# Electronic Supplementary Information (ESI)

## Well Dispersed MoC Quantum Dots in Ultrathin Carbon Film as Efficient Co-catalyst for Photocatalytic $H_2$ Evolution

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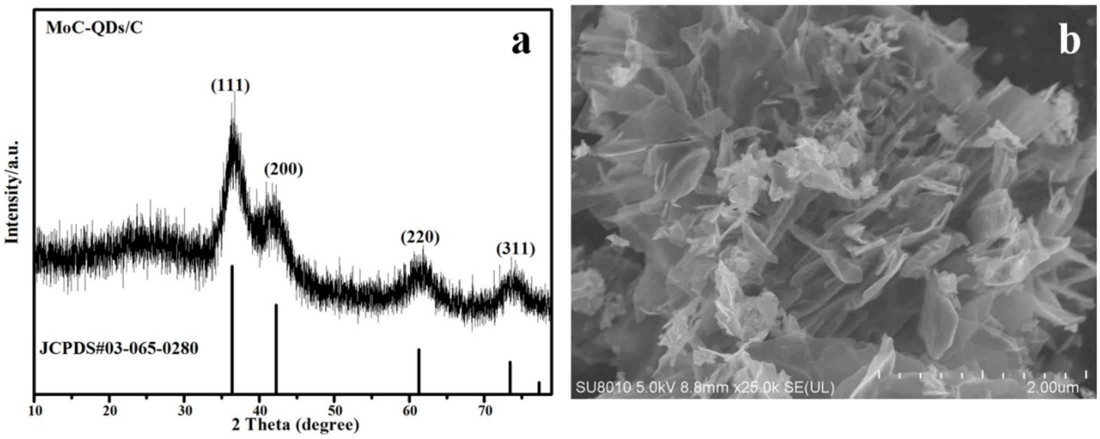


**Fig. S1** (a) XRD pattern and (b) SEM image of the MoC-QDs/C hybrid.

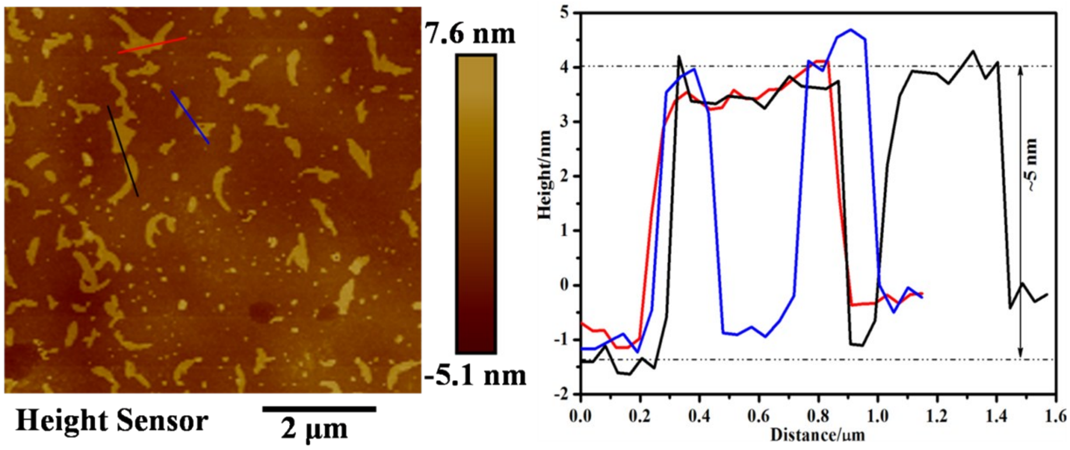


**Fig. S2** (a) AFM image of as-prepared MoC-QDs/C hybrid and (b) the average thickness of selected area is almost 5 nm.

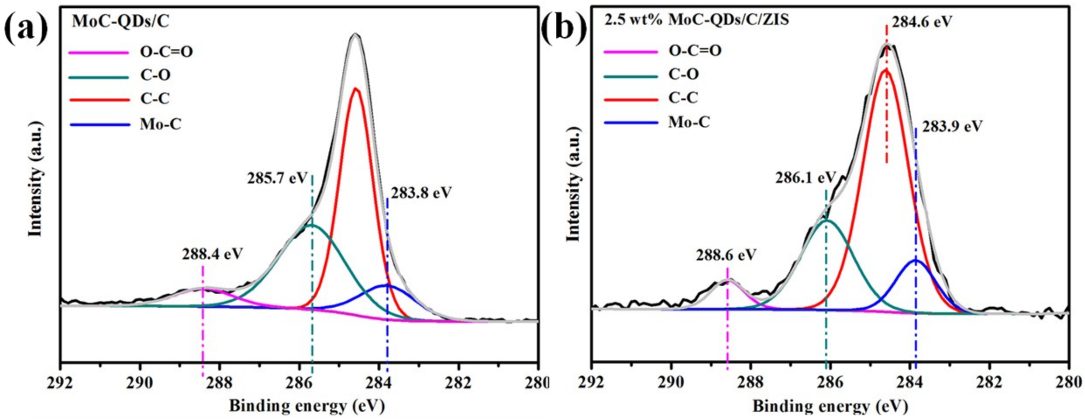


**Fig. S3** XPS spectra of C 1s of MoC-QDs/C (a) and 2.5 wt% MoC-QDs/C/ZIS, respectively.

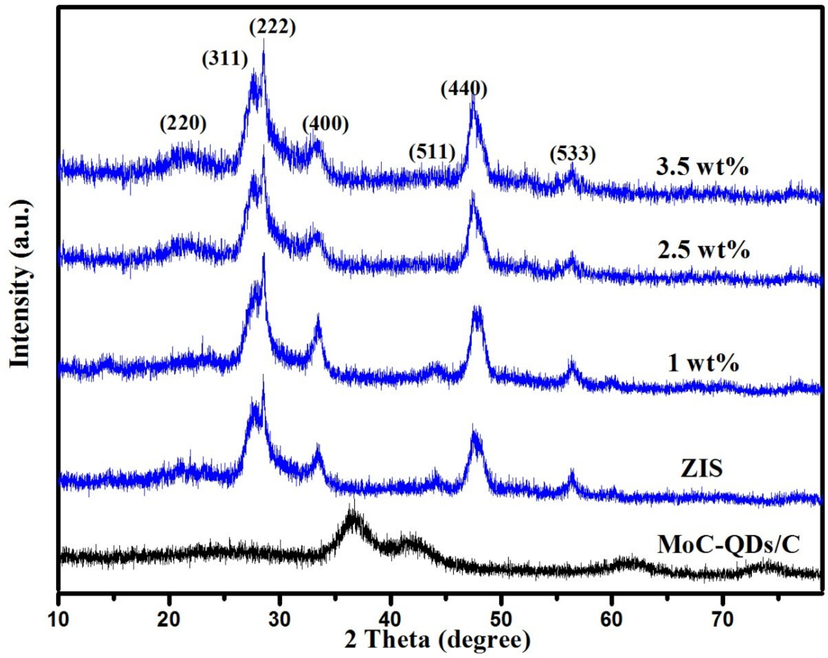


**Fig. S4** XRD patterns of MoC-QDs/C and different loading of MoC-QDs/C composites.

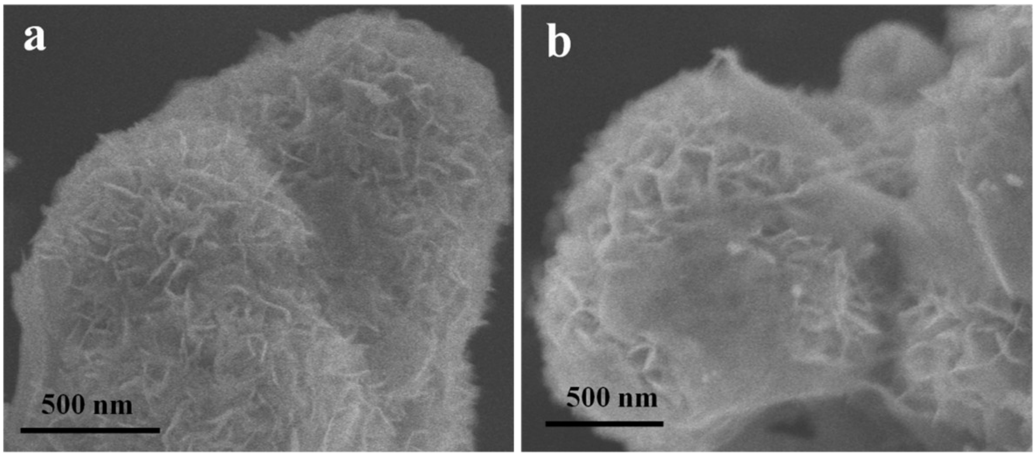


**Fig. S5** SEM images of (a) ZIS and (b) 2.5 wt% MoC-QDs/C/ZIS.

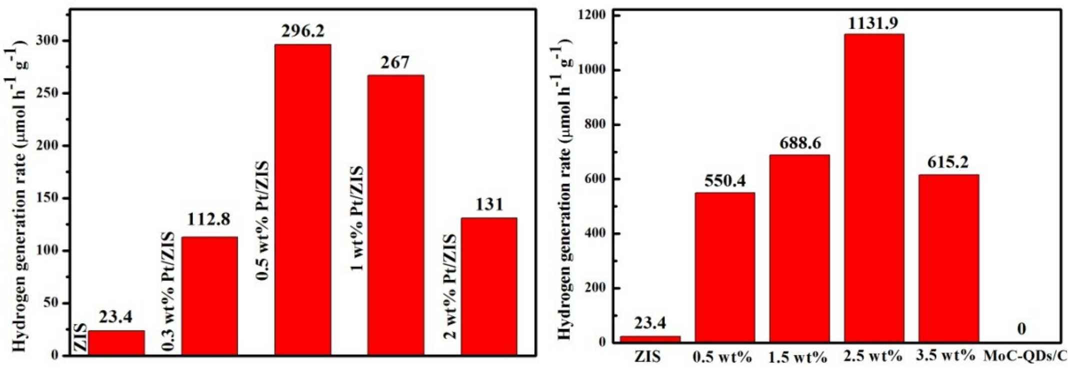


**Fig. S6** The co-catalytic performance comparisons between Pt and MoC-QDs/C.

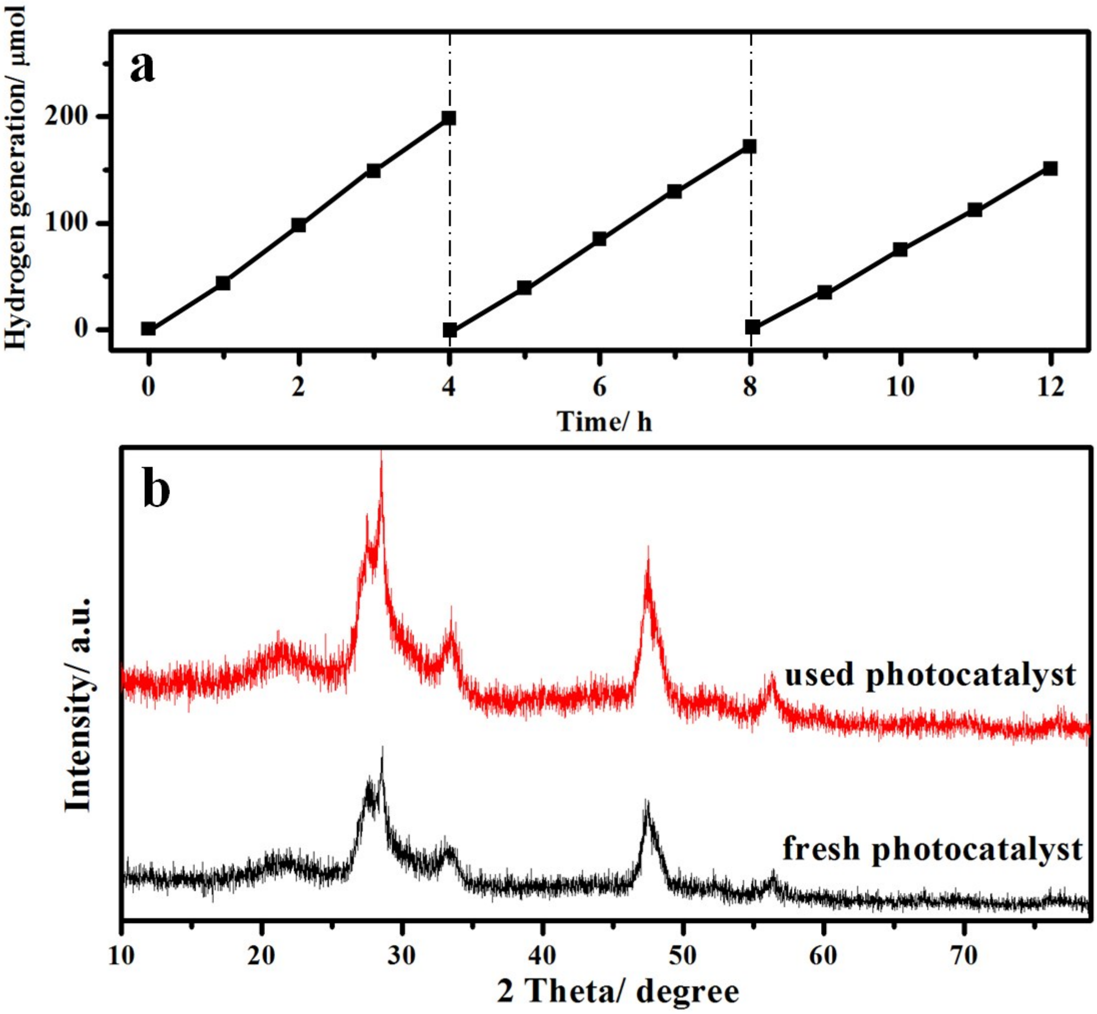


**Fig. S7** (a) Stability evaluation of $H_2$ production under visible light irradiation (conditions: 50 mg catalyst, $\lambda \geq 400$ nm); (b) XRD pattern of 2.5 wt% MoC-QDs/C/ZIS before and after recycling tests.

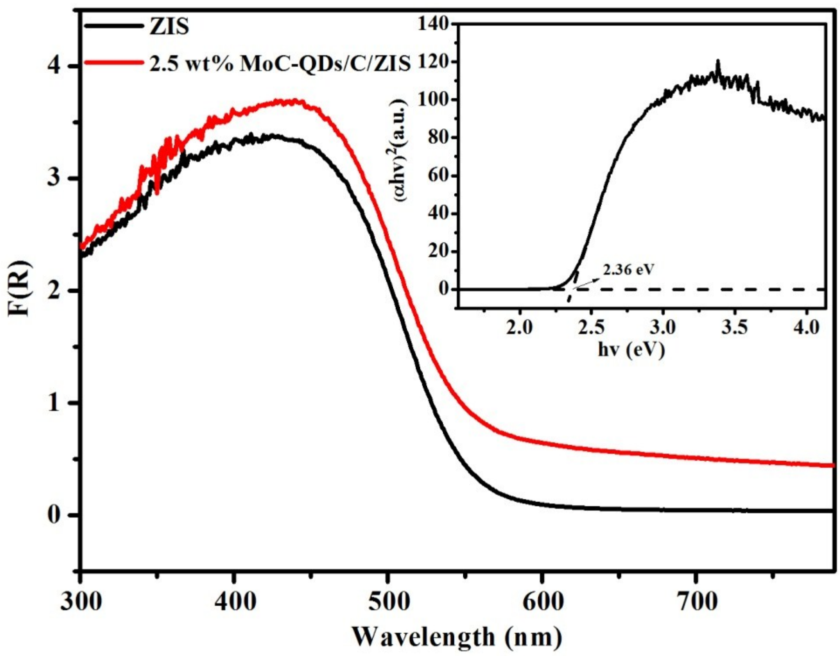


**Fig. S8** UV-Vis DRS of the as-prepared ZIS and 2.5 wt% MoC-QDs/C/ZIS. Inset is Tauc's plot of $(\alpha h\nu)^2$ versus photon energy for optical band-gap calculations.

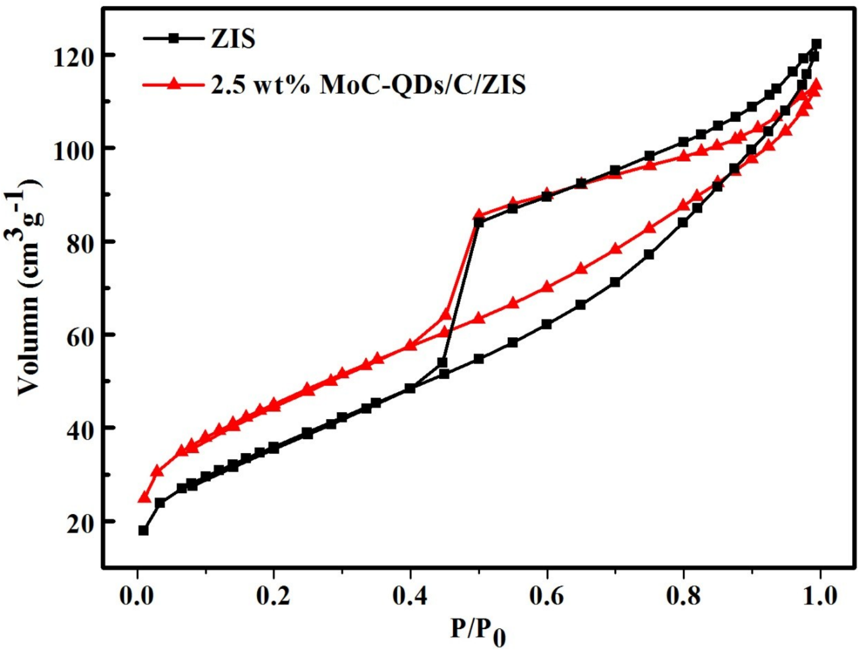


**Fig. S9** $N_2$ adsorption-desorption isotherms for bare ZIS and 2.5 wt% MoC-QDs/C/ZIS.

**Table 1.** Summary of molybdenum carbide-based photocatalysts for PHER.

| Year | Co-catalyst | Photocatalyst | T (℃)[a] | Morphology [b] | Size (nm)[b] | Gas[c] | PHER rate[d] |
|---|---|---|---|---|---|---|---|
| 2016 [1] | $Mo_2C$ | CdS | 700 | — | — | $H_2/CH_4$ | 10 |
| 2017 [2] | $Mo_2C$@C | CdS | 800 | nanosphere | 200 | Ar | 25 |
| 2017 [3] | $Mo_2C$ | $TiO_2$ | 850 | nanoparticle | — | $Ar/H_2$ | 25 |
| 2017 [4] | $Mo_2N/Mo_2C$/GR | CdS | 750 | — | — | $N_2$ | 18 |
| 2018 [5] | $Mo_2C$ | $SrTiO_3$ | 800 | shell (nanofiber) | — | Ar | 15 |
| This work | MoC-QDs/C | $ZnIn_2S_4$ | 700 | nanosheet | 5 (thickness) | Ar | 48 |

[a] T refers to the required temperature of synthesis for molybdenum carbide. [b] The morphology and size are morphology and size of co-catalyst, respectively. [c] Gas denotes the gas atmosphere in synthesizing molybdenum carbide-based co-catalyst. [d] PHER rate denotes the hydrogen evolution rate of times higher than pristine photocatalyst.

# References


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