

Supporting information for

Amorphous Co₃O₄ quantum dots hybridizing with 3D hexagonal CdS single crystals to construct 0D/3D p-n heterojunction for highly efficient photocatalytic H₂ evolution

Xuqiang Hao^{1, 2, 3*}, Dingzhou Xiang^{1, 2, 3}, Zhiliang Jin^{1, 2, 3*}

1. School of Chemistry and Chemical Engineering, North Minzu University, Yinchuan 750021, P.R.China

2. Ningxia Key Laboratory of Solar Chemical Conversion Technology, North Minzu University, Yinchuan 750021, P.R.China

3. Key Laboratory for Chemical Engineering and Technology, State Ethnic Affairs Commission, North Minzu University, Yinchuan 750021, P.R.China

*Corresponding author: haoxuqiang@126.com (X.Q. Hao) zl-jin@nun.edu.cn (Z.L. Jin).

Table S1 performance comparison of noble-metal-free photocatalysts for H₂ production

| Photocatalyst | Light source | Sacrificial agents | Production rate | Refs |
|-------------------------------------|--|---|--|-----------|
| CQDs/CdS | 5W LED ($\lambda \geq 420\text{nm}$) | Na ₂ S/Na ₂ SO ₃ | 17.5 mmol h ⁻¹ g ⁻¹ | This work |
| CdS-NCS | 350W Xe lamp($\lambda \geq 420\text{nm}$) | Na ₂ S/Na ₂ SO ₃ | 6.86 mmol h ⁻¹ g ⁻¹ | [1] |
| CdS@WO ₃ /CoP | 5W LED ($\lambda \geq 420\text{nm}$) | lactic acid | 14.73 mmol h ⁻¹ g ⁻¹ | [2] |
| TiO ₂ /CdS | 350W Xe lamp($\lambda \geq 420\text{nm}$) | methanol | 2.32 mmol h ⁻¹ g ⁻¹ | [3] |
| CdS/VC | 300W Xe lamp($\lambda \geq 420\text{nm}$) | lactic acid | 14.2 mmol h ⁻¹ g ⁻¹ | [4] |
| CMo/CdS | 300W Xe lamp($\lambda \geq 420\text{nm}$) | lactic acid | 12.38 mmol h ⁻¹ g ⁻¹ | [5] |
| Co ₉ S ₈ /CdS | 300W Xe lamp($\lambda \geq 420\text{nm}$) | Na ₂ S/Na ₂ SO ₃ | 5.15 mmol h ⁻¹ g ⁻¹ | [6] |
| CdS/Sn | 300W Xe lamp($\lambda \geq 420\text{nm}$) | glycerol | 1.61 mmol h ⁻¹ g ⁻¹ | [7] |
| P-MoS ₂ /CdS | 300W Xe lamp($\lambda \geq 420\text{nm}$) | Na ₂ S/Na ₂ SO ₃ | 5.89 mmol h ⁻¹ g ⁻¹ | [8] |
| CdS/PI | 300W Xe lamp($\lambda \geq 420\text{nm}$) | lactic acid | 0.613 mmol h ⁻¹ g ⁻¹ | [9] |
| CdS/MOF-5 | 300W Xe lamp($\lambda \geq 420\text{nm}$) | Na ₂ S/Na ₂ SO ₃ | 11.62 mmol h ⁻¹ g ⁻¹ | [10] |

References:

- [1] Wei Zhong, Ying Huang, Xuefei Wang, Jijie Fan, Huogen Yu. Colloidal CdS and CdZnS nanocrystal photocatalysts with massive S²⁻-adsorption: one-step facile synthesis and highly efficient H₂-evolution performance. *Chemical Communications*. 2020, 56, 9316-9319.
- [2] Yupeng Zhang, Xuqiang Hao, Xiaoli Ma, Hai Liu, Zhiliang Jin. Special Z-scheme CdS@WO₃ hetero-junction modified with CoP for efficient hydrogen evolution, *International Journal of*

- Hydrogen Energy. 2019, 44, 13232-13241.
- [3] Haonan Ge, Feiyan Xu, Bei Cheng, Jiaguo Yu, Wingkei Ho. S-Scheme Heterojunction TiO₂/CdS Nanocomposite Nanofiber as H₂-Production Photocatalyst. *ChemCatChem*. 2019, 11, 6301-6309.
- [4] Lei Tian, Shixiong Min, Fang Wang. Integrating noble-metal-free metallic vanadium carbide cocatalyst with CdS for efficient visible-light-driven photocatalytic H₂ evolution. *Applied Catalysis B: Environmental*. 2019, 259, 118029.
- [5] Chang Feng, Zhuoyuan Chen, Jian Hou, Jiarun Li, Xiangbo Li, Likun Xu, Mingxian Sun, Rongchang Zeng. Effectively enhanced photocatalytic hydrogen production performance of one-pot synthesized MoS₂ clusters/CdS nanorod heterojunction material under visible light. *Chemical Engineering Journal*. 2018, 345, 404-413.
- [6] Pengfei Tan, Yi Liu, Anquan Zhu, Weixuan Zeng, Hao Cui, Jun Pan. Rational design of Z-scheme system based on 3D hierarchical CdS supported 0D Co₉S₈ nanoparticles for superior photocatalytic H₂ generation. *ACS Sustainable Chemistry & Engineering*. 2018, 6, 10385-10394.
- [7] Xianglin Xiang, Bicheng Zhu, Bei Cheng, Jiaguo Yu, Hongjin Lv. Enhanced Photocatalytic H₂-Production Activity of CdS Quantum Dots Using Sn²⁺ as Cocatalyst under Visible Light Irradiation. *Small*, 2020, 16, 2001024.
- [8] Jixiang Xu, Xuemei Yan, Yinhong Qi, Yunlei Fu, Chao Wang, Lei Wang. Novel phosphidated MoS₂ nanosheets modified CdS semiconductor for an efficient photocatalytic H₂ evolution. *Chemical Engineering Journal*. 2019, 375, 122053.
- [9] Yue Hu, Xuqiang Hao, Zhiwei Cui, Jun Zhou, Siqi Cu, Ying Wang, Zhigang Zou. Enhanced photocarrier separation in conjugated polymer engineered CdS for direct Z-scheme photocatalytic hydrogen evolution. *Applied Catalysis B: Environmental*. 2020, 260, 118131.
- [10] Xuqiang Hao, Zhiwei Cui, Jun Zhou, Yicong Wang, Yue Hu, Ying Wang, Zhigang Zou. Architecture of high efficient zinc vacancy mediated Z-scheme photocatalyst from metal-organic frameworks. *Nano Energy*. 2018, 52, 105-116.