Supporting Information

Photocatalytic CO_2 Reduction of $Ag/Ag_2S/Ti_3C_2T_X$ Heterojunctions with Enhanced Interfacial Charge Transfer

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Section S1. Standard curves of methanol and ethanol

The methodology employed for the derivation of standard curves pertaining to organic alcohols, specifically methanol and ethanol, is delineated as follows: Standard solutions with concentrations of 0, 0.25, 0.5, 1.0, 2.0, 4.0, and 8.0 mg/L were meticulously prepared utilizing chromatographic grade methanol and ethanol, respectively. Subsequently, the aforementioned standard solutions were subjected to analysis via gas chromatography (Table S1). Concurrently, the standard curves for methanol and ethanol were constructed by plotting the concentration of the standard solution along the horizontal axis and the peak area, as detected by gas chromatography, along the vertical axis (Fig. S1). The derived standard curves, as well as their linear relationships, were subsequently analyzed.

Table S1 Retention time and peak area of standard solutions of methanol and ethanol

Methanol concentration (mg/L)	Retention time (min)	Peak area (S)	Ethanol concentration (mg/L)	Retention time (min)	Peak area (S)
0	-	-	0	-	-
0.25	5.055	0.111	0.25	5.425	0.1587
0.5	5.056	0.223	0.5	5.427	0.3055
1	5.054	0.502	1	5.422	0.6316
2	5.052	0.9784	2	5.428	1.316
4	5.053	2.177	4	5.429	2.874
8	5.058	4.375	8	5.423	5.868

Table S2 Yields of methanol and ethanol from photocatalytic CO_2 reduction over Ag/Ag_2S with increasing irradiation time under visible light.

Reaction time	Methanol ($\mu mol\ g_{catal.}^{-1}$)	Ethanol ($\mu mol\ g_{catal.}^{-1}$)
2h	12.43	12.12
4h	25.53	16.93

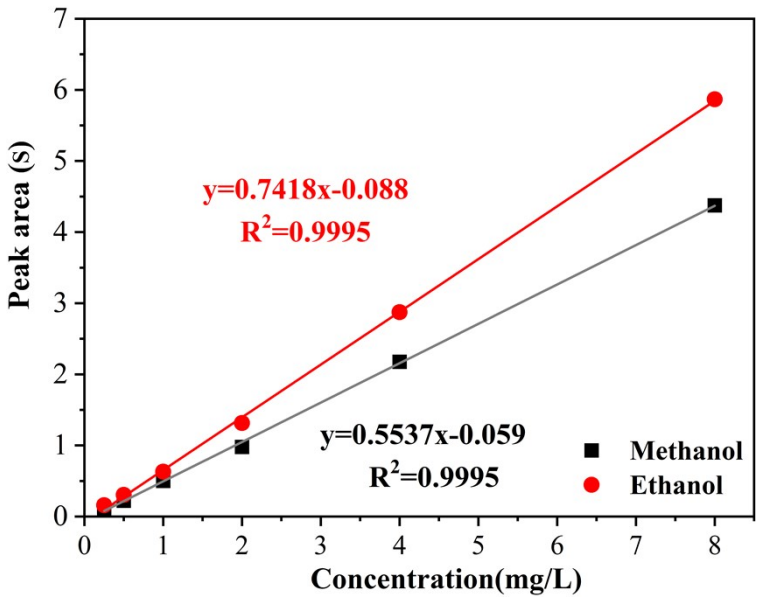

Figure S1 Standard curve of methanol and ethanol

It became evident that there existed a positive correlation between the concentration of the standard solution and the peak area of the corresponding chromatographic peaks, demonstrating a commendable degree of correlation. Upon conducting an analysis of the regression line equation and the linear correlation coefficient (R^2) pertaining to the standard curve, the linear equations deduced for methanol and ethanol manifest themselves as y=0.5537x-0.059; y=0.7418x-0.088 respectively. Two accompanying linear correlation coefficients were noted to be R^2=0.9995.

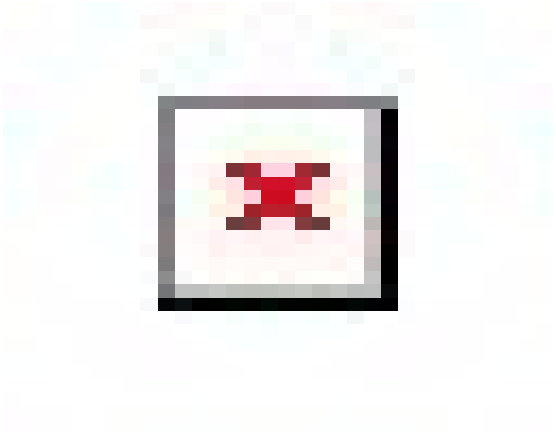

Figure S2. Pore size distributions of Ag_2S, $Ti_3C_2T_X$, and $Ag/Ag_2S/Ti_3C_2Tx$ composites.

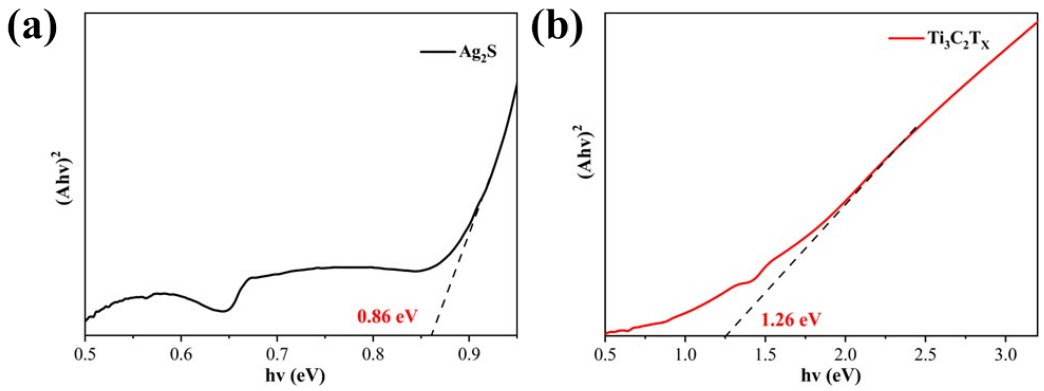

Figure S3. Plots of transformed Kubelka–Munk function $(Ahv)^2$ vs light energy (hv) for Ag_2S and $Ti_3C_2T_X$.

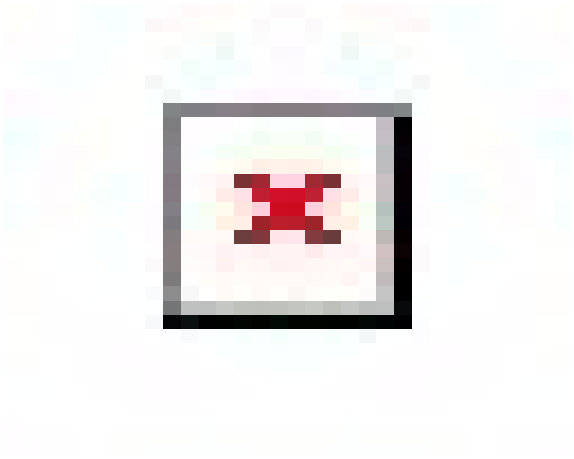

Figure S4. Photocurrent responses of Ag_2S, $Ti_3C_2T_X$, and 7.5AAT composites.

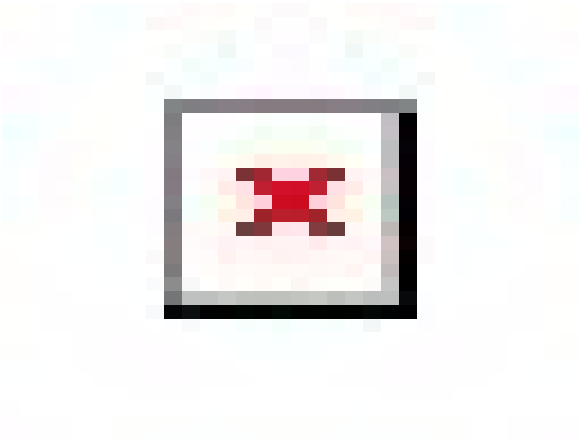

Figure S5. Total yield of methanol and ethanol obtained using 7.5AAT as the catalyst for cycling runs.

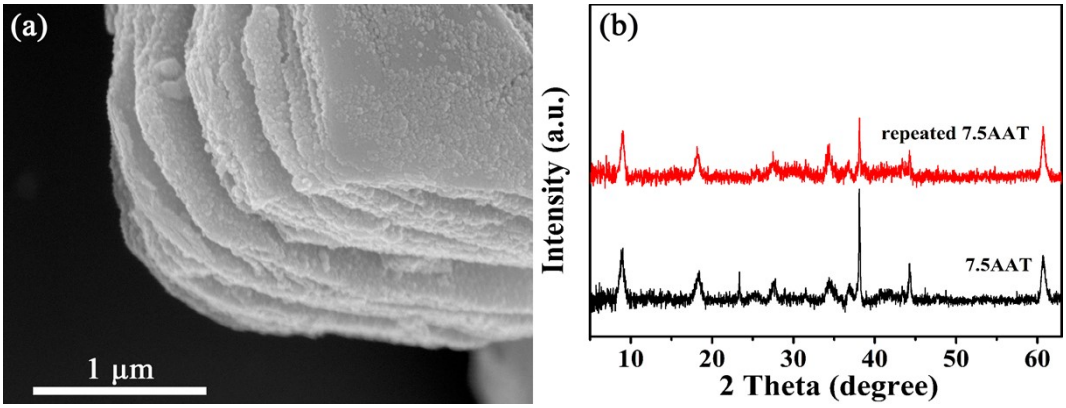

Figure S6. SEM images (a) and XRD patterns (b) of 7.5AAT composites after photocatalytic CO_2 reduction tests for five times.