Supporting information

Effect of Zn in Ag-Loaded Zn-Modified $ZnTa_2O_6$ for Photocatalytic Conversion of CO_2 by H_2O

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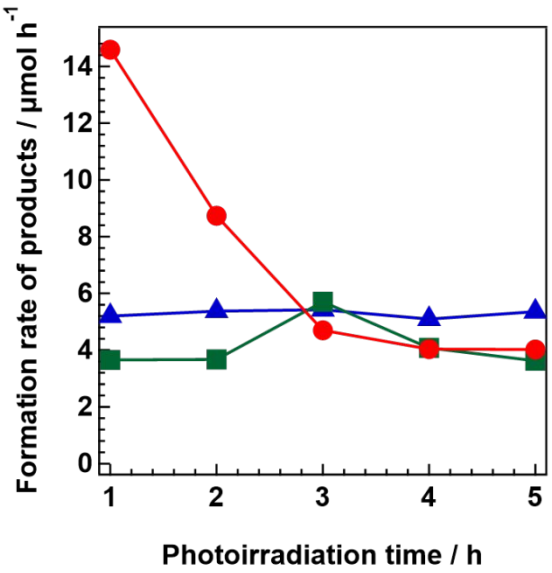


Figure S1. Time-dependent evolution of H_2 (blue), O_2 (green), and CO (red) 3.0Ag/ $Zn_3Ta_2O_8$

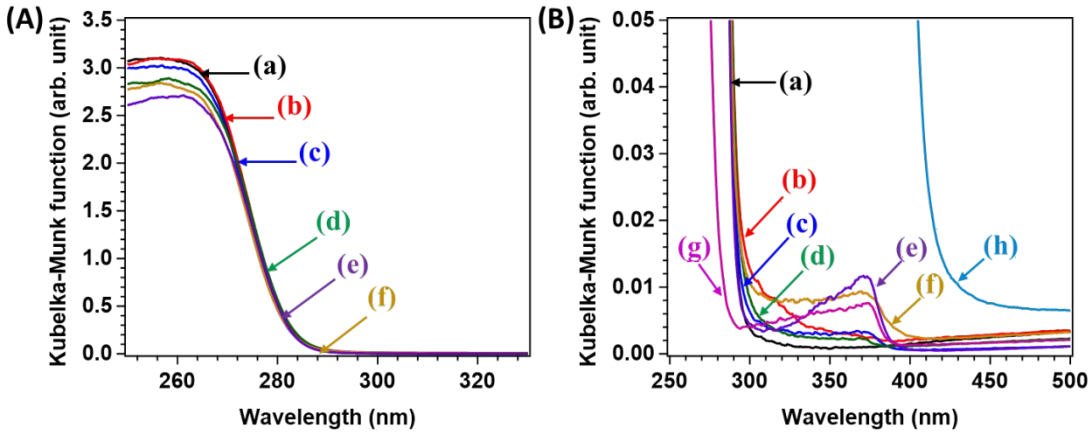


Figure S2 UV-vis spectra of (a) $ZnTa_2O_6$, (b) $2.5Zn/ZnTa_2O_6$, (c) $10Zn/ZnTa_2O_6$, (d) $15Zn/ZnTa_2O_6$, (e) $20Zn/ZnTa_2O_6$, (f) $40Zn/ZnTa_2O_6$, (g) $Zn_3Ta_2O_8$, (h) ZnO

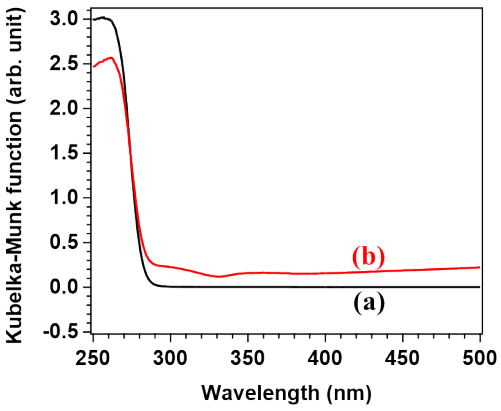


Figure S3 UV-vis spectra of (a) 10Zn/$ZnTa_2O_6$; (b) Ag/10Zn/$ZnTa_2O_6$

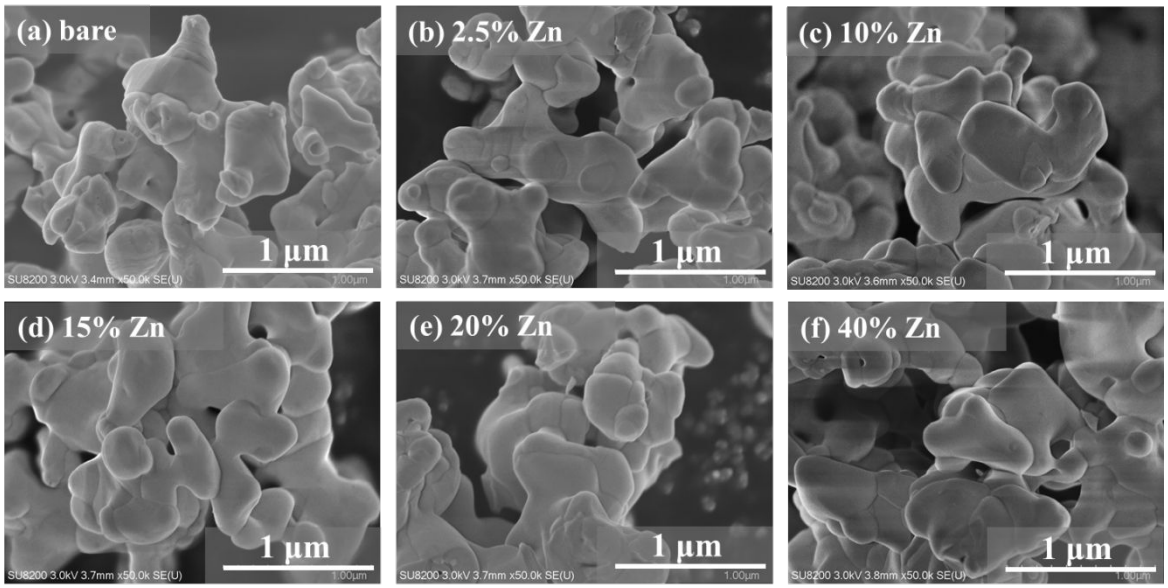


Figure S4 SEM images of the (a) $ZnTa_2O_6$, (b) $2.5Zn/ZnTa_2O_6$, (c) $10Zn/ZnTa_2O_6$, (d) $15Zn/ZnTa_2O_6$, (e) $20Zn/ZnTa_2O_6$, (f) $40Zn/ZnTa_2O_6$,

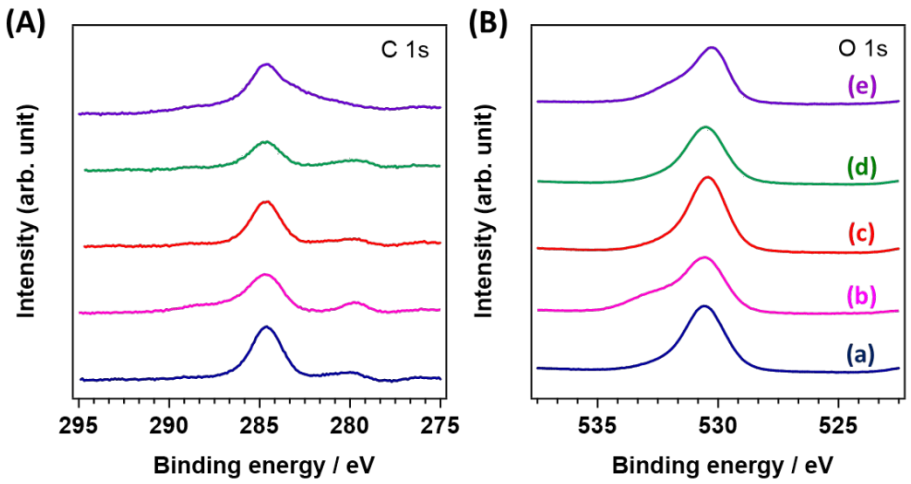


Figure S5. XPS spectra of (A) C 1s and (B) O 1s for (a)$ZnTa_2O_6$, (b) $10Zn/ZnTa_2O_6$ without calcination; (c) $10Zn/ZnTa_2O_6$, (d) $Zn_3Ta_2O_8$, and (e) ZnO

Table S1. The ratio of Zn to Ta detected by EDS and XPS

	Zn/Ta in theory	Zn/Ta by EDS	Zn/Ta by XPS	BET / m^2g^{-1}
$ZnTa_2O_6$	0.50	0.50	0.63	2.5
$10Zn/ZnTa_2O_6$	0.55	0.57	1.24	2.2
$3.0Ag/10Zn/ZnTa_2O_6$	0.55	0.57	1.01	/
$Zn_3Ta_2O_8$	1.50	1.54	2.61	/

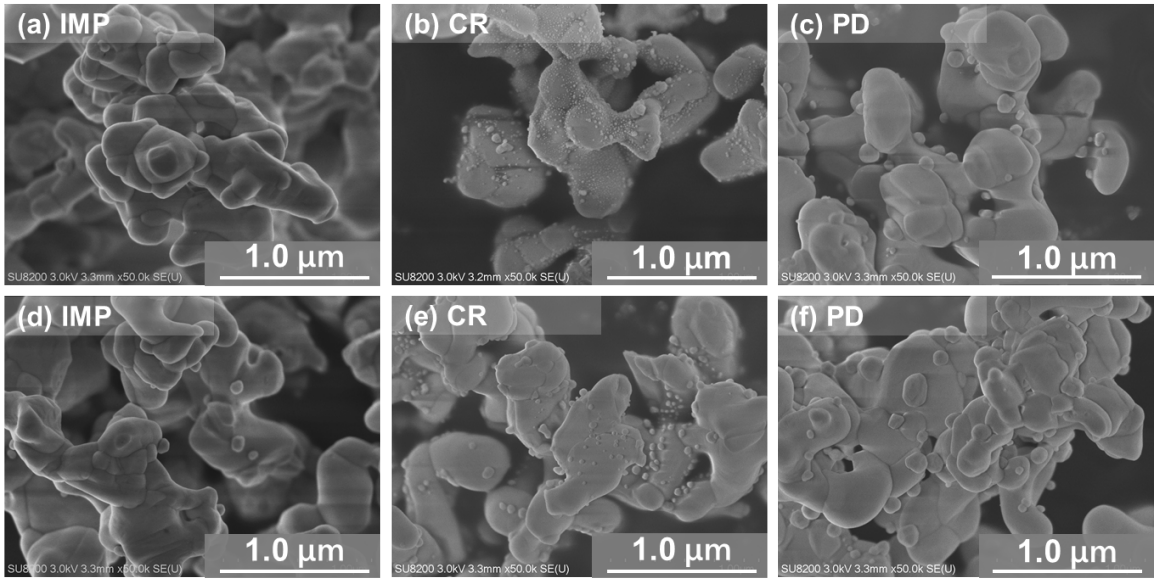


Figure S6. SEM images of (a), (d) 1.5Ag/10Zn/$ZnTa_2O_6$ (IMP method); (b), (e) 1.5Ag/10Zn/$ZnTa_2O_6$ (CR method); and (c), (f) 1.5Ag/10Zn/$ZnTa_2O_6$ (PD method). (a–c) before reaction, and (d–f) after reaction.

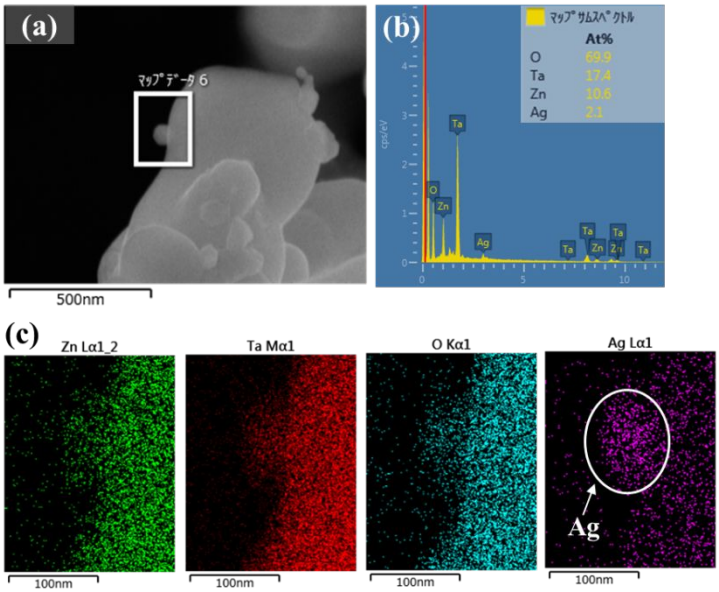


Figure S7. (a) 3.0Ag/10Zn/$ZnTa_2O_6$: Zn prepared by IMP method, after reaction; (b) EDS mapping of the Ag-loaded$ZnTa_2O_6$: Zn after photocatalytic reactions; (c) EDS mapping of the Zn, Ta, O, and Ag element

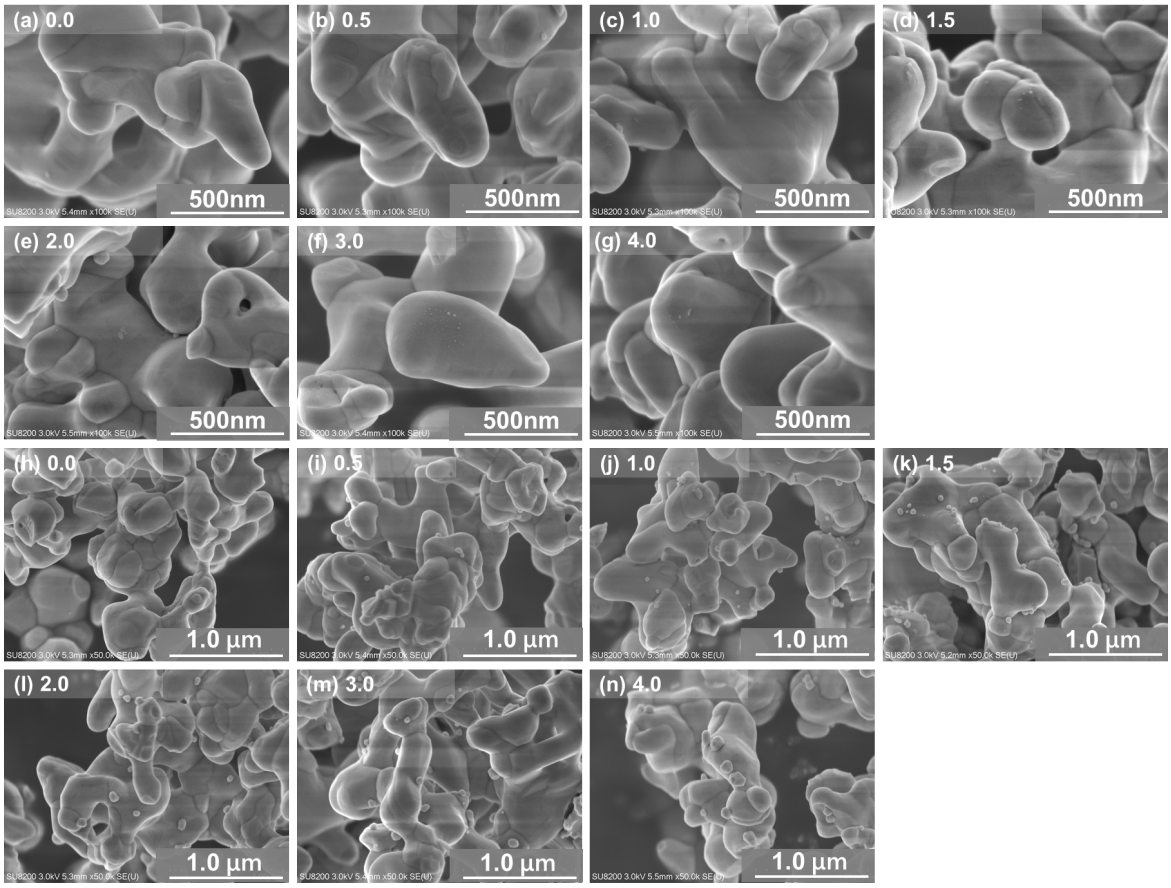


Figure S8. SEM image of the 10Zn/$ZnTa_2O_6$ loaded with various amount of Ag cocatalyst (a-g) before rection; (h-n) After 5-h photocatalytic reaction. (a) and (h) 0.0Ag; (b) and (i) 0.5Ag; (c) and (j) 1.0Ag; (d) and (k) 1.5Ag; (e) and (l) 2.0Ag; (f) and (m) 3.0Ag; (g) and (n) 4.0Ag.

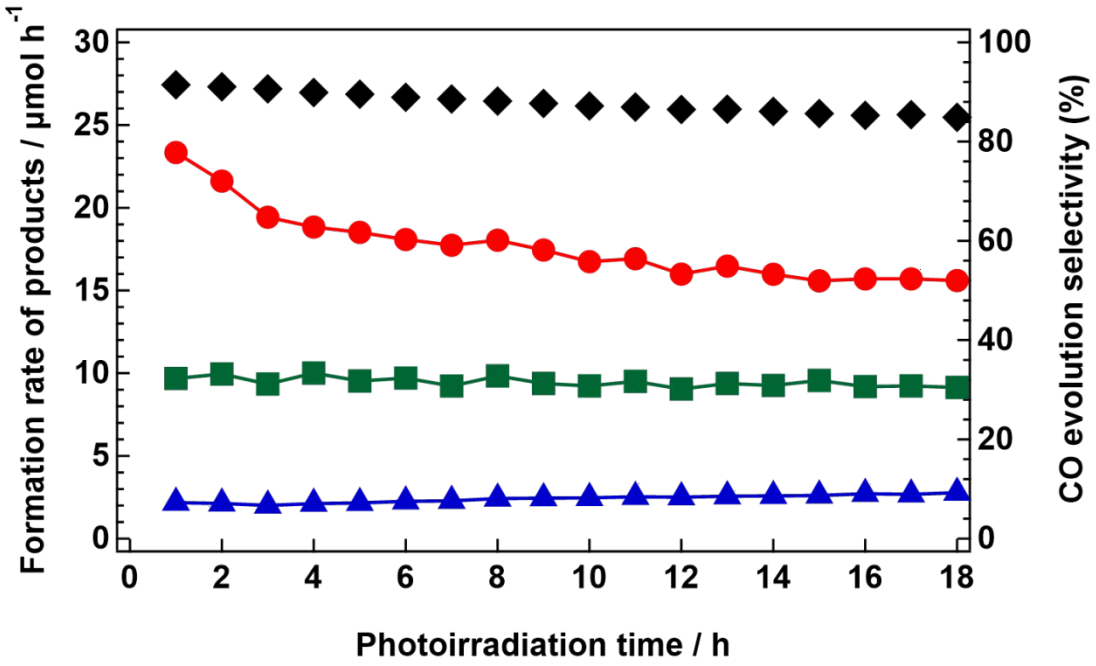


Figure S9. Time-dependent evolution of H_2 (blue), O_2 (green), and CO (red) over 3.0Ag/10Zn/$ZnTa_2O_6$

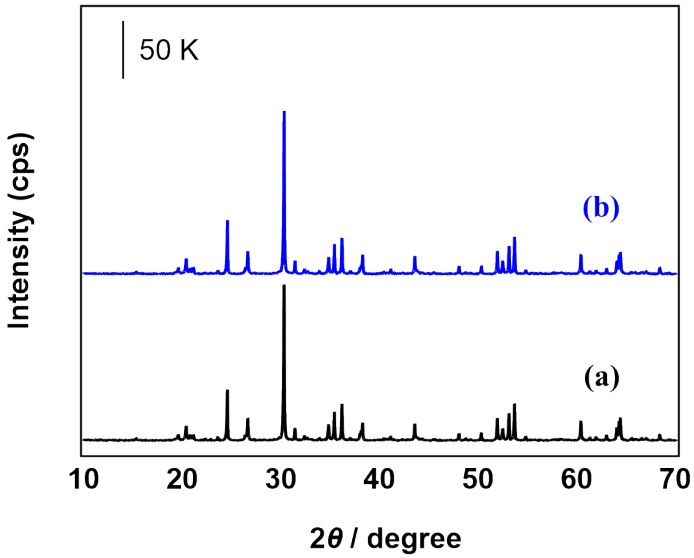


Figure S10. XRD patterns of 3.0Ag/10Zn/$ZnTa_2O_6$ (a) before and (b) after 15 h photocatalytic reaction.

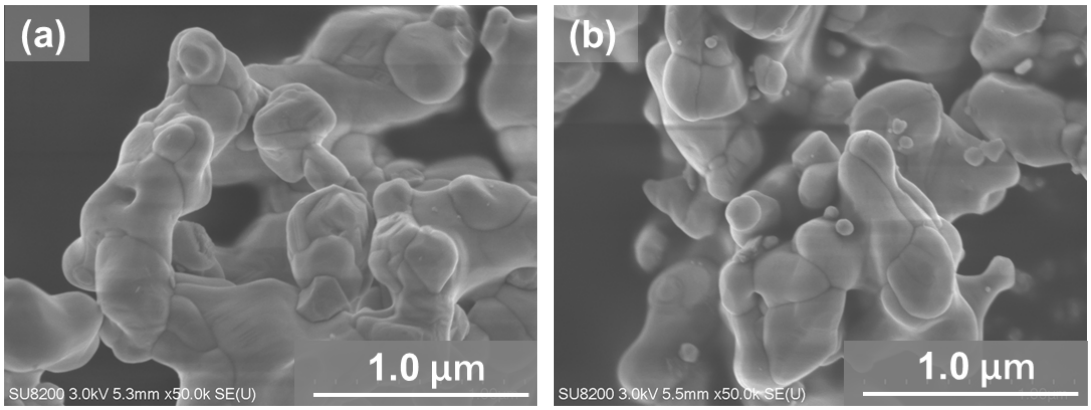


Figure S11. SEM images of 3.0Ag/10Zn/$ZnTa_2O_6$ (a) before and (b) after 15 h photocatalytic reaction.

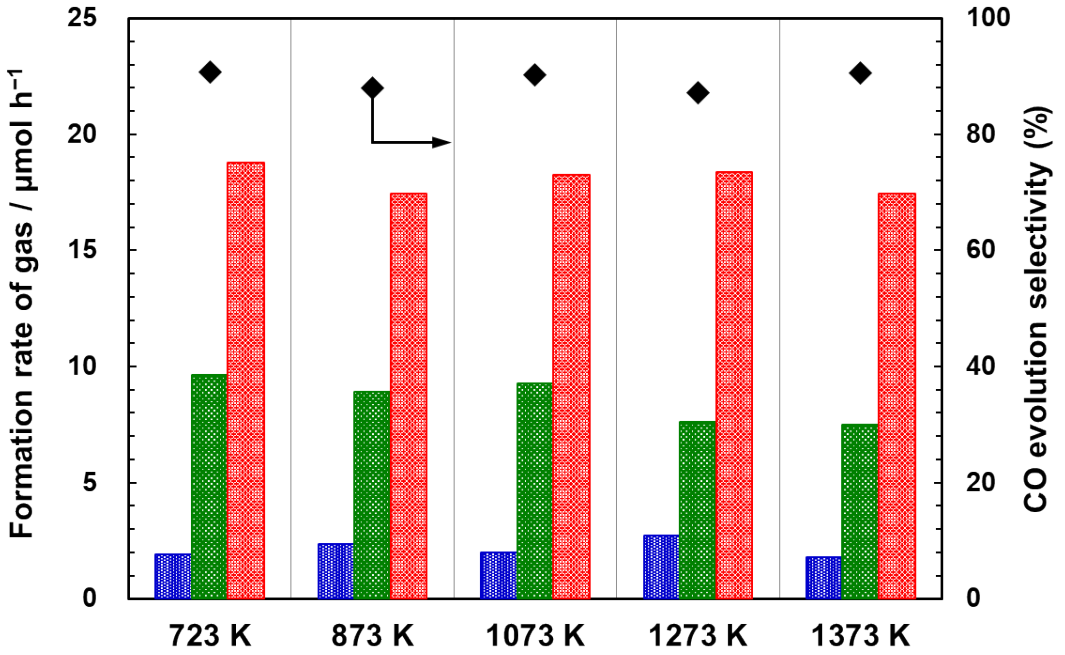
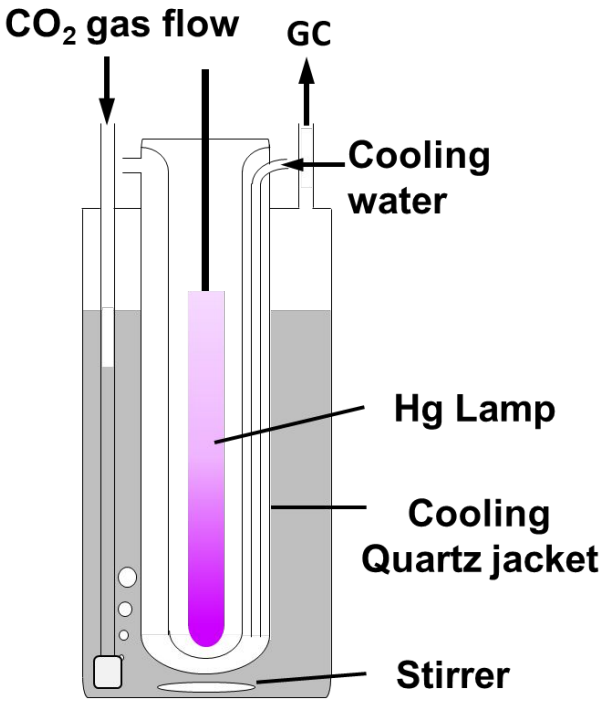


Figure S12 the formation rate of H_2 (blue), O_2 (green), and CO (red) over the $Ag/Zn/ZnTa_2O_6$ fabricated at various kinds calcination temperature.

Scheme S1. The scheme of the inner irradiation reactor



The formation rates of the products (CO, H_2 and O_2) were calculated by the follow equation:

Formation rate of products / mol h^{-1} = *Sc*/(1 mL)*(30 mL/min)*60 min**

Where ***S*** represents the peak area of gas products detected by the TCD-GC, and FID-GC, ***c*** represents a factor of the relationship between the amount of the gas products and the peak area of gas products such as CO, H_2, and O_2. The factor ***c*** was obtained by flowing the Ar-diluted mixture gas which contained certain concentration of CO, H_2, and O_2 at different flow rate. The sample loop of TCD-GC and FID-GC is 1 mL. The flow rate of the CO_2 gas in the system is 30 mL/min.