ^oC for further characterization.

Preparation of Ag/C-$ZnTa_2O_6$ with different Ag contents: 0.10 g of pre-prepared $ZnTa_2O_6$ powder was introduced into the diluted $AgNO_3$ solution (1.0 g/L, 5 mL/10 mL/15 mL) and mixed for 30 min to form a suspension in the dark. And the mixture is continued to be agitated for 2 h under the xenon lamp (500 W) irradiation. The product was filtered and washed by water for three times until NO_3^- was completely removed. The final products were dried in an oven at 60 ^oC. A series of Ag/$ZnNb_2O_6$ catalysts were obtained by setting up the initial Ag contents to 5 wt.%, 10 wt.%, and 15 wt.%, respectively.

Synthesis of Ag/$Na_2Ta_2O_6$: Typically, 0.266 g of tantalum hydroxide ($Ta(OH)_5$, 1.0 mmol), 0.20 g sodium hydroxide (NaOH, 5.0 mmol), and 15.0 mL of deionized water were added into round-bottom flask followed by 10 min stirring under room temperature. And then the above mixture was transferred into a 30 mL Teflon lined autoclave, which was heated at 220 °C for 24 h. And 0.10 g of obtained precipitate

was mixed with $AgNO_3$ solution (1.0 g/L, 10 mL, the initial content of Ag was set at 10 wt.%), and then followed the same procedure of Ag/C-$ZnTa_2O_6$.

Synthesis of Ag/SiO_2: 0.10 g of purchased SiO_2 powder was introduced into the diluted $AgNO_3$ solution (1.0 g/L, 10 mL, the initial content of Ag was set at 10 wt.%), , and then followed the same procedure of Ag/C-$ZnTa_2O_6$.

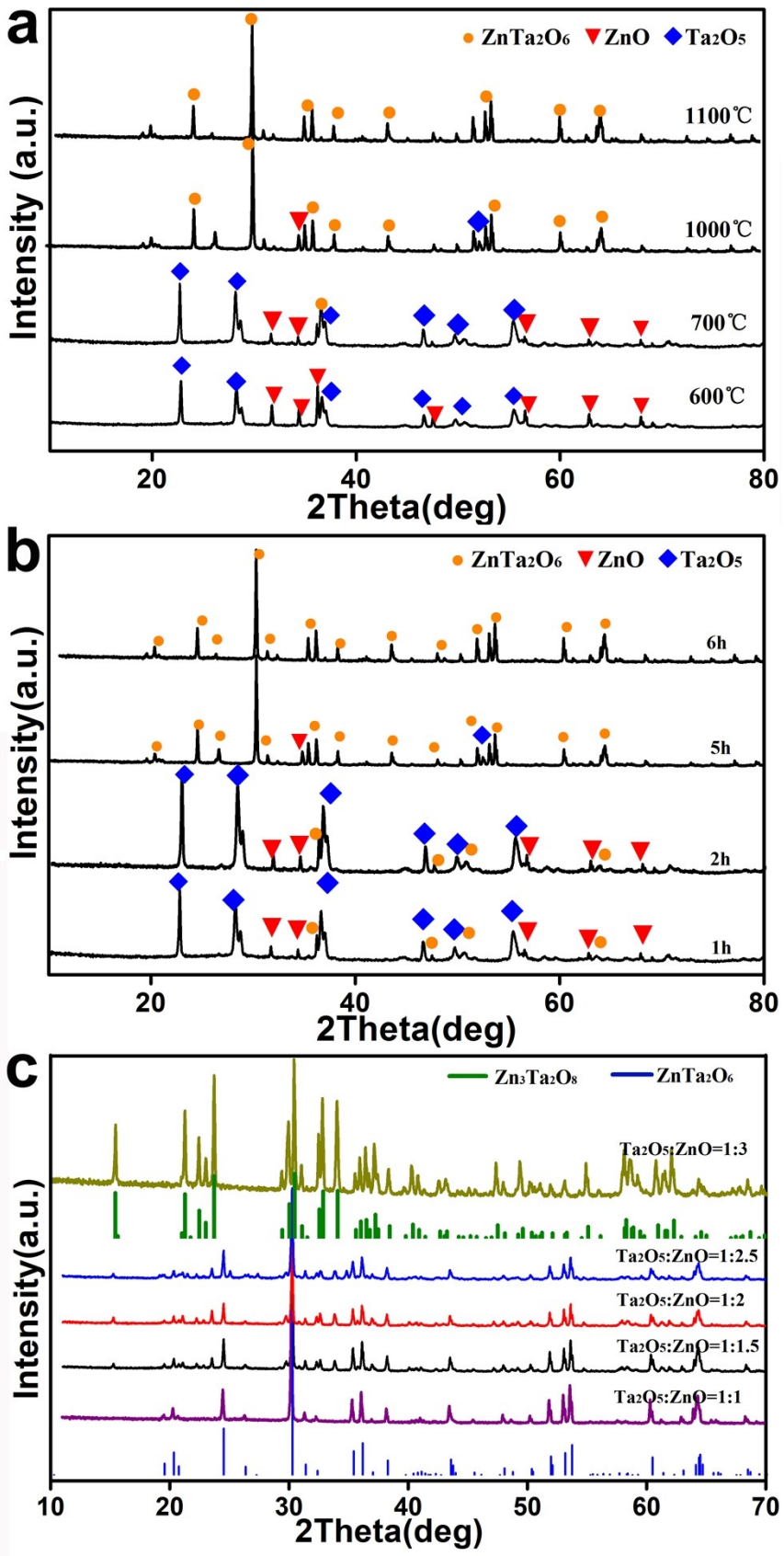

Fig. S1. XRD patterns of as-obtained products in typical synthesis with (a) different temperature, (b) duration, and (c) molar ratio of Ta_2O_5/ZnO.

Table S1. Carbon contents in C-$ZnTa_2O_6$ and Ag/C-$ZnTa_2O_6$ measured by XPS spectrum.

Catalysts	Carbon content/ wt.%
C-$ZnTa_2O_6$	0.035
Ag/C-$ZnTa_2O_6$	0.033

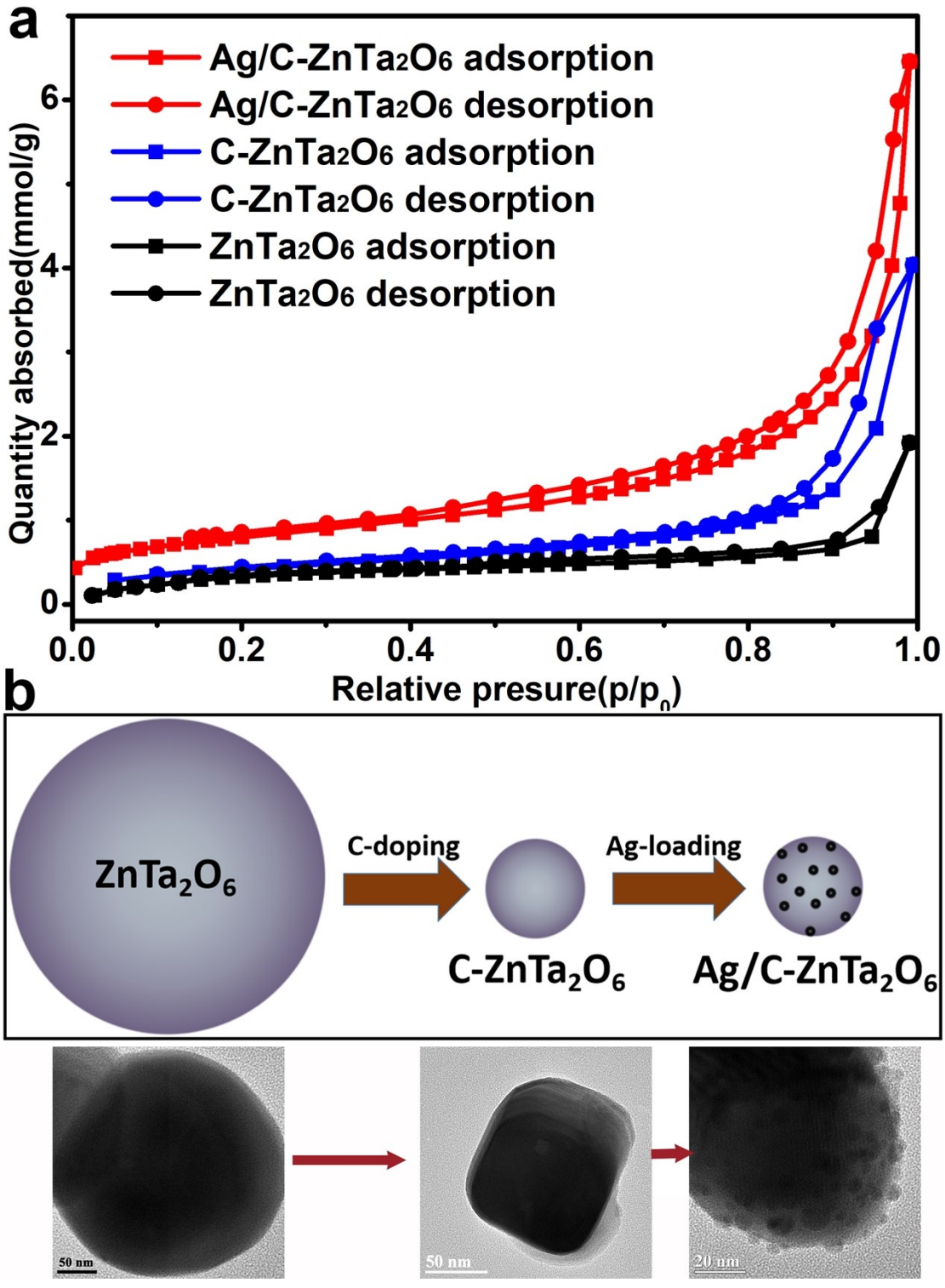

Fig. S2. (a) N_2 adsorption-desorption isotherms for as-synthesized pure $ZnTa_2O_6$, C-$ZnTa_2O_6$ and Ag/C-$ZnTa_2O_6$ in typical synthesis, and (b) schematic diagram of sample morphology and TEM images from pure $ZnTa_2O_6$ to C-$ZnTa_2O_6$ and then to Ag/C-$ZnTa_2O_6$.

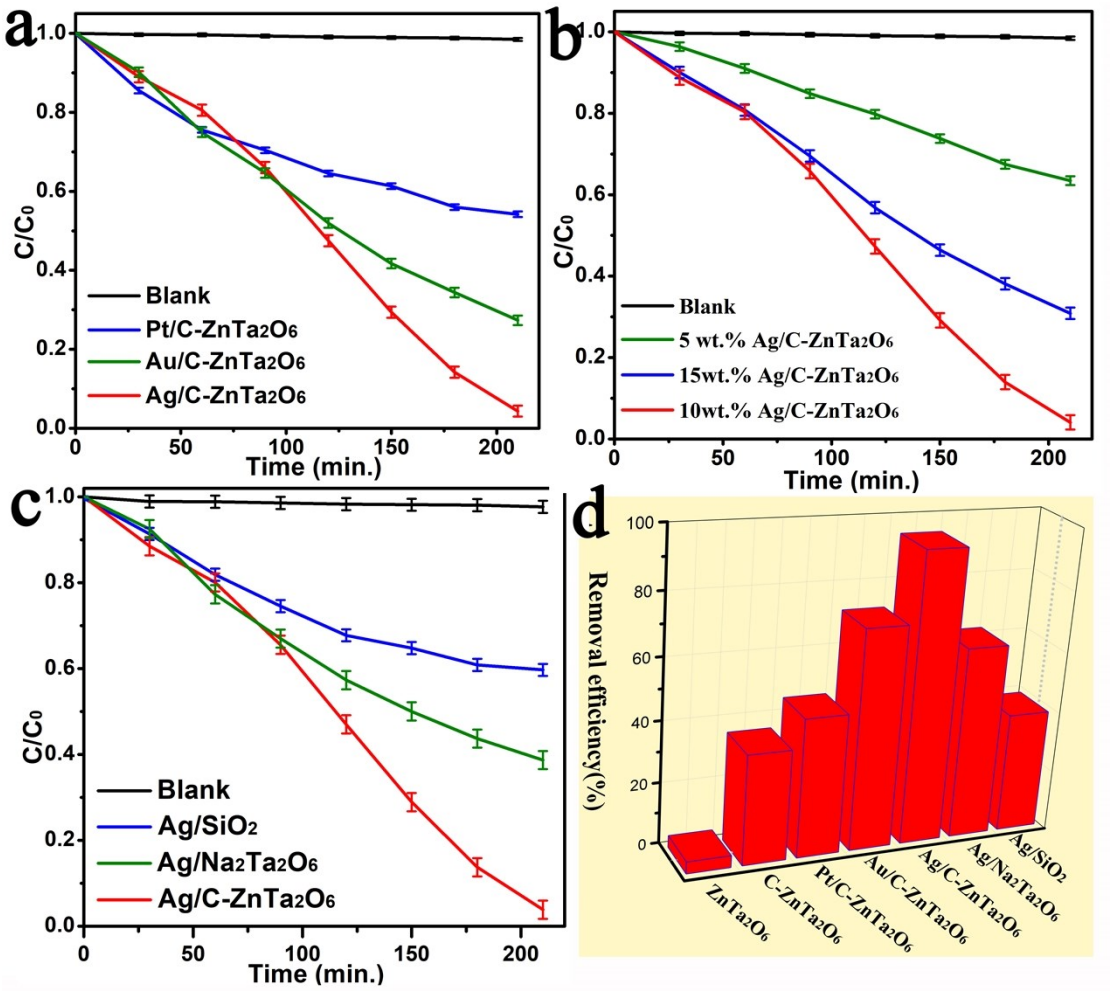

Fig. S3. The photocatalytic degradation of HCl-TC with (a) C-$ZnTa_2O_6$ loaded with different noble metal (Pt, Au, Ag), (b) Ag/C-$ZnTa_2O_6$ catalyst with different loading content of Ag, (c) Ag loaded with different supporters ($Na_2Ta_2O_6$, SiO_2, C-$ZnTa_2O_6$) (d) removal efficiency of different photocatalysts under visible light irradiation.

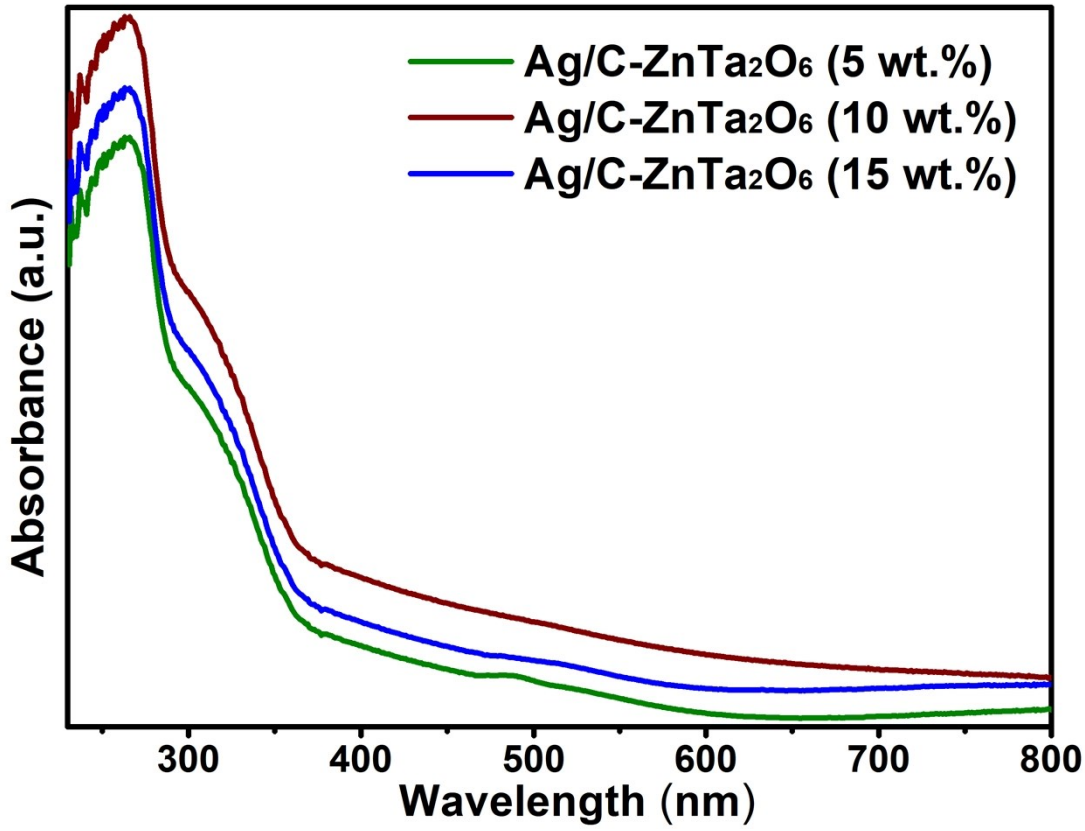

Fig. S4. UV-vis absorption spectra of Ag/C-$ZnNb_2O_6$ with different initial loading content of silver.