Electronic Supplementary Material (ESI) for Materials Chemistry Frontiers.

Supporting Information

1T-MoS_2 nanopatch/Ti_3C_2 MXene/TiO_2 nanosheet hybrids for efficient photocatalytic hydrogen evolution

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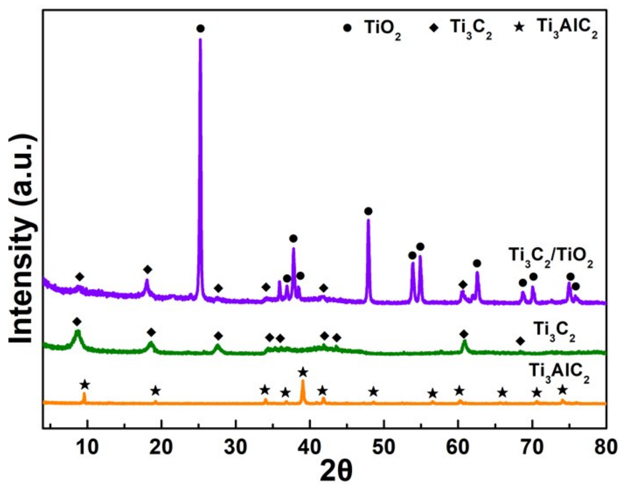

Figure S1. XRD pattern of Ti_3AlC_2, Ti_3C_2 MXene and Ti_3C_2/TiO_2 composites.

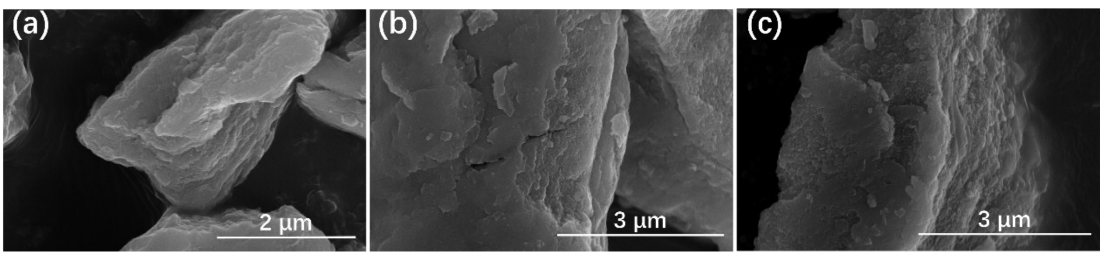

Figure S2. SEM images of bulk 1T phase MoS_2.

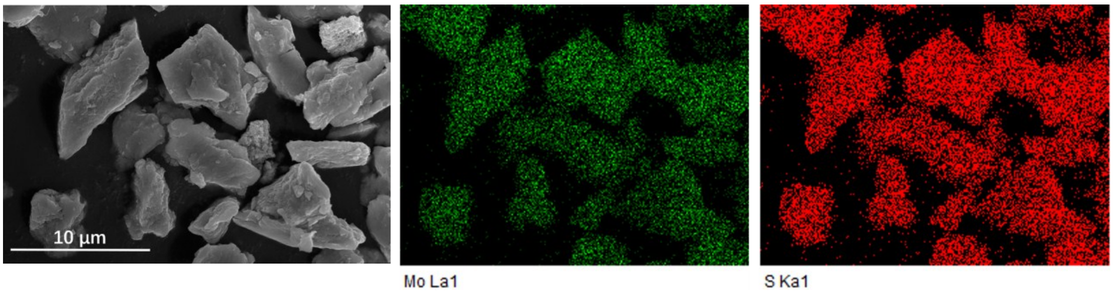

Figure S3. Energy dispersive X-ray spectroscopy (EDS) mapping images of bulk 1T phase MoS_2.

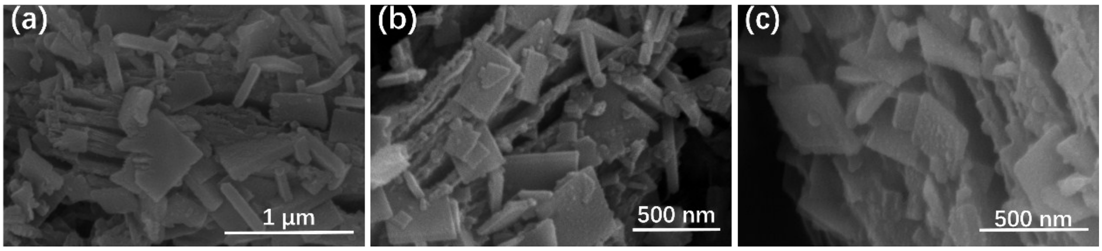

Figure S4. SEM images of Ti_3C_2/TiO_2/1T-MoS_2 composites with different MoS_2 loading amount (a) 10 wt%, (b) 25 wt% and (c) 30 wt%.

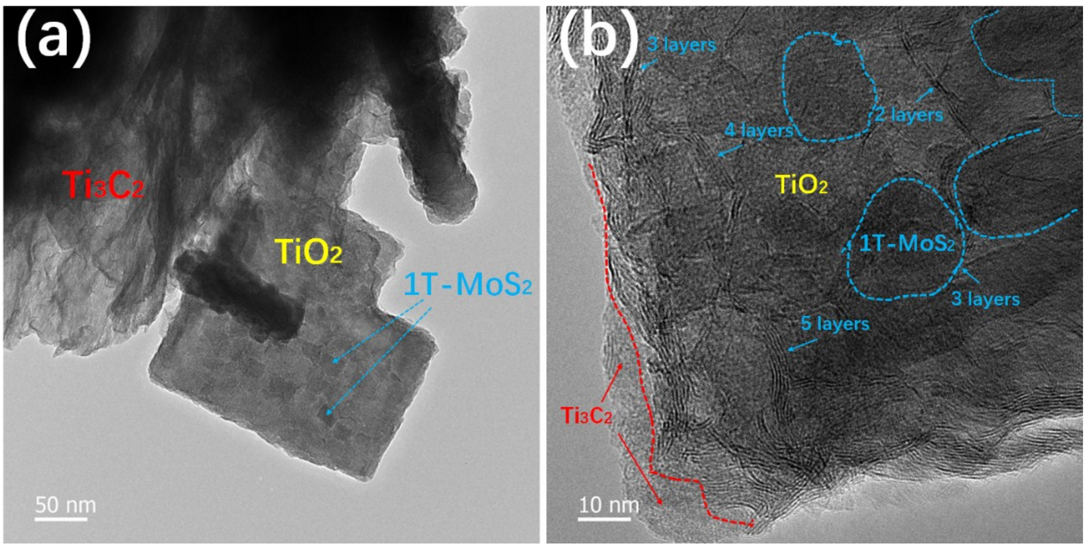

Figure S5. TEM images of Ti_3C_2/TiO_2/1T-MoS_2 composites (15 wt% MoS_2).

Table S1. BET surface area of Ti_3C_2 MXene, $Ti_3C_2/TiO_2/1T\text{-}MoS_2$ composites with different MoS_2 loading amounts (10 wt%, 15 wt%, 25 wt% and 30 wt% MoS_2) and the mixed phase MoS_2.

Samples	BET Surface area ($m^2\ g^{-1}$)
Ti_3C_2 MXene	7.081
$Ti_3C_2/TiO_2/1T\text{-}MoS_2$-10 wt%	20.947
$Ti_3C_2/TiO_2/1T\text{-}MoS_2$-15 wt%	22.138
$Ti_3C_2/TiO_2/1T\text{-}MoS_2$-25 wt%	17.631
$Ti_3C_2/TiO_2/1T\text{-}MoS_2$-30 wt%	16.358
bulk $1T\text{-}MoS_2$	5.107

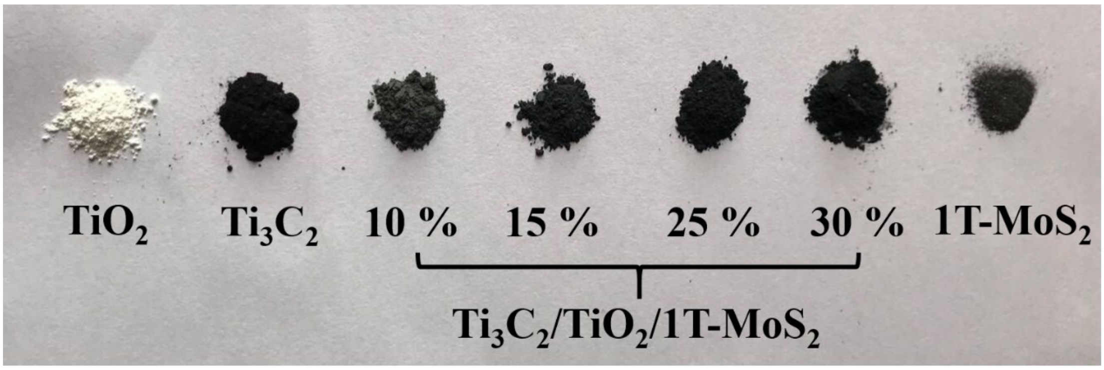

Figure S6. Optical photographs of TiO_2 NSs, Ti_3C_2 MXene, $Ti_3C_2/TiO_2/1T\text{-}MoS_2$ composites with different MoS_2 loading amounts (10 wt%, 15 wt%, 25 wt% and 30 wt% MoS_2) and $1T\text{-}MoS_2$.

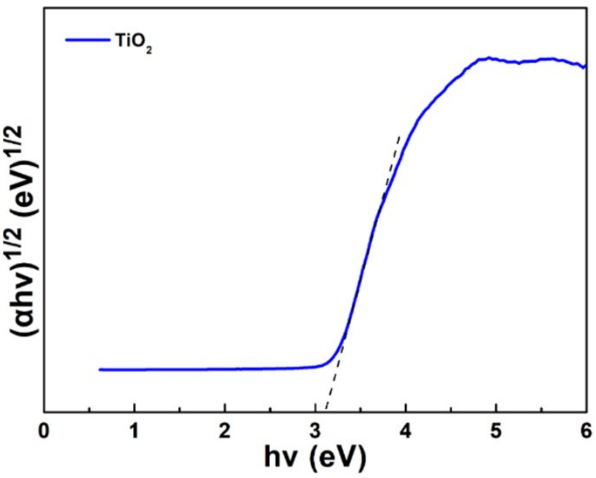

Figure S7. Band gap value of TiO_2.

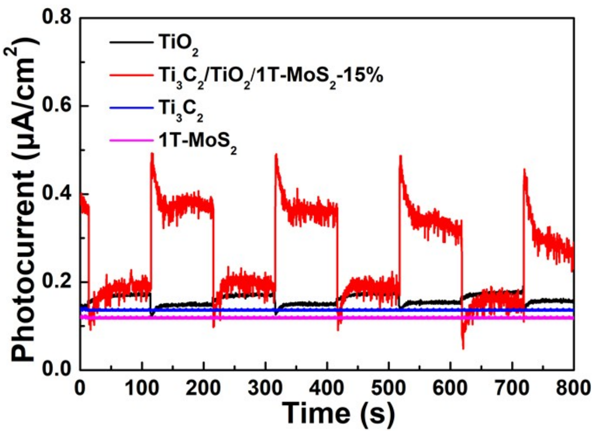

Figure S8. Transient photocurrent responses of TiO_2 NSs, $Ti_3C_2/TiO_2/1T\text{-}MoS_2$ composites (15 wt% MoS_2), Ti_3C_2 and $1T\text{-}MoS_2$.

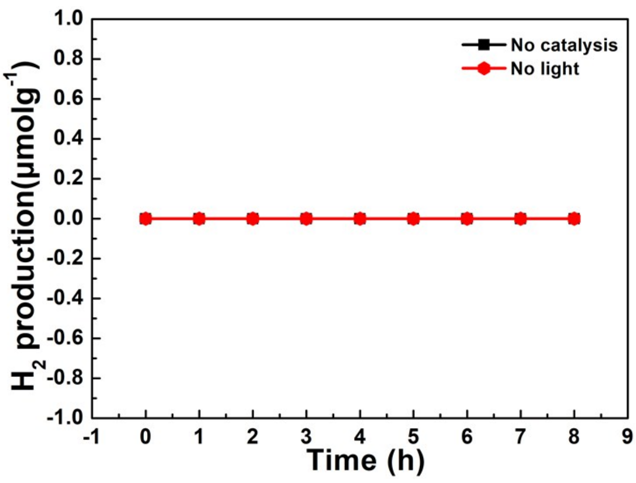

Figure S9. Photocatalytic H_2 production of control experiments in the absence of irradiation and photocatalyst.

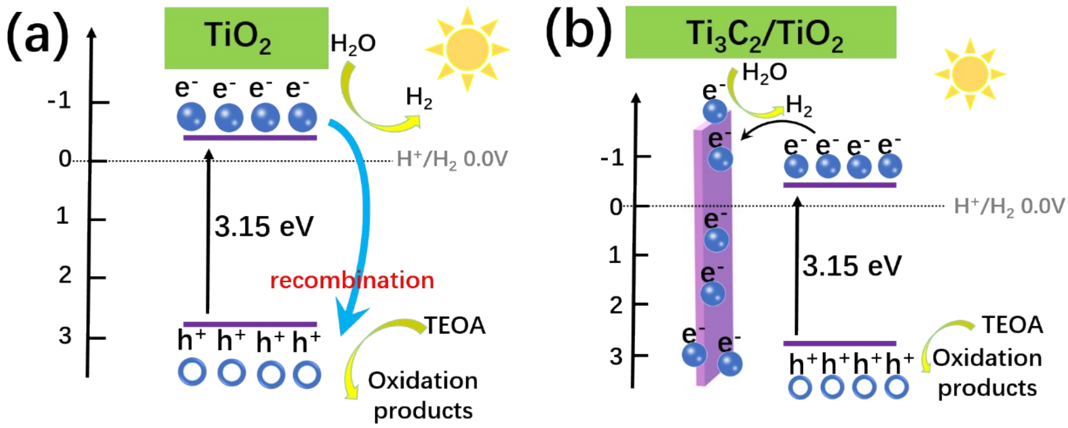

Figure S10. Schematic photocatalytic mechanism for (a) TiO_2 NSs and (b) Ti_3C_2/TiO_2 composites.

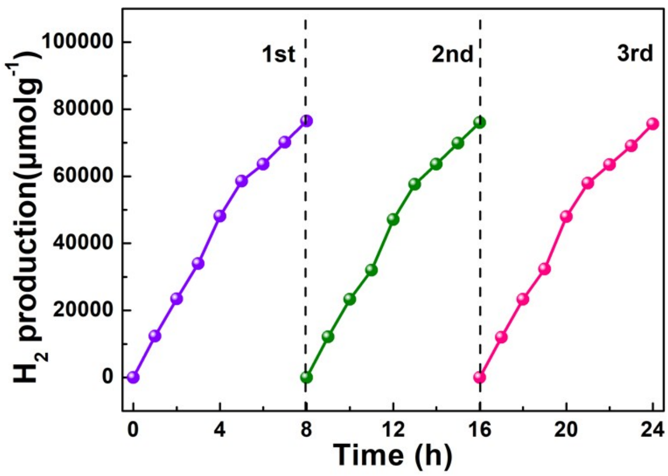

Figure S11. Stability and recyclability of the $Ti_3C_2/TiO_2/1T\text{-}MoS_2$ composites (15 wt% MoS_2).

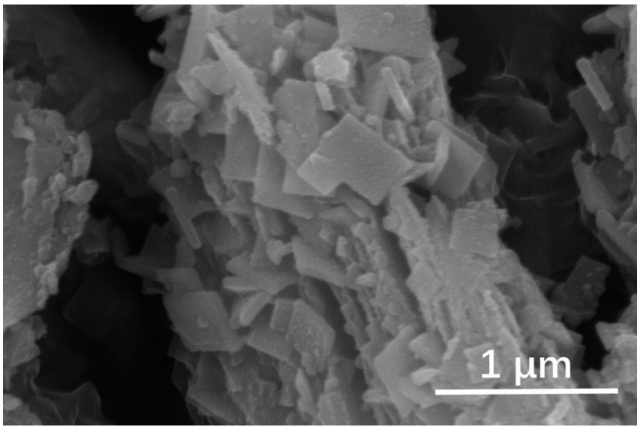

Figure S12. SEM image of $Ti_3C_2/TiO_2/1T\text{-}MoS_2$ composites (15 wt% MoS_2) after 3 cycles.

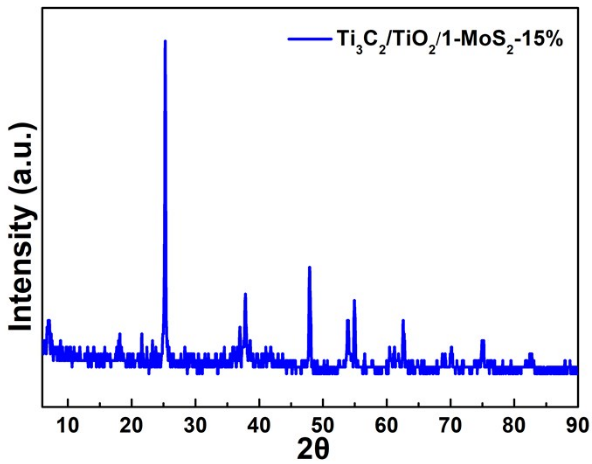

Figure S13. XRD pattern of $Ti_3C_2/TiO_2/1T\text{-}MoS_2$ composites (15 wt% MoS_2) after 3 cycles.

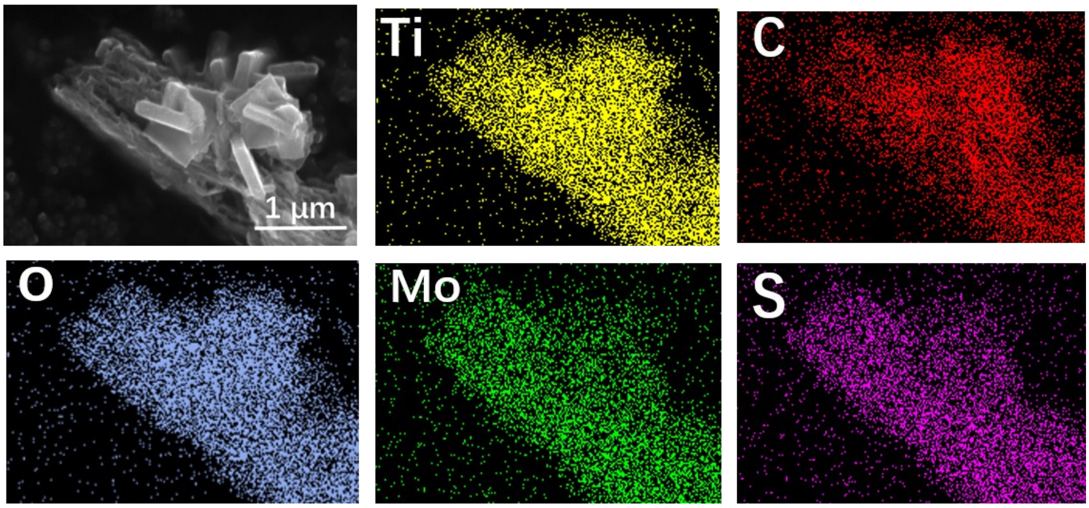

Figure S14. SEM image and EDS mapping images of $Ti_3C_2/TiO_2/2H\text{-}MoS_2$ composites (15 wt% MoS_2).

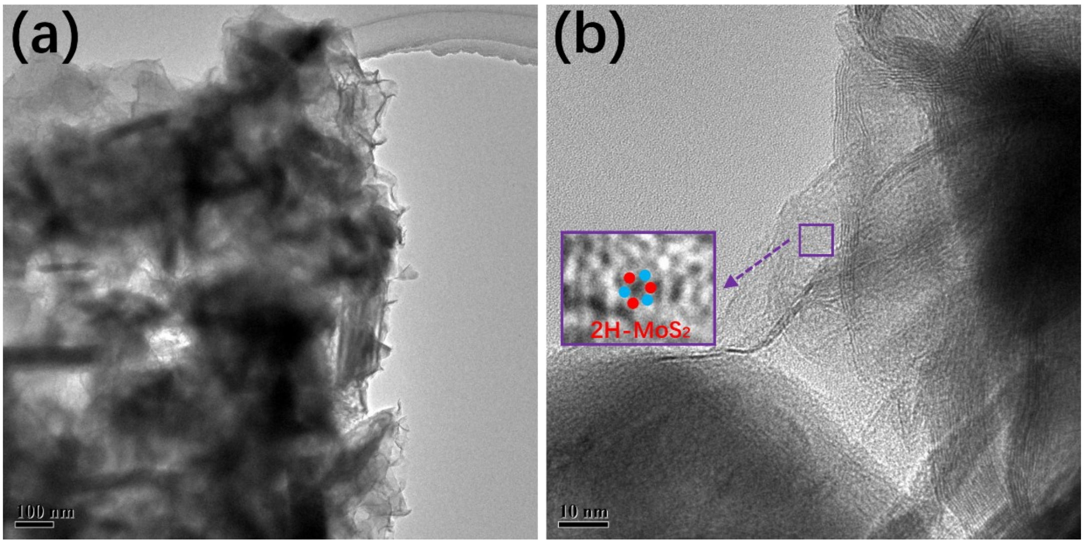

Figure S15. TEM images of $Ti_3C_2/TiO_2/2H\text{-}MoS_2$ composites (15 wt% MoS_2).

Table S2. Comparison of AQE values over the photocatalysts.

Sample	**AQE values (%)**
Ti_3C_2/TiO_2	0.644%

$Ti_3C_2/TiO_2/1T-MoS_2$-10 wt%	6.24%
$Ti_3C_2/TiO_2/1T-MoS_2$-15 wt%	6.86%
$Ti_3C_2/TiO_2/1T-MoS_2$-25 wt%	5.07%
$Ti_3C_2/TiO_2/1T-MoS_2$-30 wt%	4.17%
TiO_2 NSs	0.0529%

Table S3. Hydrogen evolution performance of the as-prepared $Ti_3C_2/TiO_2/1T-MoS_2$ composites compared with some of the typical semiconductors.

Photocatalysts	H_2 evolution (mmol g^{-1} h^{-1})	Test condition	Light source	Ref.
MoS_2/TiO_2	2.16	20 mg of photocatalysts, 6 ml TEOA, 100 ml aqueous acetone	300 W Xeon lamp, λ > 420 nm	1
BP/MoS_2	1.29	10 mg of photocatalysts, 0.1M $Na_2S+Na_2SO_3$, 250 mL water	300 W Xeon lamp, λ > 420 nm	2
$Au/MoS_2/ZnO$	1.12	50 mg of photocatalysts, 0.3 M $Na_2S+Na_2SO_3$, 50 mL water	300 W Xeon lamp	3
$g-C_3N_4$ $2RGO/MoS_2$	0.32	TEOA aqueous solution	visible light irradiation, λ > 420 nm	4
$1T-MoS_2/TiO_2$	2.28	100 mg of photocatalysts, 300 mL methanol aqueous solution (20%)	300 W Xeon lamp, λ > 350 nm	5
$Ti_3C_2/TiO_2/1T-MoS_2$ (this paper)	9.74	20 mg of photocatalysts, 6 ml TEOA, 100 ml aqueous acetone	300 W Xeon lamp	

1. X.L. Hu, S.C. Lu, J. Tian, N. Wei, X.J. Song, X.Z. Wang, H.Z. Cui, *Appl. Catal. B: Environ.,* 2019, **241**, 329-337.
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