

# Noble metal-free Metal Sulphides as Highly Efficient Visible Light Driven Photocatalysts for H<sub>2</sub> Production from H<sub>2</sub>S

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## Abstract

Hydrogen sulfide is an extremely toxic gas which is generated from both nature and human factors. Recently, photocatalytic splitting of H<sub>2</sub>S into H<sub>2</sub> and S has attracted great attention because hydrogen production and H<sub>2</sub>S removal are simultaneously achieved. However, the deactivation of the photocatalysts and lack of suitable setup for photocleavage of H<sub>2</sub>S to H<sub>2</sub> limit its wide application. Herein, we constructed a complete setup for H<sub>2</sub> production from H<sub>2</sub>S. This setup has some functions including H<sub>2</sub>S absorption, decomposition and product recovery. Simultaneously, a series of MnS/In<sub>2</sub>S<sub>3</sub> composites were successfully fabricated by a solvothermal method. A maximum H<sub>2</sub> production rate of 8360 μmol g<sup>-1</sup> h<sup>-1</sup> can be achieved over MnS/In<sub>2</sub>S<sub>3</sub>\_0.7 catalyst, and the corresponding QE of this sample is as high as 34.2% at 450 nm even in the absence of any noble-metal co-catalysts. Importantly, MnS/In<sub>2</sub>S<sub>3</sub> composite displays a good stability and also anti-photocorrosion. Additionally, in order to further enhance visible-light photocatalytic H<sub>2</sub> production activity of MnS/In<sub>2</sub>S<sub>3</sub>, MnS/In<sub>2</sub>S<sub>3</sub>/CuS composites were prepared through solvothermal treatment. And a maximum H<sub>2</sub> production rate of 29252 μmol g<sup>-1</sup> h<sup>-1</sup> can be achieved over a MnS/In<sub>2</sub>S<sub>3</sub>/CuS with optimized composition, which is 3.5 times higher than that of MnS/In<sub>2</sub>S<sub>3</sub>\_0.7, and this reveals that the addition of CuS can effectively increase the photocatalytic activity for splitting H<sub>2</sub>S into H<sub>2</sub>. All in all, suitable setup for photocatalytic splitting of H<sub>2</sub>S and noble-metal free metal sulphides photocatalysts have great significance for photocleavage of H<sub>2</sub>S to H<sub>2</sub>.

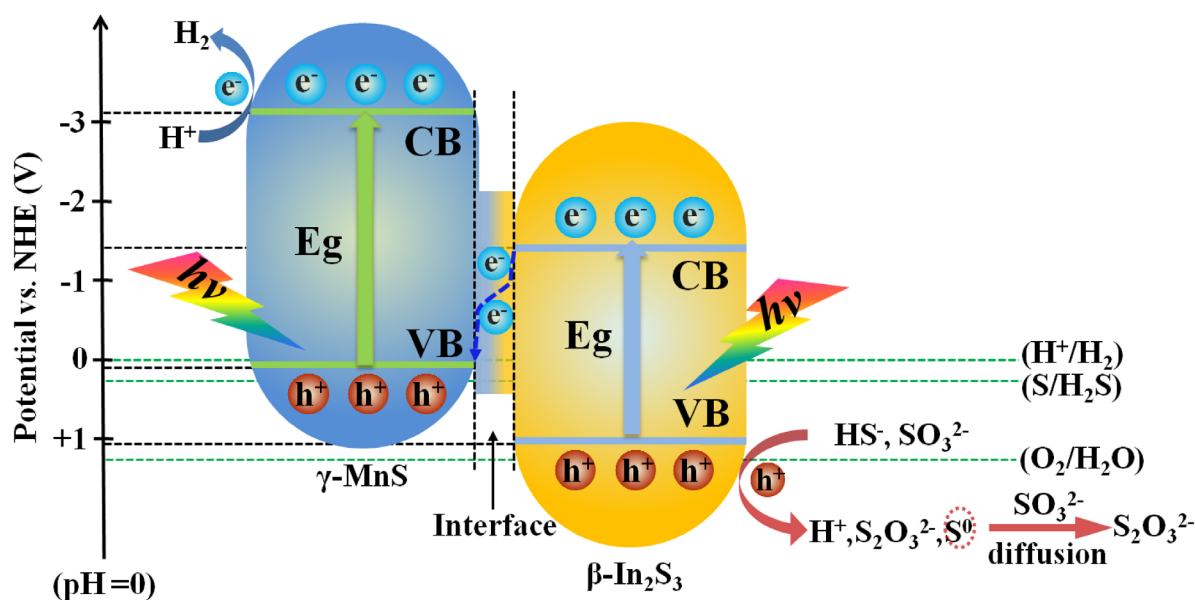


Figure 1. Photocatalytic process of splitting H<sub>2</sub>S in 0.6 M Na<sub>2</sub>SO<sub>3</sub>/0.1 M Na<sub>2</sub>S/3 M H<sub>2</sub>S solution.

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