Supporting Information

A Novel Architecture of Dandelion-like Mo_2C/TiO_2 Heterojunction Photocatalysts: Towards High-Performance Photocatalytic Hydrogen Production from Water Splitting

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Fig. s and Tables

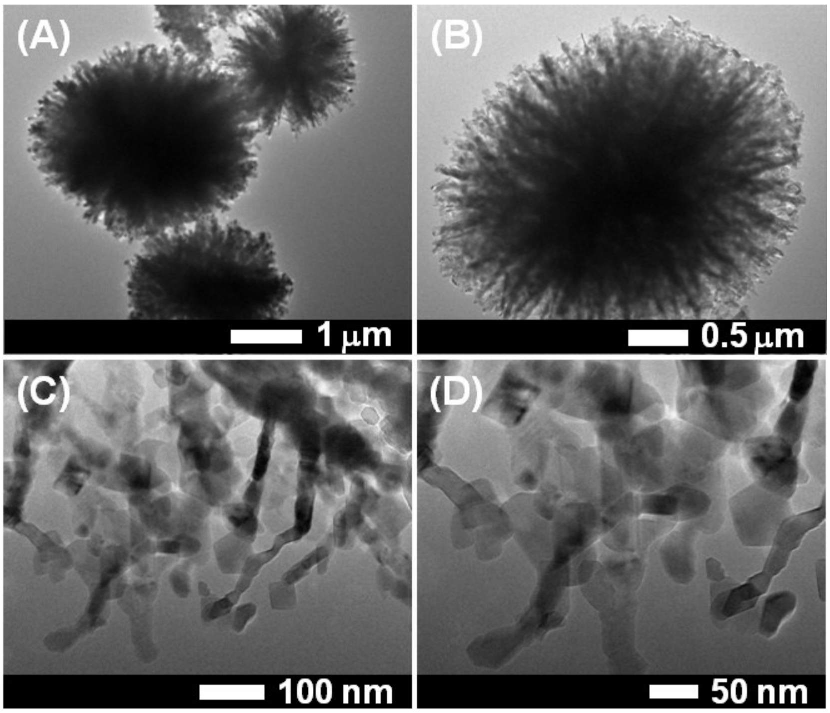


Fig. S1 TEM images of pure TiO_2 of low-resolution (A,B) and high-resolution (C,D).

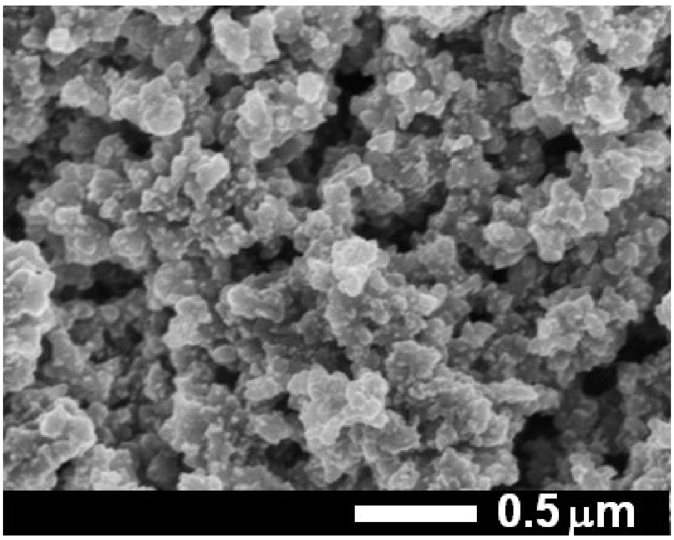


Fig. S2 SEM images of pure Mo_2C.

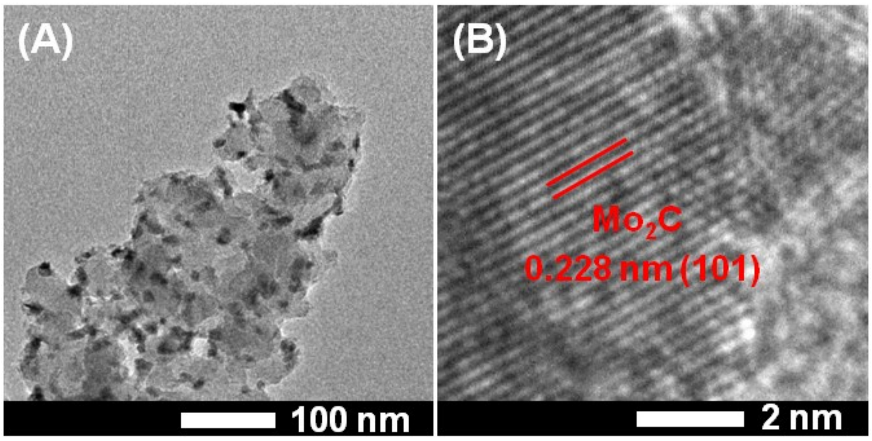
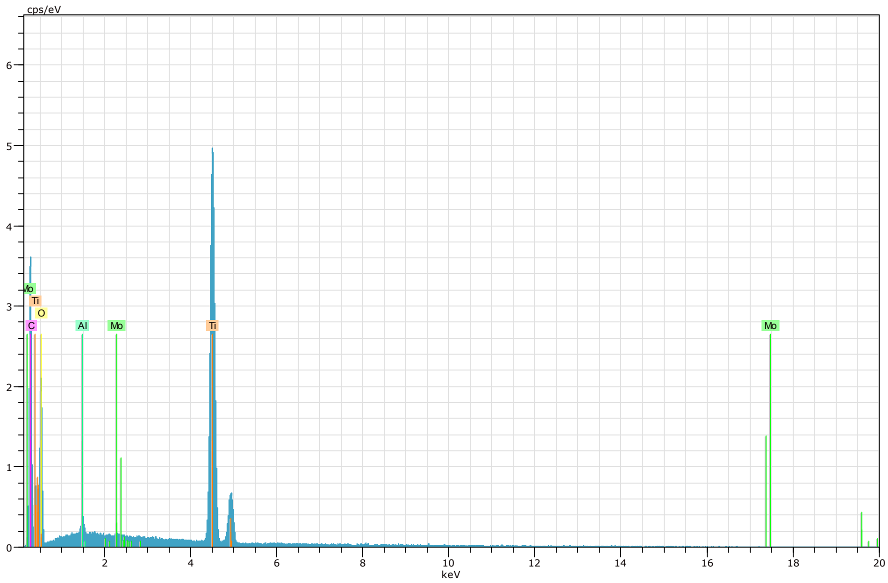


Fig. S3 A) TEM, and B) HRTEM images of pure Mo_2C.



El	AN	Series	unn. C (wt.%)	norm. C (wt.%)	Atom. C (at.%)	1 Sigma (wt.%)
C	6	K-series	42.84	31.22	45.93	5.45
O	8	K-series	53.57	39.04	43.12	7.20
Ti	22	K-series	40.64	29.62	10.93	1.16
Mo	42	L-series	0.18	0.13	0.02	0.04
Al	13	K-series	0.00	0.00	0.00	0.00

Fig. S4 EDX analysis of 1 wt% Mo_2C/TiO_2 sample.

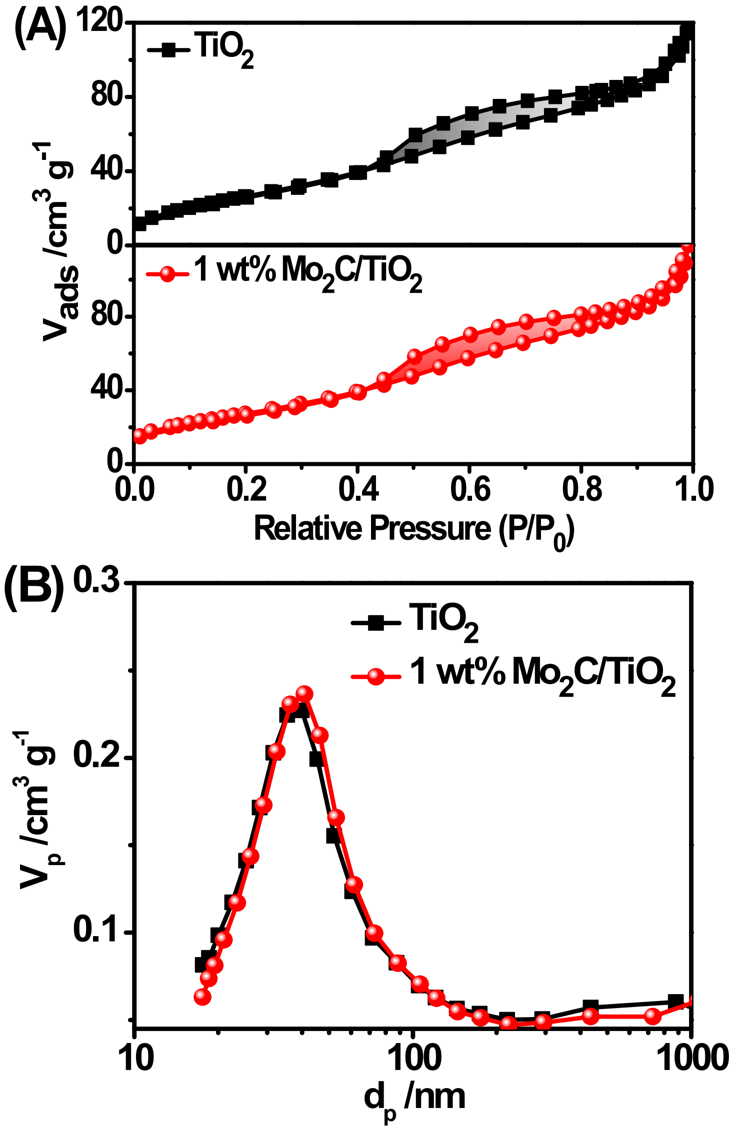


Fig. S5 (A) BET adsorption-desorption isotherms, and (B) BJH pore size distribution of the bare TiO_2 and 1 wt% Mo_2C/TiO_2 samples.

Nitrogen adsorption-desorption isotherms were performed to investigate the Brunauer-Emmett-Teller (BET) surface areas and porous structures of TiO_2 and 1 wt% Mo_2C/TiO_2. As shown in Fig. S5, the isotherms of the two present samples exhibit H3-type hysteresis behavior according to the classification of IUPAC, indicating the presence of mesopores and macropores.[S1] The specific surface areas of TiO_2 and 1 wt% Mo_2C/TiO_2 are 104.0 and 105.6 m^2 g^{-1}, suggesting that Mo_2C's loading is not improve the surface area of TiO_2.

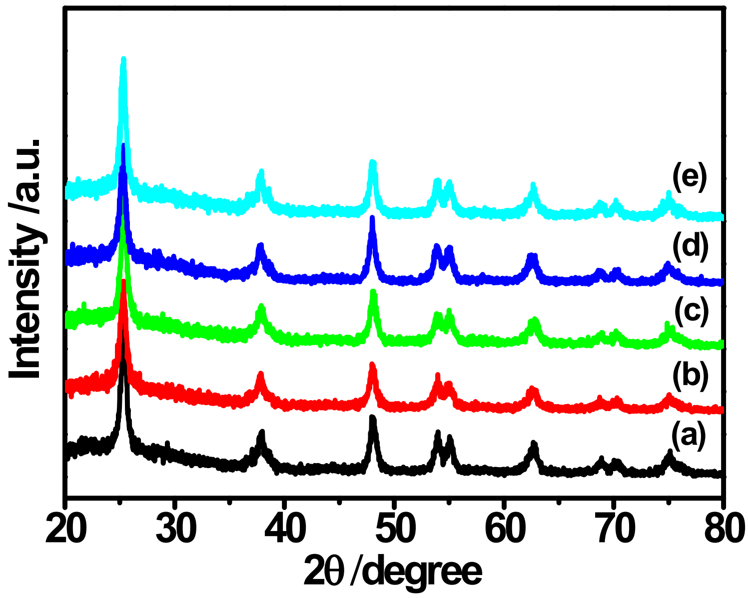


Fig. S6 XRD patterns of Mo_2C/TiO_2 hybrid with varying Mo_2C contents: (a) 0.25 wt%, (b) 0.5 wt%, (c) 1 wt%, (d) 2 wt%, and (e) 4 wt%.

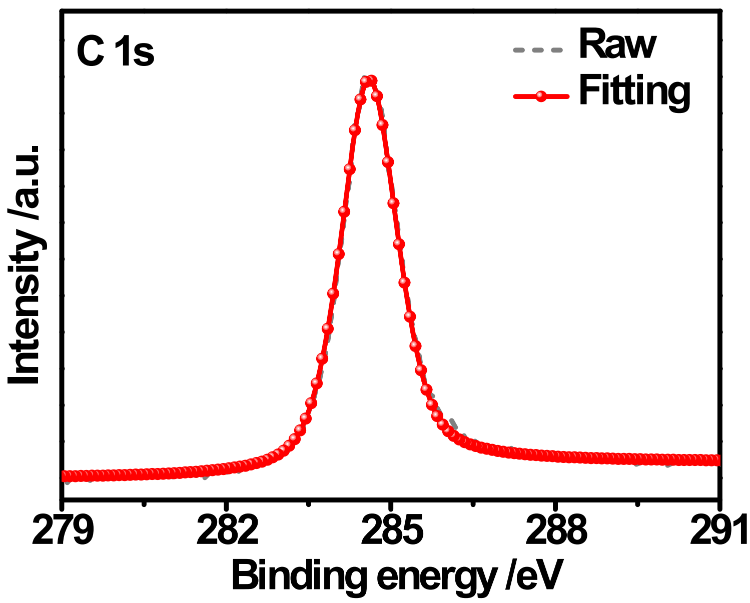


Fig. S7 XPS spectrum of C 1s for pure Mo_2C sample.

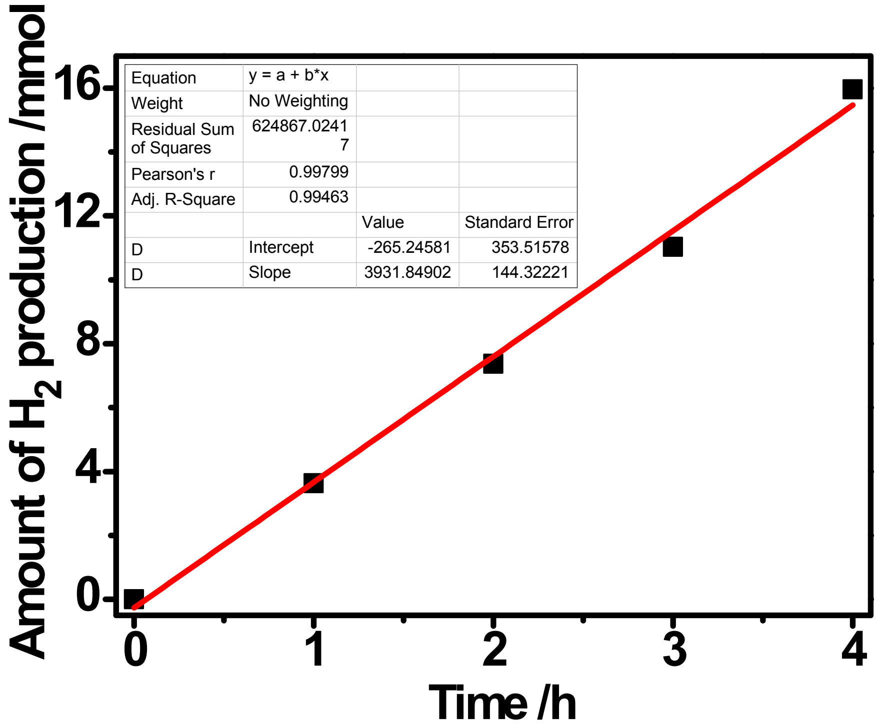


Fig. S8 Photocatalytic H_2 production measured for 1 wt% Mo_2C/TiO_2 under monochromatic light of 365 nm in 10 vol% triethanolamine aqueous solution.

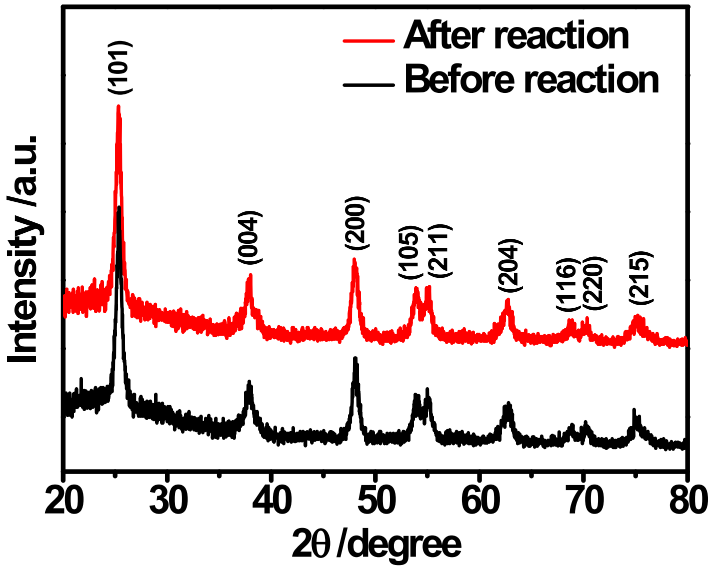


Fig. S9 XRD patterns of 1 wt% Mo_2C/TiO_2 before and after the recycling experiments.

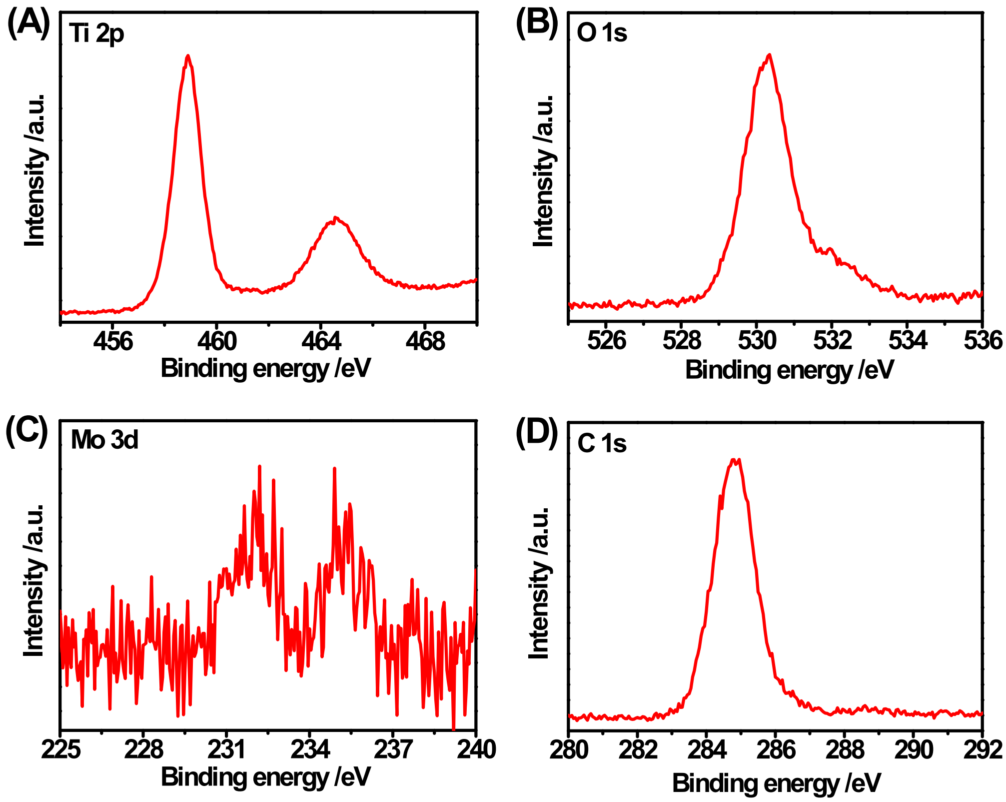


Fig. S10 The high-resolution XPS profiles of 1 wt% Mo_2C/TiO_2 after the recycling experiments for A) Ti 2p, B) O 1s, C) Mo 3d, and D) C 1s, respectively.

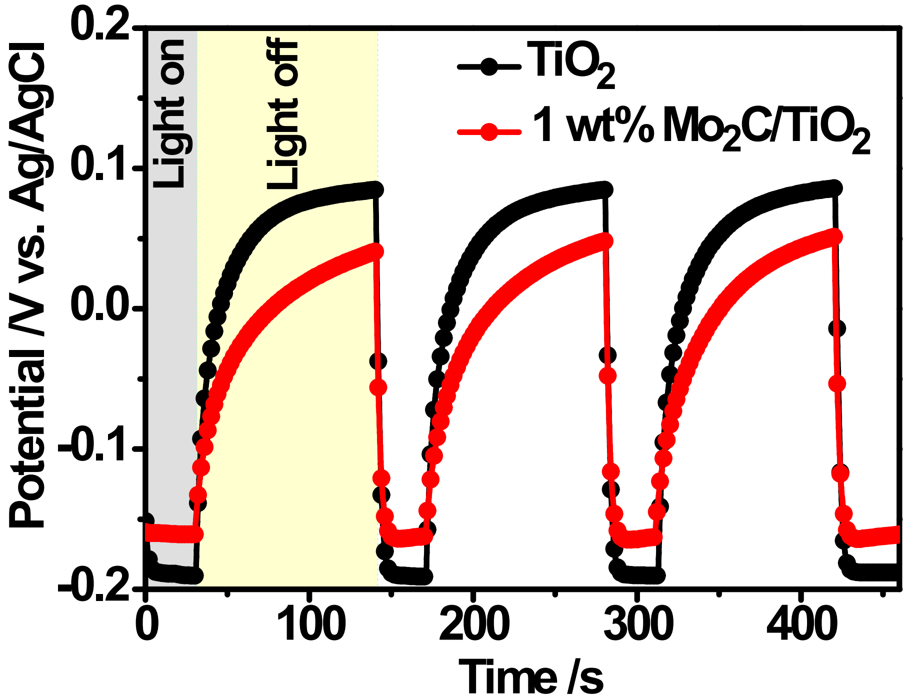


Fig. S11 OCP as a function of time under simulated solar light irradiation.

The open circuit photovoltage (OCP) decay curves were recorded under simulated solar light irradiation with on-off switches, as shown in Fig. S11. Generally, OCP decay kinetics reflects the surface charge recombination in the electrode, because bulk recombination usually occurs in the scale of nanosecond/microsecond.[51]

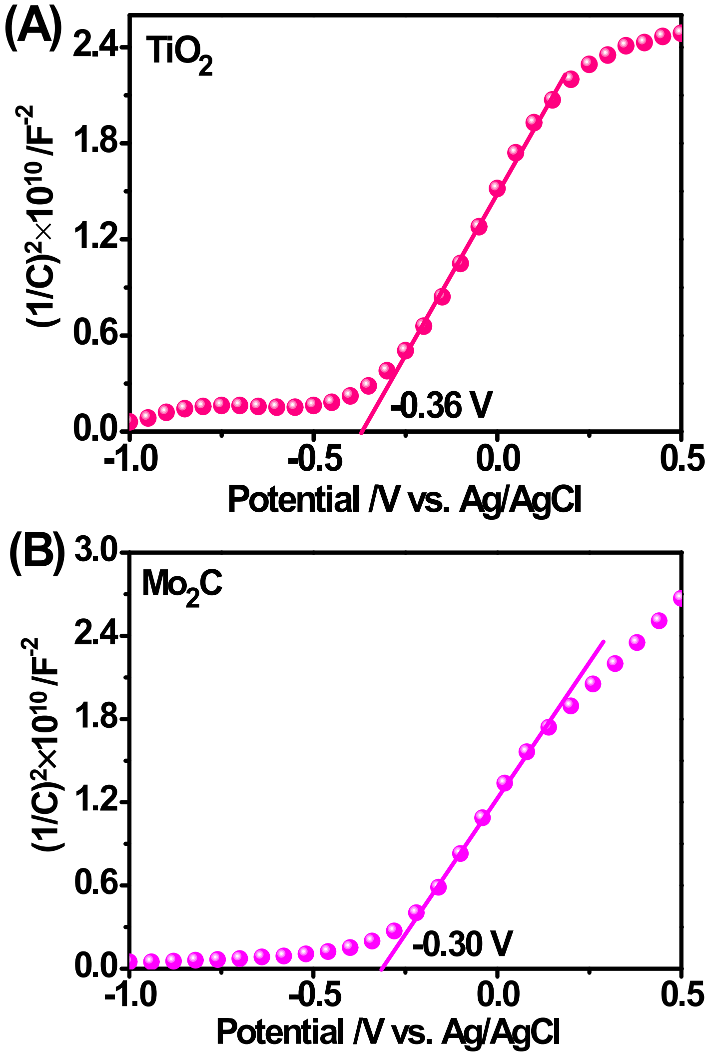


Fig. S12 M-S plots for A) TiO_2, and B) Mo_2C in 0.5 M Na_2SO_4 solution (PH = 7).

Table S1. The band gap energy, energy levels of calculated conduction band edge and valence band edges for Mo_2C and TiO_2.

Semiconductors	Band gap energy E_g /eV	Conduction band edge (V vs. NHE)	Valence band edge (V vs. NHE)
Mo_2C	1.10	-0.30	0.80
TiO_2	3.27	-0.36	2.91

Table S2. Comparison of photocatalytic hydrogen production performances for Mo_2C/TiO_2 system with other promising photocatalysts.

Photocatalyst	Light source	H_2 (μmol h^{-1} g^{-1})	Ref.
FeP/TiO_2	200 W Hg	1900	ACS Nano 2014, **8**,11101[21]
Cu/TiO_2	UV-LED (365 nm)	5104	Nano Lett. 2015, **15**, 4853[S2]
$MoS_2/RGO/TiO_2$	350 W Xe	2066	J. Am. Chem. Soc. 2012, **134**, 6575[S3]
GO/TiO_2	300 W Hg	1930	ChemSusChem 2014, **7**, 618[S4]
$Cu(OH)_2/TiO_2$	UV-LED (365 nm)	3418	Energy Environ. Sci., 2011, **4**, 1364[S5]
Prorous TiO_2	300 W Xe	23740	J. Mater. Chem. A, 2015, **3**, 3710[S6]
$Ni(OH)_2/TiO_2$	UV-LED (365 nm)	3056	J. Phys. Chem. C 2011, **115**, 4953[S7]
$Au/B-TiO_2$	300 W Xe	2740	ACS Catal. 2014, **4**, 1451[S8]
$Au@TiO_2/CdS$	300 W Xe	1970	ACS Appl. Mater. Interfaces 2013, **5**, 8088[S9]
$PdAu/TiO_2$	UV-LED (365 nm)	19600	ACS Nano 2014, **8**,3490[13]
PtO/TiO_2	300 W Xe	4400	Nat. Commun. 2013, **4**, 2500[S10]
CNT/TiO_2	200 W Hg	2940	Appl. Catal. B Environ. 2015, **179**, 574[S11]
MoS_2/TiO_2	300 W Xe	1600	Small 2013, **9**,140[11]
Au/TiO_2	300 W Xe	6900	Nat. Chem. 2011, **3**, 489[12]
Mo_2C/TiO_2	**300 W Xe**	**39400**	**This work**

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