Supporting Information

In situ ion exchange synthesis of MoS_2/g-C_3N_4 heterojunction for highly efficient hydrogen production

Min Wang,[a, b, 1] Peng Ju,[d, 1] Yun Zhao,[a, b] Jiajia Li,[a, b] Xiuxun Han [a, c] * and Zhaomin Hao [e]

[a] Laboratory of Clean Energy Chemistry and Materials, Lanzhou Institute of Chemical Physics, Chinese Academy of Sciences, 18 Tianshui Middle Road, Lanzhou 730000, PR China

[b] University of Chinese Academy of Sciences, 19 (Jia) Yuquan Road, Beijing 100039, PR China

[c] Qingdao Center of Resource Chemistry & New Materials, 36 Jinshui Road, Qingdao 266100, PR China

[d] Marine Ecology Center, The First Institute of Oceanography, State Oceanic Administration, 6 Xianxialing Road, Qingdao 266061, PR China

[e] Henan University, 85 Minglun Road, Kaifeng 410200, PR China

* Corresponding author

Tel.: +86-931-4968054; Fax: +86-931-4968054

E-mail: xxhan@licp.cas.cn (X. Han)

[1] These two authors contributed equally to this work.

Table S1 MoS_2 loading amount in MoS_2/CNNS samples determined by ICP-AES.

	Composite (g L^{-1})	Mo (mg L^{-1})	S (mg L^{-1})	MoS_2/composite (wt%)
MoS_2/CNNS(15)	1.0	12.2	8.2	2.0
MoS_2/CNNS(20)	1.0	23.9	15.5	3.9
MoS_2/CNNS(30)	1.0	34.7	22.3	5.7
MoS_2/CNNS(50)	1.0	34.9	22.5	5.7

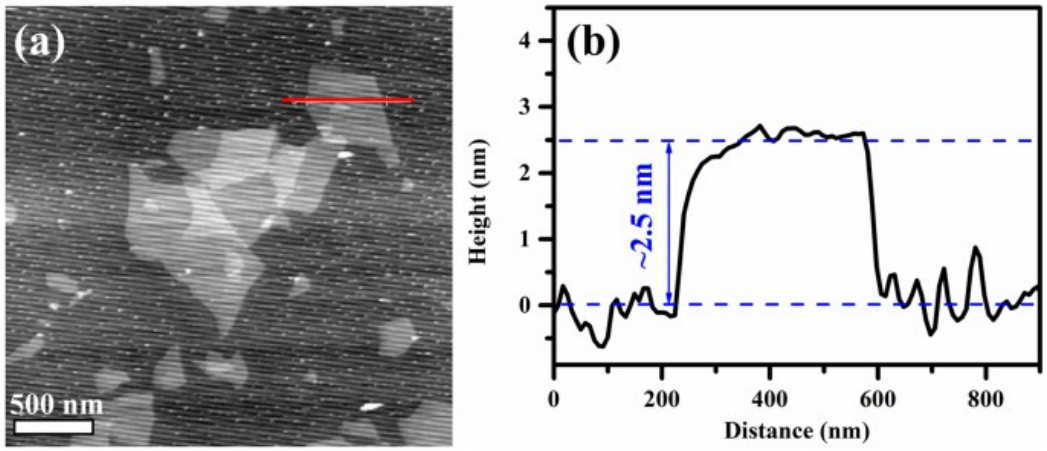

Fig. S1 (a) AFM image of CNNS deposited on the silicon wafer substrate, (b) The corresponding height curve determined along the red line in (a).

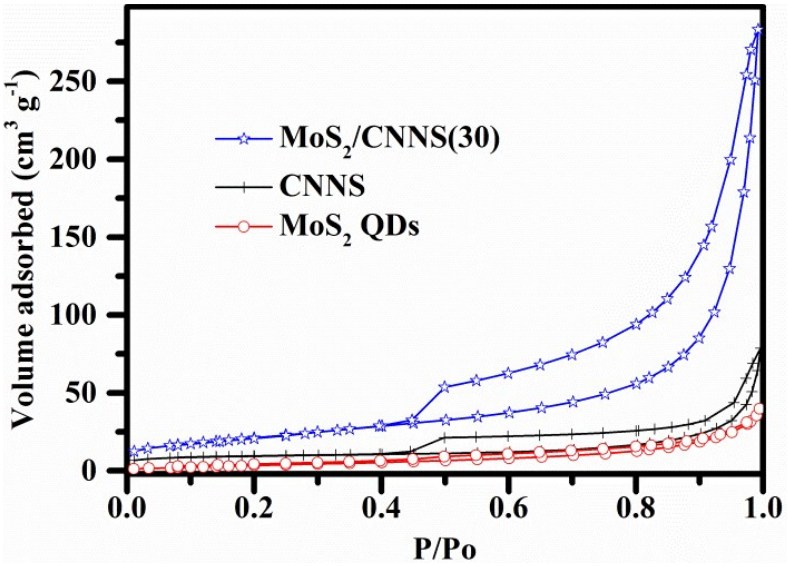

Fig. S2 N_2 adsorption/desorption isotherm curves of MoS_2 QDs, CNNS, and MoS_2/CNNS(30).

The calculations of BET specific surface area were based on N_2 adsorption/desorption isotherm curves of MoS_2 QDs, CNNS and the MoS_2/CNNS(30) composite, as shown in Fig. S2. MoS_2 QDs possess a small surface area (29.15 m^2 g^{-1}) due to aggregation, while the MoS_2/CNNS(30) composite shows the larger specific surface area (78.95 m^2 g^{-1}).

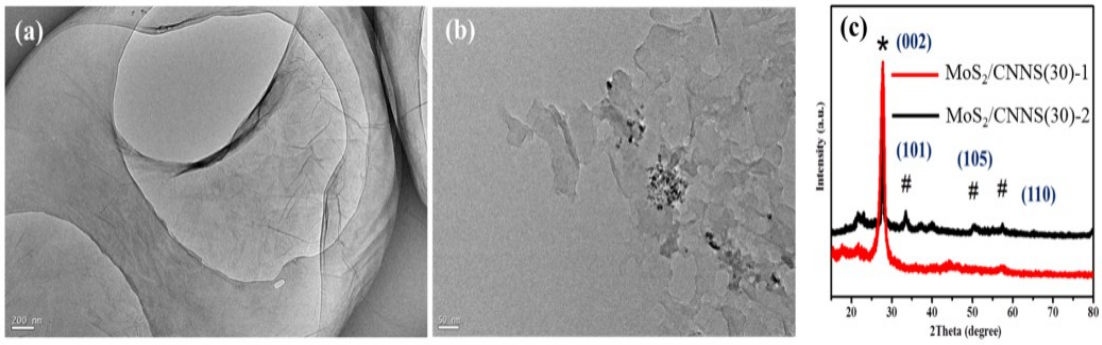

Fig. S3 TEM images of (a) MoS_2/CNNS(30)-1 and (b) MoS_2/CNNS(30)-2; (c) XRD patterns of MoS_2/CNNS(30)-1 and MoS_2/CNNS(30)-2.

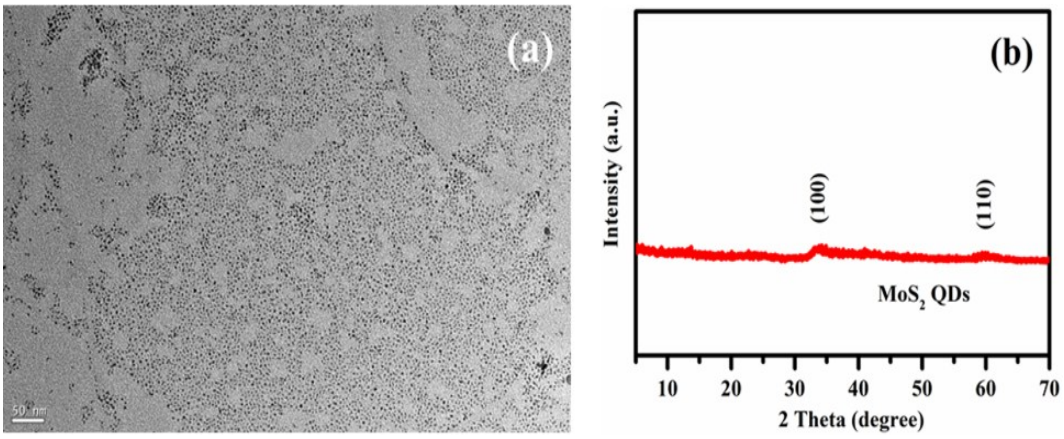

Fig. S4 (a) TEM image and (b) XRD pattern of MoS_2 QDs.

MoS_2 QDs were characterized by means of TEM and XRD. A typical TEM image of the MoS_2 QDs (Fig. S4a) shows highly uniform and monodisperse nanocrystals in narrow distribution of 2.15 ± 0.34 nm in diameter (the size is statistically calculated from more than 100 QDs in the TEM images). It can be seen in Fig. S4b that two major diffraction peaks can be clearly observed in the XRD pattern of MoS_2 QDs, which can be attributed to the (100) and (110) planes of MoS_2, respectively. Moreover, it can be seen that the peak intensity is weak, implying the poor crystalline of MoS_2 QDs. These results are in good agreement with the morphology and phase structure of MoS_2 QDs in MoS_2/CNNS composites.

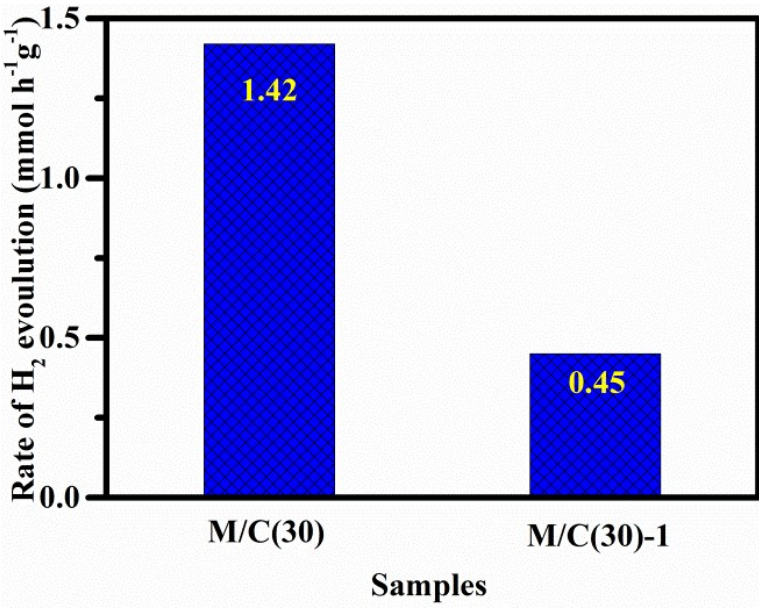

Fig. S5 Photocatalytic H_2 production rates of MoS_2/CNNS (30) and MoS_2/CNNS (30)-1.

Table S2 Comparison of the photocatalytic performance of MoS_2/CNNS prepared by ion exchange process and MoS_2/C_3N_4 photocatalysts reported previously.

Photocatalyst	Light source	Concentration of photocatalysts (g L^{-1})	H_2 evolution (μmol h^{-1} g^{-1})	Ref.
0.2 wt% MoS_2/mpg-CN (+1 wt% Pt)	300 W Xe lamp (λ > 420 nm)	0.2	1250	1
0.5 wt% MoS_2/g-CN (+5 wt% Pt)	300 W Xe lamp (λ > 400 nm)	0.8 g	231	2
2.89 wt% MoS_2/g-C_3N_4 (+5 wt% Pt)	300 W Xe lamp (λ > 400 nm)	1.0 g	252	3
1 wt% MoS_2 QDs/CN (+1 wt% Pt)	300 W Xe lamp (λ > 420 nm)	0.5 g	393	4
0.5 wt% MoS_2/HCNS (+1 wt% Pt)	300 W Xe lamp (λ > 420 nm)	0.2 g	1340	5
5.7 wt% MoS_2/CNNS (without Pt)	Simulated Sunlight (AM1.5G)	0.5 g	1420	This work

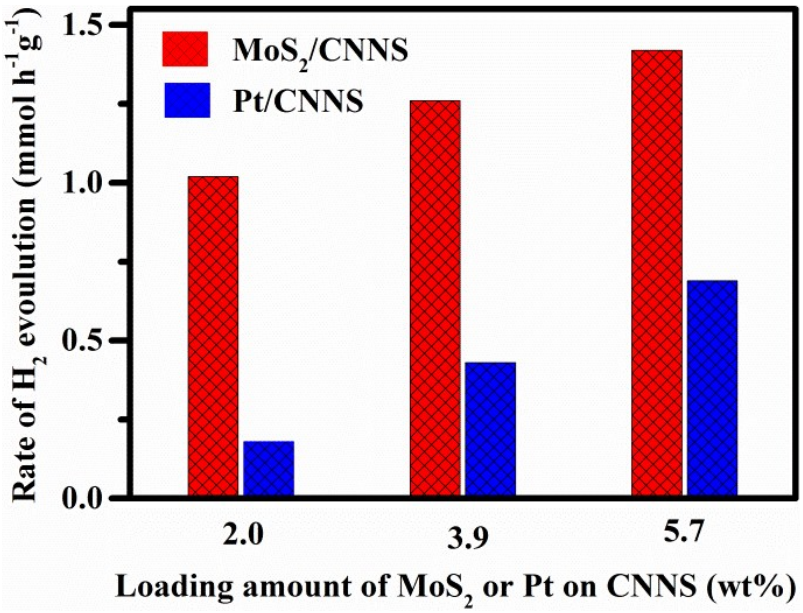

Fig. S6 The H_2 production rate of CNNS loaded with different amounts of MoS_2 or Pt.

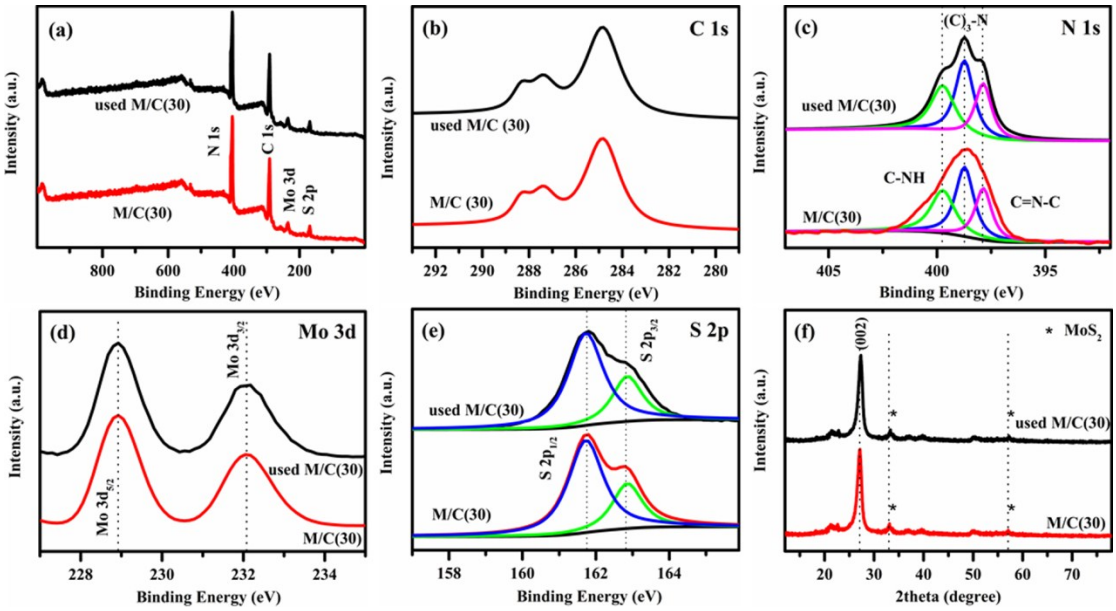

Fig. S7 (a) XPS spectrum, high resolution XPS spectra of (b) C 1s, (c) N 1s, (d) Mo 3d, and (e) S 2p, and (f) XRD patterns of MoS_2/CNNS(30) before and after reaction.

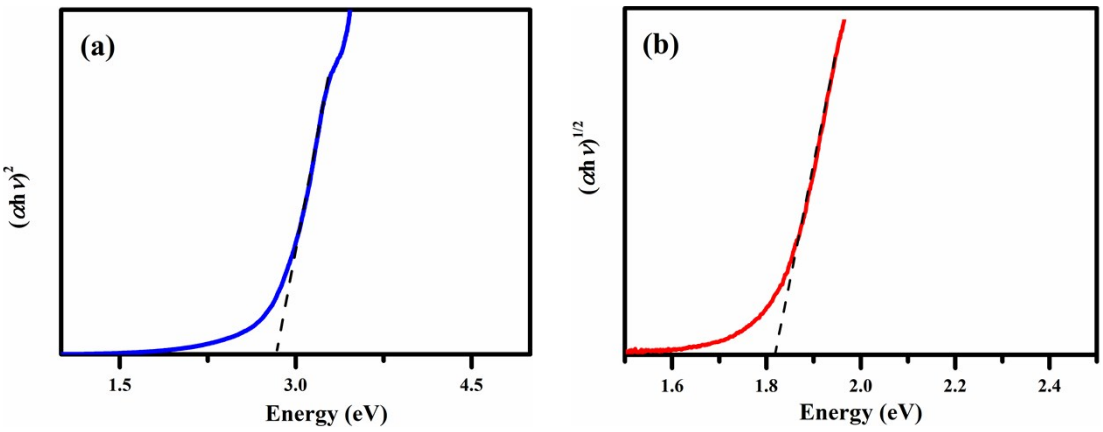

Fig. S8 Tauc plots of (a) CNNS and (b) MoS_2 QDs.

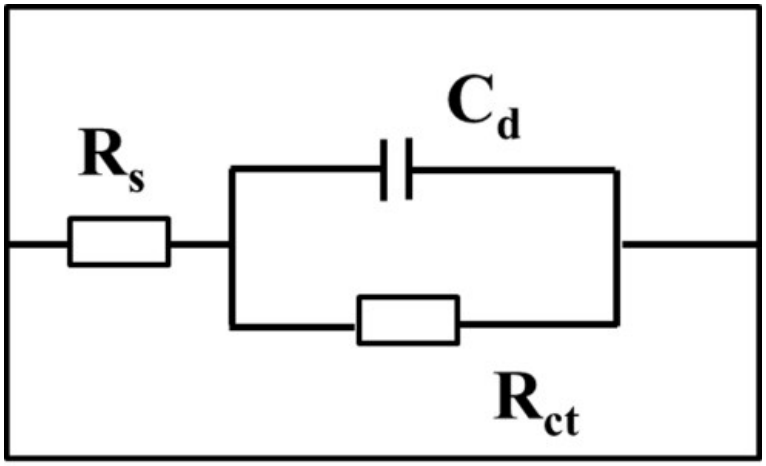

Fig. S9 The equivalent electric circuit used for fitting the EIS experiment results in Fig. 5b.

Table S3 Parameters used to fit the experimental impedance data in Fig. S8.

	R_s (Ω)	C_d (F)	R_{ct} (Ω)
CNNS	16.83	16	17 585
MoS_2 QDs	16.83	12	12 698
MoS_2/CNNS(30)	16.83	46	2 395

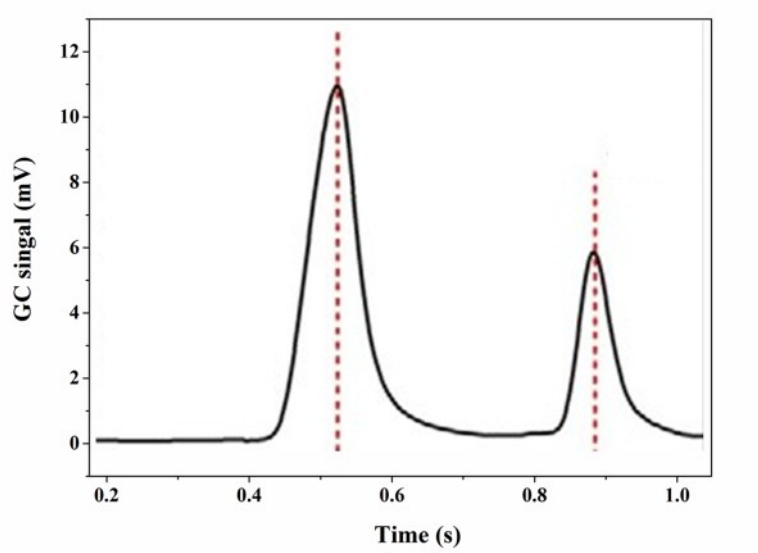

Fig. S10 The typical signal detected in the photocatalytic test.

As shown in Fig. S10, H_2 (t_1 = 0.523 s) and O_2 (t_2 = 0.890 s) can be detected in our photocatalytic test simultaneously.

References

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