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Supporting Information

Metallic 1T-phase MoS_2 quantum dots/g-C_3N_4 heterojunctions for enhanced photocatalytic hydrogen evolution

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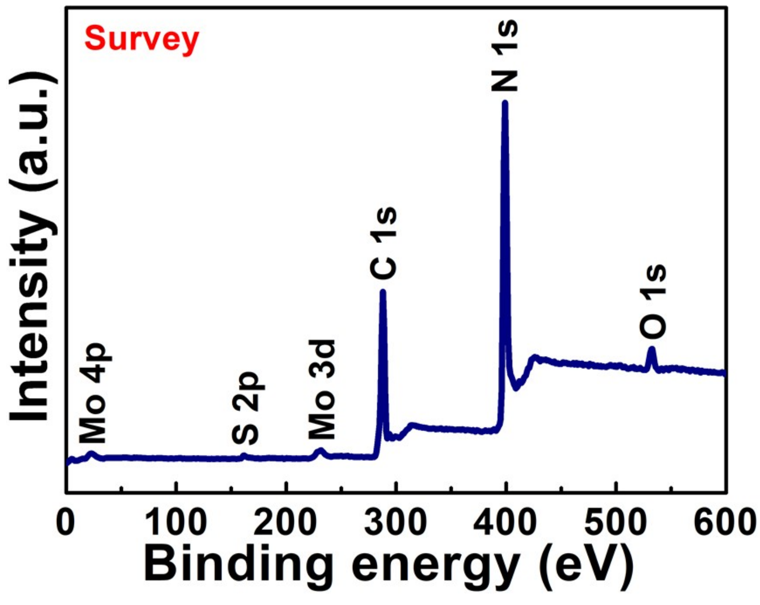

Fig. S1. XPS survey spectra of 1T-MoS_2 QDs@g-C_3N_4 composites (15 wt%).

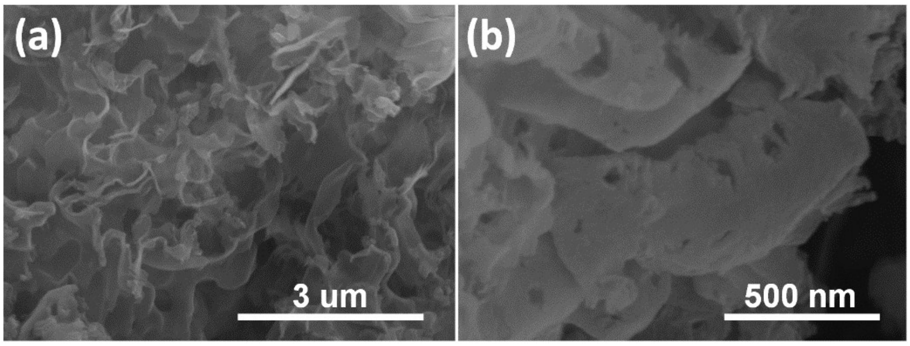

Fig. S2. SEM images of pure g-C_3N_4 NSs.

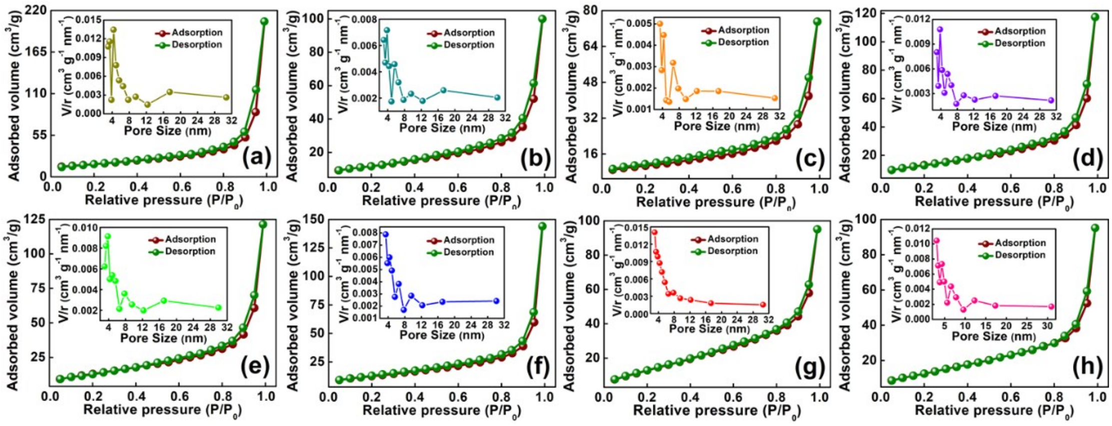

Fig. S3. Nitrogen adsorption/desorption isotherms of (a) g-C_3N_4 NSs and 1T-MoS_2 QDs@g-C_3N_4 composites containing different amounts of 1T-MoS_2 QDs: (b) 1, (c) 3, (d) 5, (e) 7, (f) 9, (g) 15 and (h) 20 wt% (inset shows the corresponding BJH pore size distribution curves).

Table S1. BET surface area of 1T-MoS_2 QDs@g-C_3N_4 composites containing different amounts of 1T-MoS_2 QDs (1, 3, 5, 7, 9, 15 and 20 wt%).

Samples	BET Surface area (m^2 g^{-1})
1T-MoS_2 QDs@g-C_3N_4-1 wt%	41.379
1T-MoS_2 QDs@g-C_3N_4-3 wt%	36.004
1T-MoS_2 QDs@g-C_3N_4-5 wt%	47.938
1T-MoS_2 QDs@g-C_3N_4-7 wt%	48.450
1T-MoS_2 QDs@g-C_3N_4-9 wt%	45.018
1T-MoS_2 QDs@g-C_3N_4-15 wt%	53.643

1T-MoS_2 QDs@g-C_3N_4-20 wt%	48.225

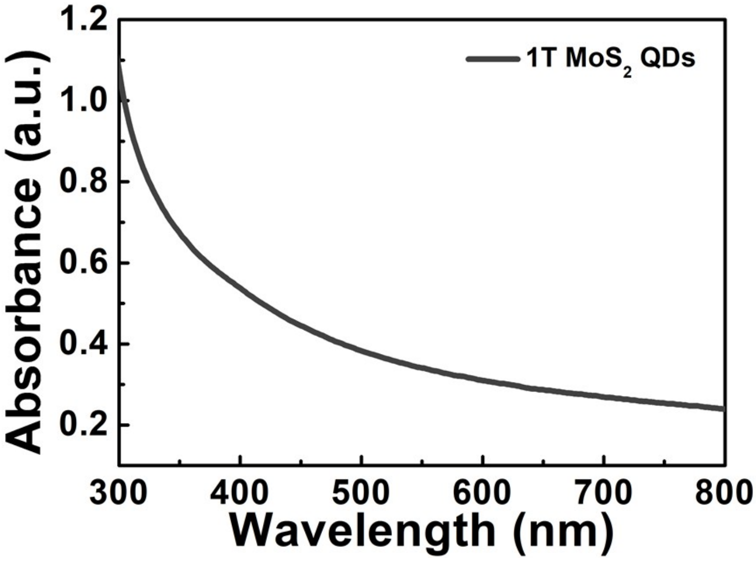

Fig. S4. UV-vis light absorption spectrum of 1T-MoS_2 QDs.

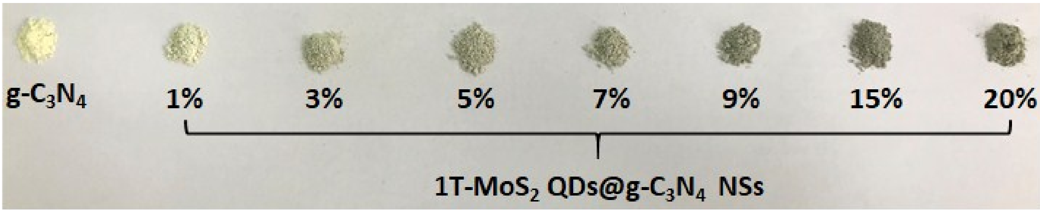

Fig. S5. Optical photographs of g-C_3N_4 NSs and 1T-MoS_2 QDs@g-C_3N_4 composites containing different amounts of 1T-MoS_2 QDs (1, 3, 5, 7, 9, 15 and 20 wt%).

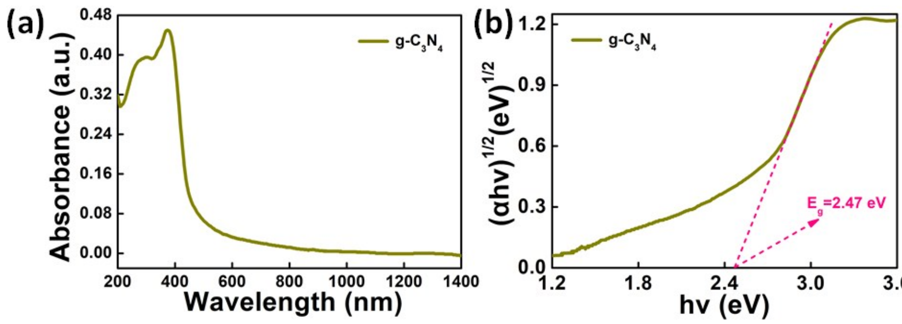

Fig. S6. (a) UV-vis-NIR diffuse reflectance spectra and (b) band gap values of pure g-C_3N_4 NSs.

Table S2. Hydrogen evolution performance of the as-prepared MoS_2@g-C_3N_4 compared with some of the typical semiconductors.

	H_2	

	evolution (μmol g^{-1} h^{-1})			
$g-C_3N_4/Ag/MoS_2$	104	100 mg of photocatalysts, 100 mL of aqueous solutions with 15 vol % of TEOA	visible light irradiation, λ > 420 nm	1
$g-C_3N_4/RGO/MoS_2$	317	TEOA aqueous solution	visible light irradiation, λ > 420 nm	2
2D-2D MoS_2/g-C_3N_4	1155	50 mg of photocatalysts, 250 ml 0.1 M TEOA aqueous acetone	300 W Xeon lamp, λ > 420 nm	3
MoS_2/g-C_3N_4/GO	1650	4 mg of photocatalysts, 20 mL aqueous solution containing Na_2SO_3 (0.25 M)	450 W xenon lamp with AM 1.5 filter	4
1T-MoS_2/O-g-C_3N_4	1841	10 mg of photocatalysts, 100 mL TEOA/H_2O (1:9 by volume)	300 W Xeon arc lamp, λ > 400 nm	5
1T-MoS_2 QDs@g-C_3N_4 (this paper)	1857	20 mg of photocatalysts, 20 ml TEOA, 80 ml deionized water	300 W Xeon arc lamp with AM-1.5 filter	

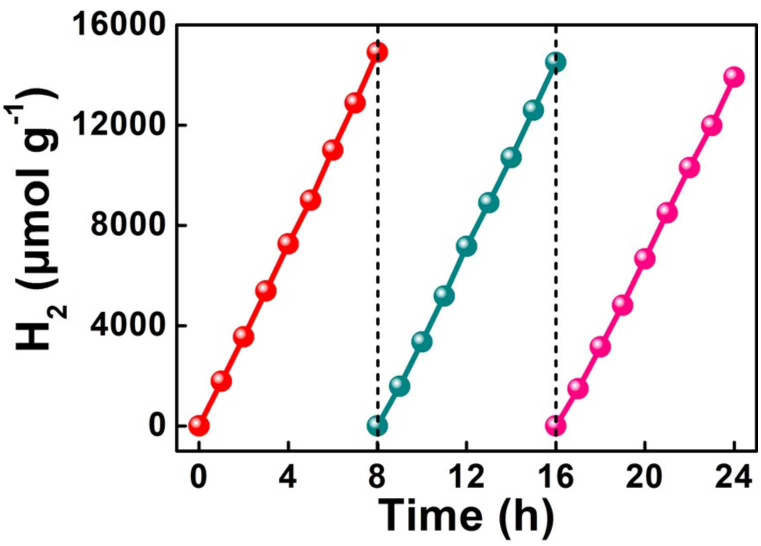

Fig. S7. Stability and recyclability of the 1T-MoS_2 QDs@g-C_3N_4 composites (15 wt%).

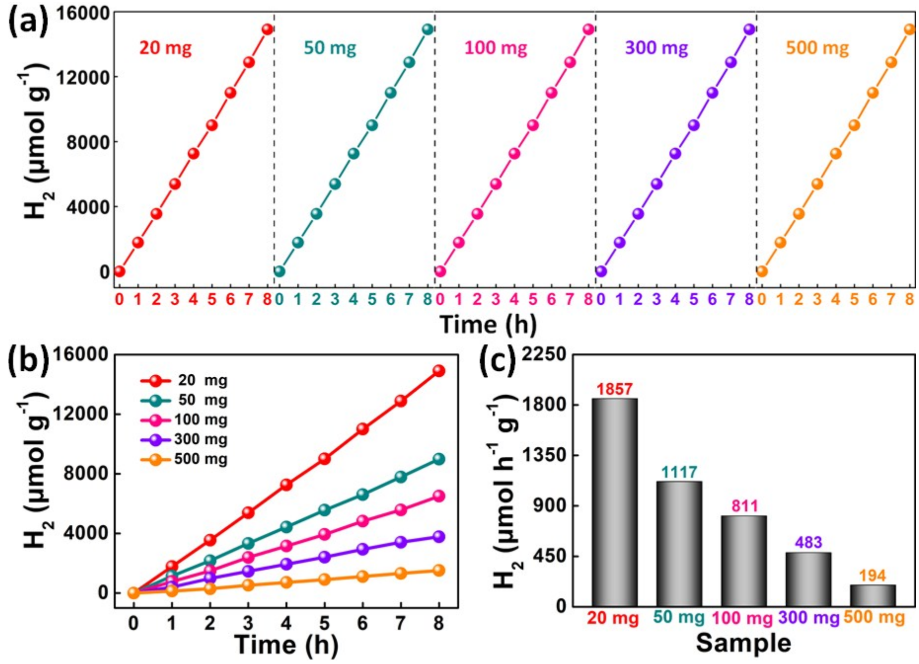

Fig. S8. (a) Cumulated evolution of 1T-MoS_2 QDs@g-C_3N_4 composites (15 wt%) of different dosages with the same concentration. (b) Cumulated evolution and (b) photocatalytic H_2 evolution rate of 1T-MoS_2 QDs@g-C_3N_4 composites (15 wt%) of different dosages and different concentration.

Table S3. Comparison of AQE values over g-C_3N_4 NSs and 11T-MoS_2 QDs@g-C_3N_4 composites containing different amounts of 1T-MoS_2 QDs (1, 3, 5, 7, 9, 15 and 20 wt%) under simulated solar light.

Samples	AQE values (%)
g-C_3N_4 NSs	0.15
1T-MoS_2 QDs@g-C_3N_4-1 wt%	1.71
1T-MoS_2 QDs@g-C_3N_4-3 wt%	2.20
1T-MoS_2 QDs@g-C_3N_4-5 wt%	2.78
1T-MoS_2 QDs@g-C_3N_4-7 wt%	3.42
1T-MoS_2 QDs@g-C_3N_4-9 wt%	4.54
1T-MoS_2 QDs@g-C_3N_4-15 wt%	5.76
1T-MoS_2 QDs@g-C_3N_4-20 wt%	4.33

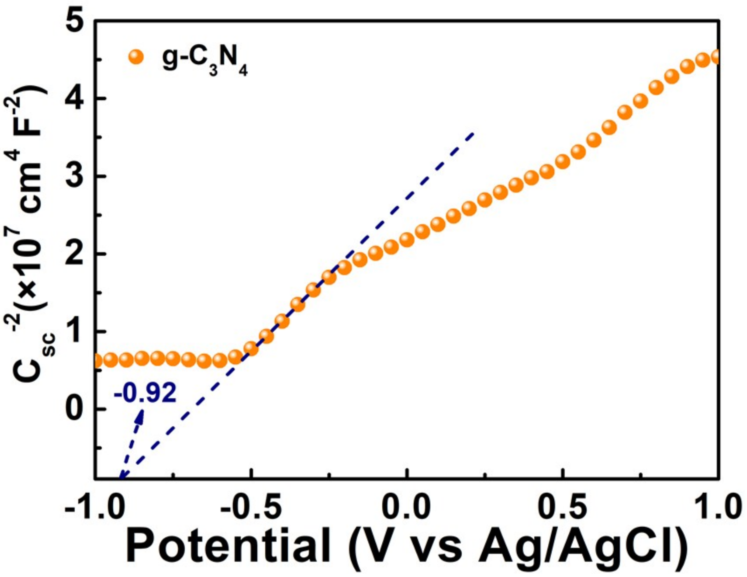

Fig. S9. Mott-Schottky plot of g-C_3N_4 NSs.

References:

1. D. Lu, H. Wang, X. Zhao, K. K. Kondamareddy, J. Ding, C. Li, P. Fang, *ACS Sustainable Chem. Eng.*, 2017, **5**, 1436-1445.
2. Y.-J. Yuan, Y. Yang, Z. Li, D. Chen, S. Wu, G. Fang, W. Bai, M. Ding, L.-X. Yang, D.-P. Cao, Z.-T. Yu, Z.-G. Zou, *ACS Appl. Energy Mater.*, 2018, **1**, 1400-1407.
3. Y.-J. Yuan, Z. Shen, S. Wu, Y. Su, L. Pei, Z. Ji, M. Ding, W. Bai, Y. Chen, Zhen-T. Yu, Z. Zou, *Appl. Catal. B-Environ.*, 2019, **246**, 120-128.
4. M. Wang, P. Ju, J. Li, Y. Zhao, X. Han, Z. Hao, *ACS Sustainable Chem. Eng.*, 2017, **5**, 7878-7886.
5. H. Xu, J. Yi, X. She, Q. Liu, L. Song, S. Chen, Y. Yang, Y. Song, R. Vajtai, J. Lou, H. Li, S. Yuan, J. Wu, P. M. Ajayan, *Appl. Catal. B-Environ.*, 2018, **220**, 379-385.