Architecting Novel Metal Sulfide Photocatalysts for Highly Efficient Resource Utilization of H_2S

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Abstract: Hydrogen sulfide (H_2S), owing to the extremely toxic, malodorous and corrosive nature, is a huge obstacle for the exploitation of acid oil and gas reservoirs. Therefore, resource utilization of H_2S has become a hotspot research in recent years. Among them, the photocatalytic splitting of H_2S into H_2 and S has attracted great attention because H_2 production and H_2S removal are simultaneously achieved. However, the deactivation of the photocatalysts and lack of suitable setup for photocleavage of H_2S to H_2 limit its wide application. Herein, we constructed a complete setup for H_2 production from H_2S. Simultaneously, a series of metal sulphide composites have been successfully designed and prepared by a simple solvothermal method. Among them, the novel MnS/In_2S_3 composites show a high photocatalytic activity for H_2 production from H_2S under the visible-light irradiation. A maximum H_2 production rate of 8360 μmol g^{-1} h^{-1} can be achieved over MnS/In_2S_3_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. Additionally, the "narrow-narrow band gap" metal sulphide composites (In_2S_3/CuS) was also prepared, and then the photocatalytic performance was studied by splitting H_2S to produce H_2, for the first time. The result demonstrated that the as-obtain In_2S_3/CuS composite possess a superior visible-light photocatalytic activity (14950 μmol g^{-1} h^{-1}) and long-term durability in H_2S splitting. In order to further enhance visible-light photocatalytic H_2 production activity. The novel $MnS/(In_xCu_{1-x})_2S_3$ composites were sucessfully constructed. And a maximum H_2 production rate of 29252 μmol g^{-1} h^{-1} can be achieved over a $MnS/(In_xCu_{1-x})_2S_3$ with optimized composition, and the corresponding QE of this sample is as high as 62.6 % at 450 nm even in the absence of any noble-metal co-catalysts. All in all, the construction of H_2S decomposition setup and selection of metal sulphides photocatalysts as photocatalysts to the resource utilization of H_2S is of vital importance and practical signifcance.

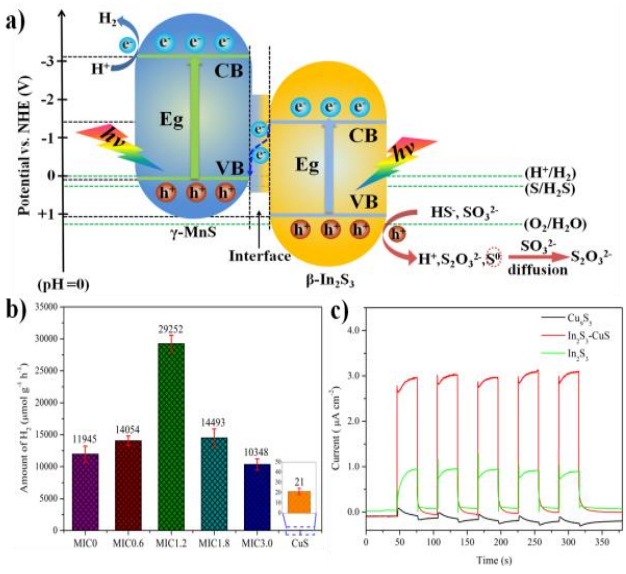

Fig.1 a) Schematic diagram of the MnS/In_2S_3 photocatalytic system; b) H_2 evolution rate over $MnS/(In_xCu_{1-x})_2S_3$ composites: c) Transient Photocurrent of In_2S_3/CuS composite under the visible-light irradiation.

References

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