Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supplementary Data

An efficient photocatalytic system composed of Ti_3C_2 quantum dots incorporated TiO_2 nanosheets and $CuWO_4$ nanoparticles: Fabrication and its photocatalytic activity for H_2 production

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Supplementary Fig. S1

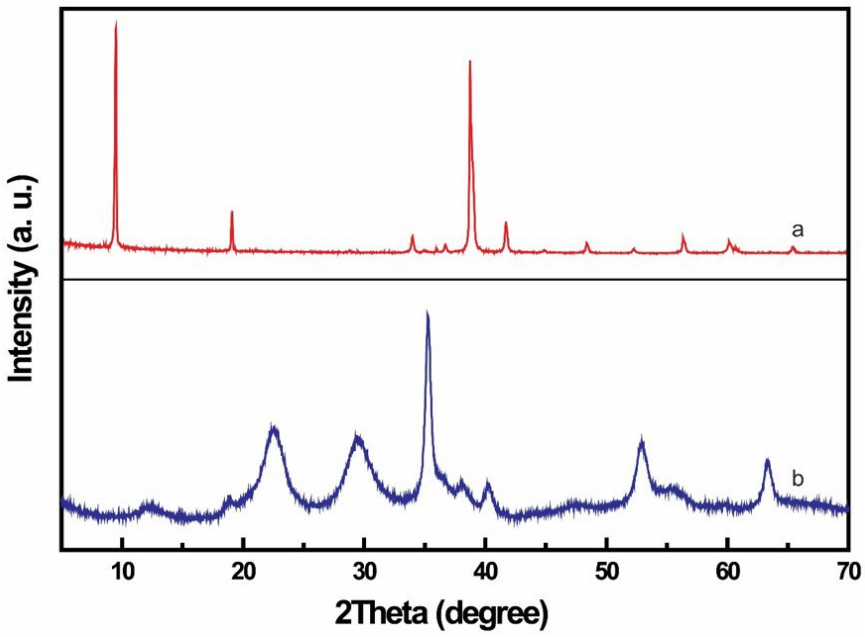

Fig. S1. XRD patterns of (a) Ti_3AlC_2 and (b) the $CuWO_4$ nanoparticles.

Supplementary Fig. S2

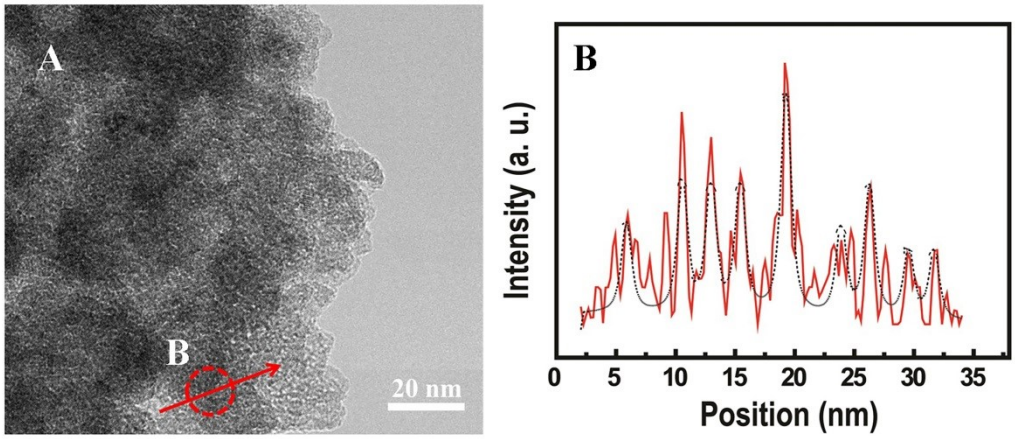

Fig. S2. (A) HRTEM image of 4% $CuWO_4$-Ti_3C_2/TiO_2 and (B) C element TEM-EDS line profile along the red arrow shown in Fig. S2A (red) and curve-fitting analysis (black).

Supplementary Fig. S3

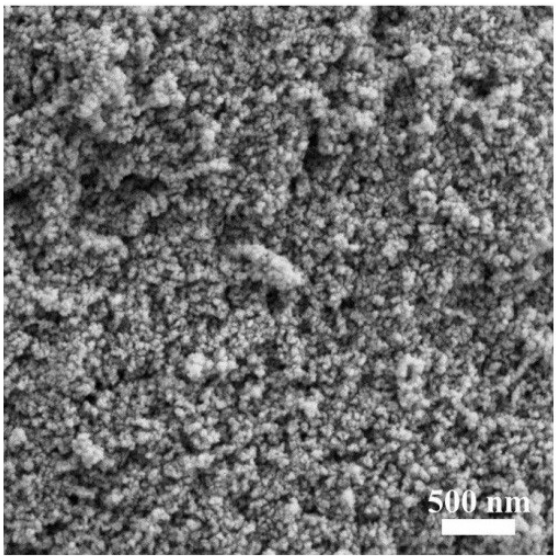

Fig. S3. SEM image of $CuWO_4$ nanoparticles.

Supplementary Fig. S4

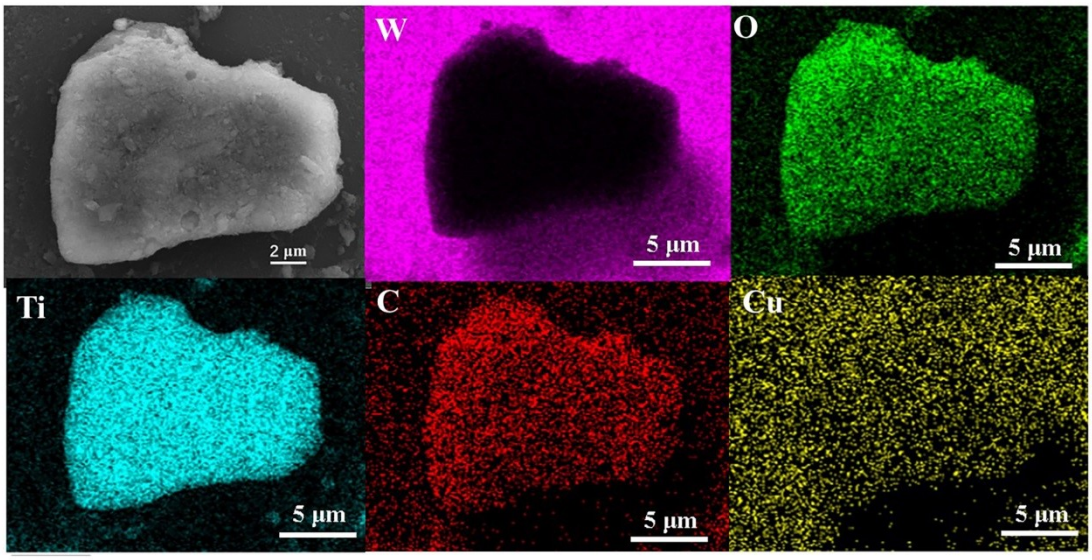

Fig. S4. Element mappings of 4% $CuWO_4$-Ti_3C_2/TiO_2 (W, O, Ti, C and Cu).

Supplementary Fig. S5

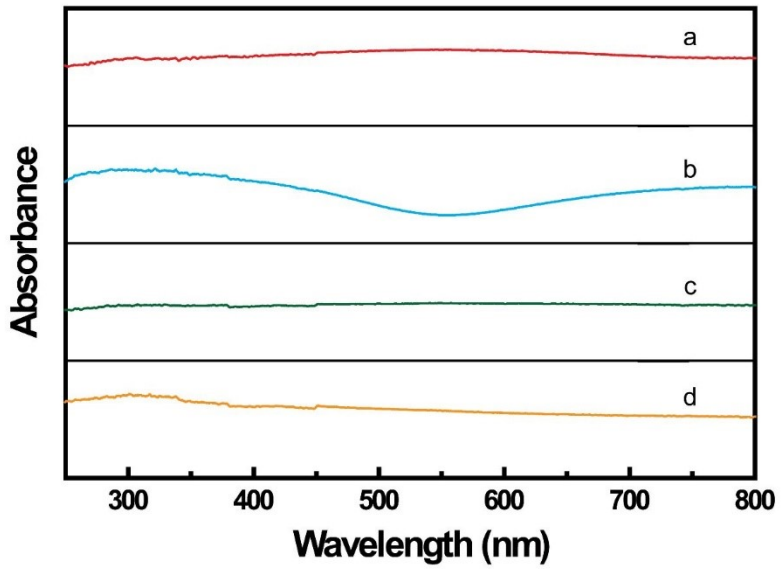

Fig. S5. UV–vis spectra of (a) the Ti_3C_2 nanosheets, (b) the $CuWO_4$ nanoparticles, (c) Ti_3C_2/TiO_2, and (d) 4% $CuWO_4$-Ti_3C_2/TiO_2.

Supplementary Fig. S6

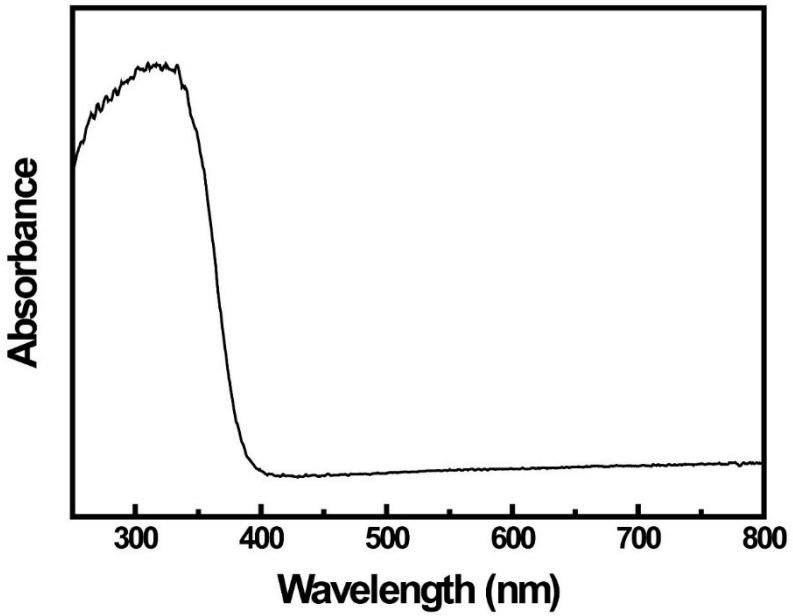

Fig. S6. UV–vis spectrum of P25.

Supplementary Table S1

Table S1. Photocatalytic activities of the photocatalysts reported previously.

Photocatalyst	**Rate of H_2 evolution (mmol g^{-1} h^{-1})**	**Stable hydrogen production time (h)**	**Ref.**
$CuWO_4$-Ti_3C_2/TiO_2	3.65	14	This work
Pt-TiO_2	0.16	5	[1]
Ti_3C_2-TiO_2/Pt	1.60	12	[2]
Au/TiO_2	0.36	4	[3]
Pd/TiO_2	3.10	1	[4]
TiO_2-Ti_3C_2/Ru	0.24	5	[5]
CuO/TiO_2	2.00	3	[6]
Truxene/TiO_2	21	5	[7]
MoS_2/TiO_2	1.38	4	[8]
CdS/Ni-MOF	2.51	3	[9]
CdS/CuS	0.30	4	[10]
Pt/IrO_2/g-C_3N_4	2.47	2	[11]
WO_3-MoS_2-Pt	0.80	2	[12]
Zn-$AgIn_5S_8$/NiS	5.2	5	[13]

Supplementary Fig. S7

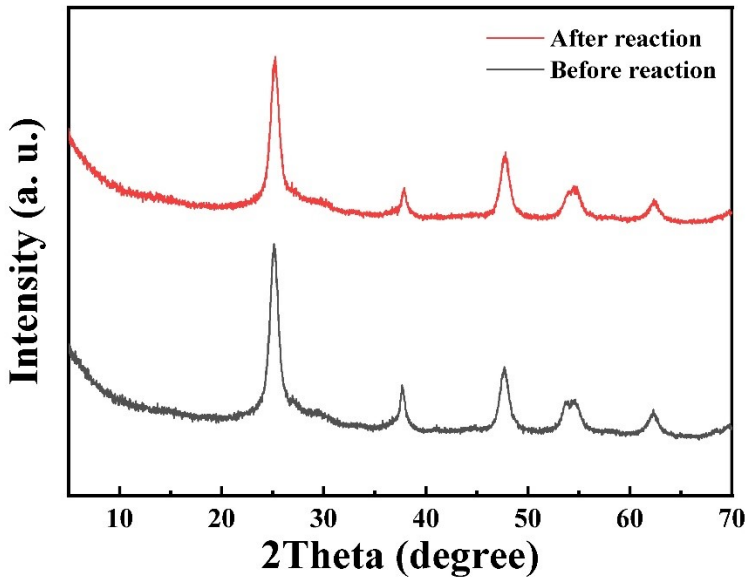

Fig. S7. XRD patterns of 4% $CuWO_4$-Ti_3C_2/TiO_2 before and after photocatalytic reaction.

Supplementary Fig. S8

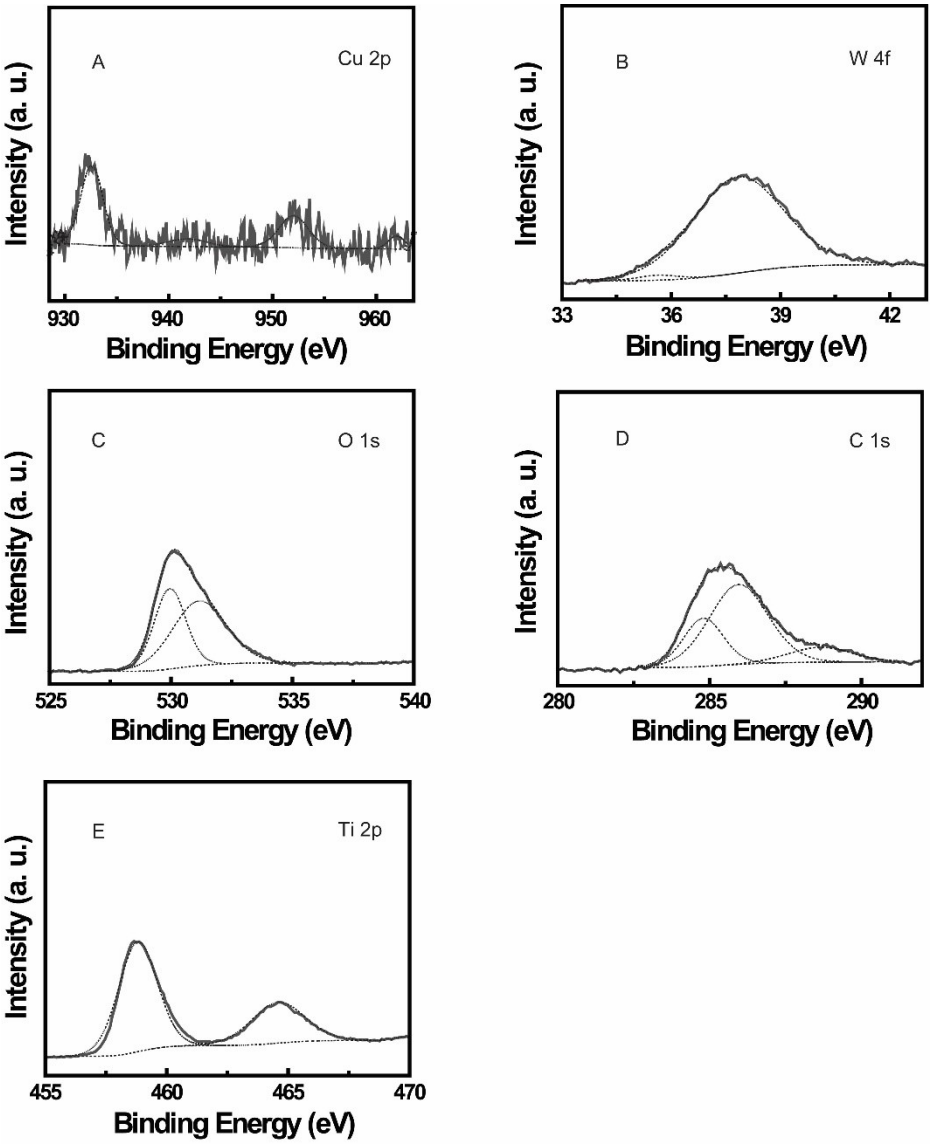

Fig. S8. XPS spectra of the used 4% $CuWO_4$-Ti_3C_2/TiO_2: (A) Cu 2p, (B) W 4f, (C) O 1s, (D) C 1s and (E) Ti 2p, high-resolution XPS spectra (solid) and curve-fitting analysis (dot line) of the states of Cu, W, O, C, and Ti.

Supplementary Fig. S9

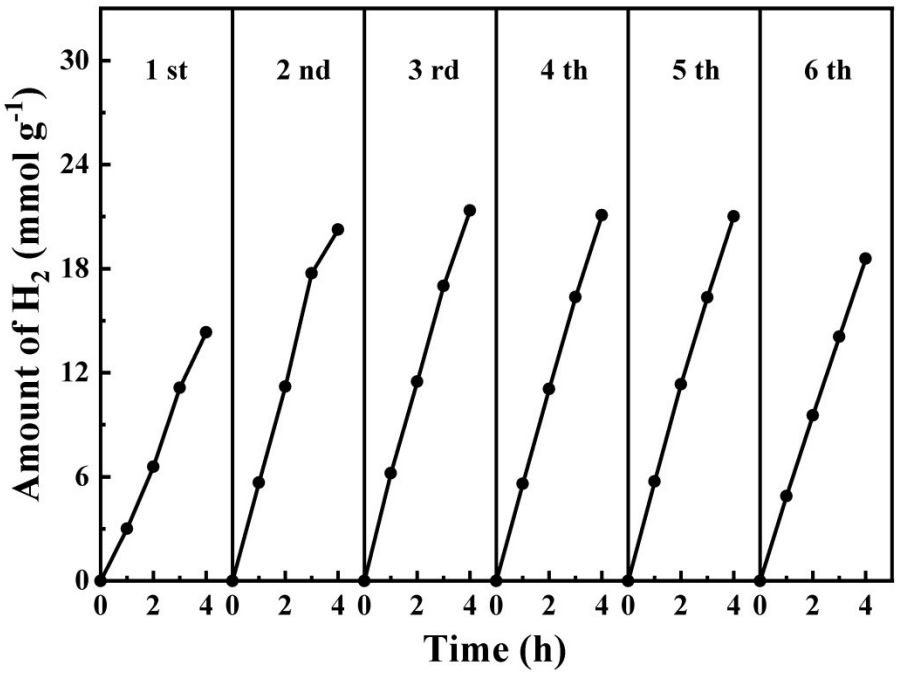

Fig. S9. Photostability of 4% $CuWO_4$-Ti_3C_2/TiO_2 for photocatalytic hydrogen evolution (photocatalyst 10 mg; ethylene glycol aqueous solution 60 mL, 16.7vol.%; pH = 8; temperature 10℃; irradiation time between the two cycles 10 min).

Supplementary Fig. S10

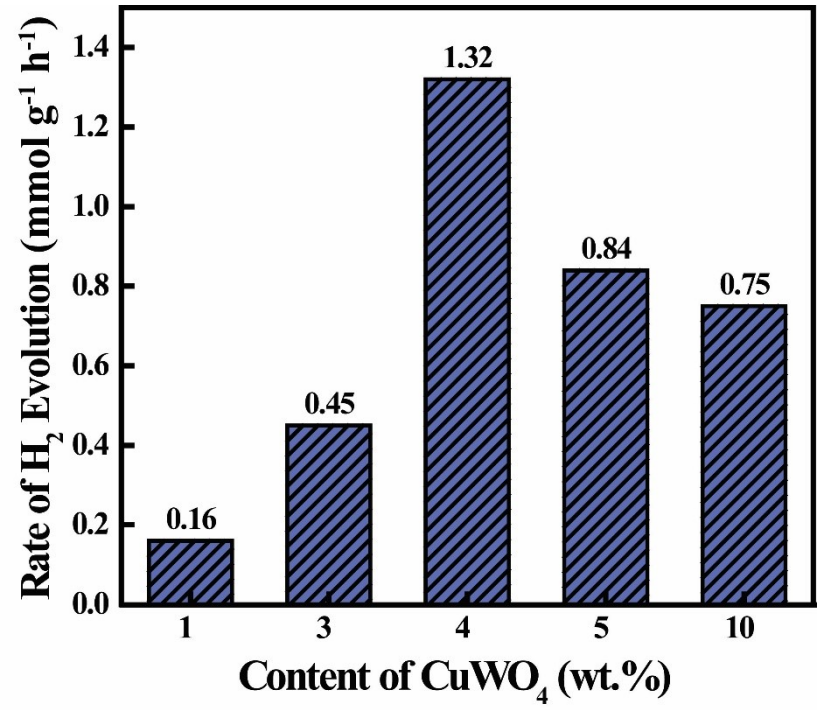

Fig. S10. Effect of the content of $CuWO_4$ nanoparticles on the photocatalytic activity of $CuWO_4$-Ti_3C_2/TiO_2 (photocatalyst 10 mg; ethylene glycol aqueous solution 60 mL, 16.7vol.%; pH = 7; temperature 10℃; irradiation time 4 h).

Supplementary Fig. S11

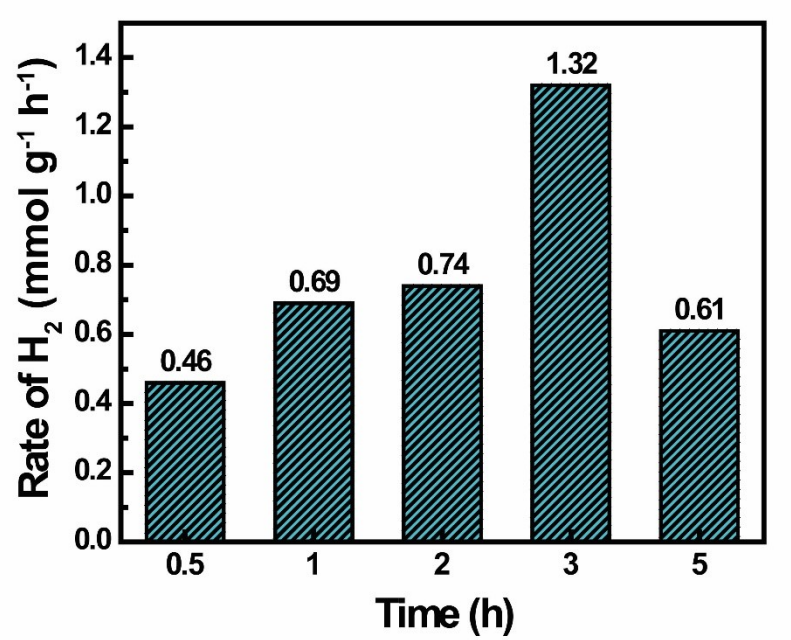

Fig. S11. Effect of oxidation time on the photocatalytic activity of 4% $CuWO_4$-Ti_3C_2/TiO_2 (photocatalyst 10 mg; ethylene glycol aqueous solution 60 mL, 16.7vol.%; pH = 7; temperature 10℃; irradiation time 4 h).

Supplementary Fig. S12

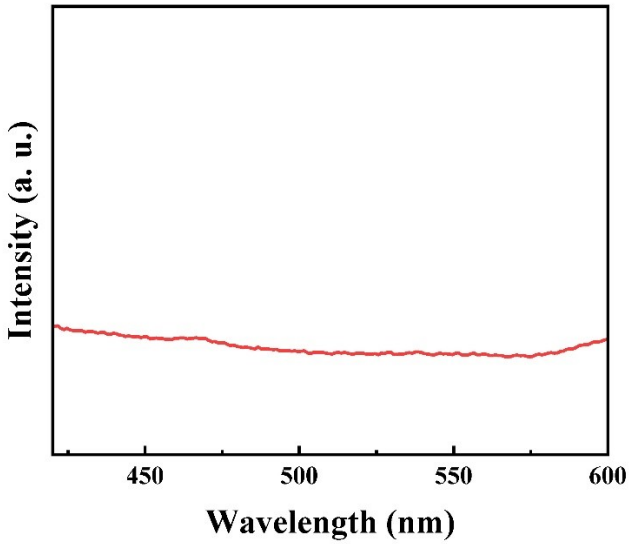

Fig. S12. Fluorescence spectrum of the Ti_3C_2 nanosheets (excitation wavelength 320 nm).

Supplementary Fig. S13

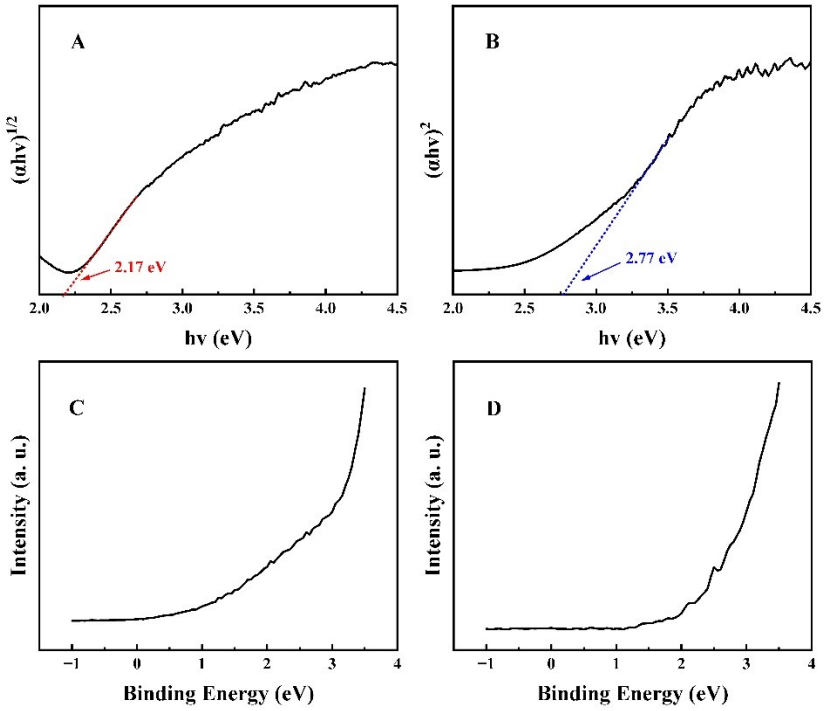

Fig. S13. Tauc plots of (A) the $CuWO_4$ nanoparticles and (B) the TiO_2 nanosheets, and UPS spectra of (C) the $CuWO_4$ nanoparticles and (D) the TiO_2 nanosheets.

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