

## Electronic supplementary information

# One-pot hydrothermal synthesis of MoS<sub>2</sub>-modified Mn<sub>0.5</sub>Cd<sub>0.5</sub>S solid solution for boosted H<sub>2</sub> production activity under visible light

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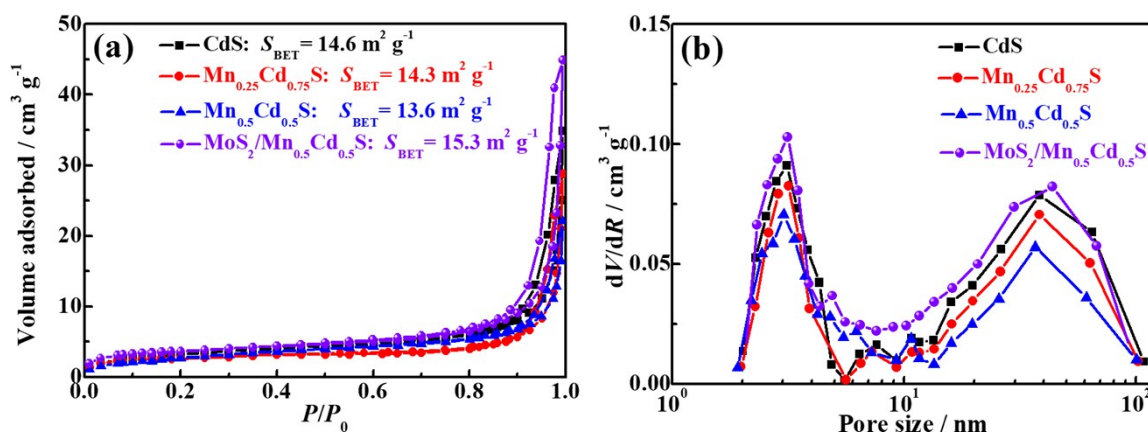
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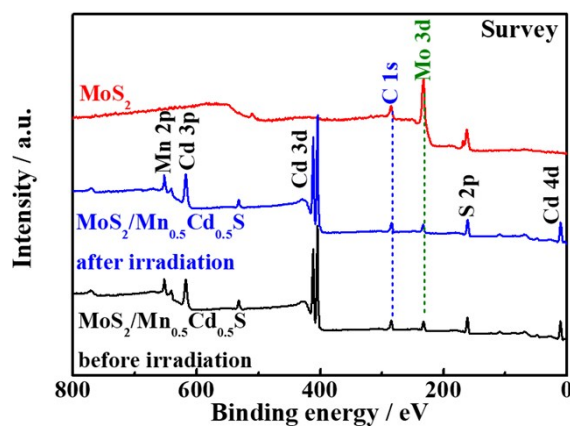
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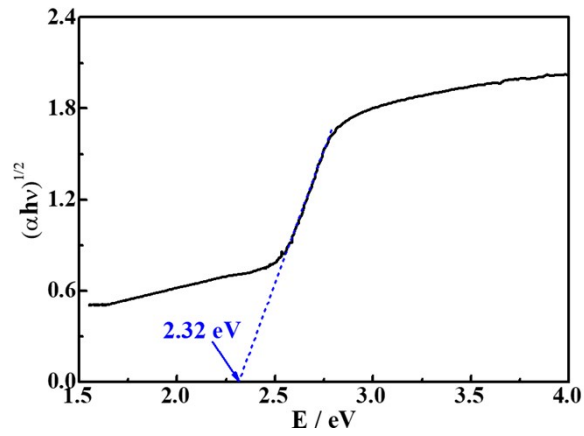
<sup>‡</sup> These authors contributed to this work equally.



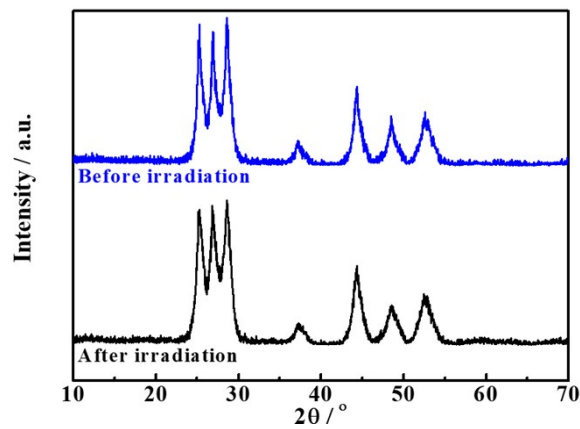
**Fig. S1** N<sub>2</sub> adsorption-desorption isotherms (a) and BJH pore size distribution curves (b) of the the as-prepared Mn<sub>x</sub>Cd<sub>1-x</sub>S products (0.25 ≤ x ≤ 0.5) and 0.5wt% MoS<sub>2</sub>/Mn<sub>0.5</sub>Cd<sub>0.5</sub>S composite.



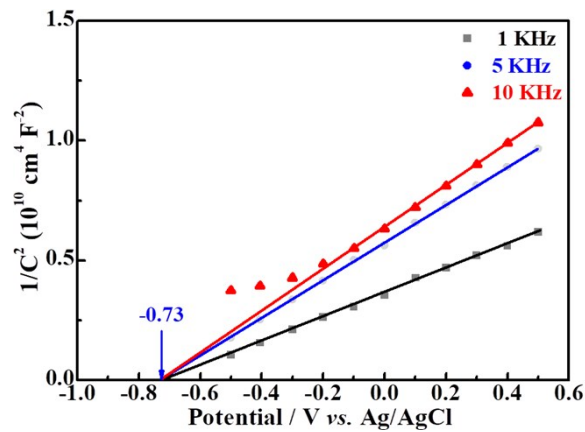
**Fig. S2** Survey XPS spectra of the obtained 0.5wt% MoS<sub>2</sub>/Mn<sub>0.5</sub>Cd<sub>0.5</sub>S composite before and after 20 h irradiation for the photoreaction as well as the single MoS<sub>2</sub>.



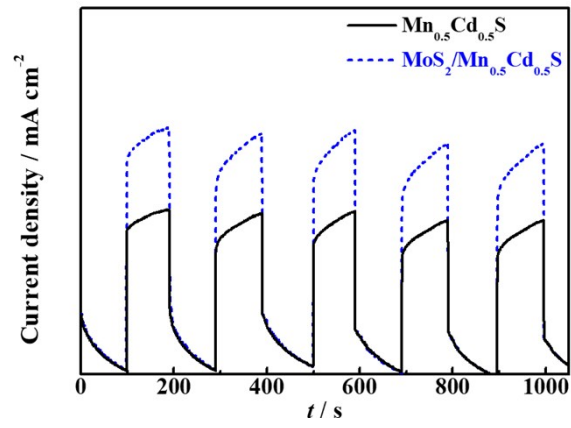
**Fig. S3** The bandgap energy of the obtained  $\text{Mn}_{0.5}\text{Cd}_{0.5}\text{S}$  solid solution by a relation of  $(\alpha h\nu)^{1/2}$  vs. Photo energy ( $h\nu$ ).



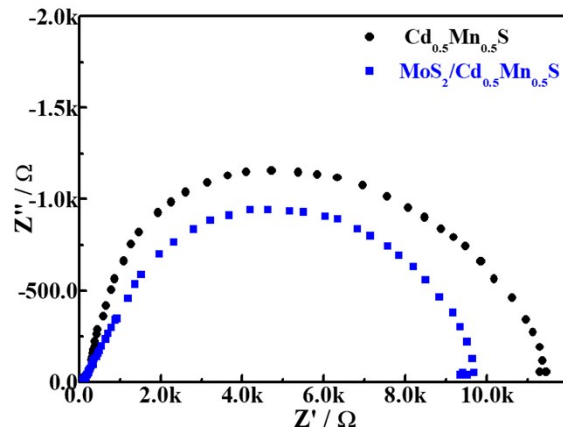
**Fig. S4** Comparisons of XRD patterns of the obtained 0.5wt%  $\text{MoS}_2/\text{Mn}_{0.5}\text{Cd}_{0.5}\text{S}$  before and after 20 h irradiation for the photoreaction.



**Fig. S5** Mott-Schottky plots of the  $\text{Mn}_{0.5}\text{Cd}_{0.5}\text{S}$  film electrode obtained at a frequency of 1, 5 or 10 KHz in a  $\text{Na}_2\text{SO}_4$  solution (1.0 M).



**Fig. S6** Photocurrent response curves of the obtained 0.5wt% MoS<sub>2</sub>/Mn<sub>0.5</sub>Cd<sub>0.5</sub>S and the pristine Mn<sub>0.5</sub>Cd<sub>0.5</sub>S under  $\lambda \geq 420$  nm light irradiation.



**Fig. S7** EIS Nyquist plots of the obtained 0.5wt% MoS<sub>2</sub>/Mn<sub>0.5</sub>Cd<sub>0.5</sub>S and the pristine Mn<sub>0.5</sub>Cd<sub>0.5</sub>S under  $\lambda \geq 420$  nm light irradiation.