

Enhanced Photocatalytic H₂ Production from H₂S on Metal Modified CdS-Zns Semiconductors

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Abstract : Photocatalytic H₂ production by H₂S decomposition is regarded to be an environmentally friendly process to produce carbon-free energy through direct solar energy conversion. For this purpose, sulphide-based materials, as photocatalysts, were widely used due to their excellent solar spectrum responses and high photocatalytic activity. The loading of proper co-catalysts that are based on cheap and earth-abundant materials on those semiconductors was shown to play an important role in the improvement of their efficiency. In this research, CdS-ZnS composite was studied because of its controllable band gap and excellent performance for H₂ evolution under visible light irradiation. The effects of the modification of this photocatalyst with different types of materials and the influence of the preparation parameters on its H₂ production activity were investigated. The CdS-ZnS composite with an enhanced photocatalytic activity for H₂ production was synthesized from ammine complexes. Two types of modification were used: compounds of Ni-group metals (NiS, PdS, and Pt) were applied as co-catalyst on the surface of CdS-ZnS semiconductor, while NiS, MnS, CoS, Ag₂S, and CuS were used as a dopant in the bulk of the catalyst. It was found that 0.1% of noble metals didn't remarkably influence the photocatalytic activity, while the modification with 0.5% of NiS was shown to be more efficient in the bulk than on the surface. The modification with other types of metals results in a decrease of the rate of H₂ production, while the co-doping seems to be more promising. The preparation parameters (such as the amount of ammonia to form the ammine complexes, the order of the preparation steps together with the hydrothermal treatment) were also found to highly influence the rate of H₂ production. SEM, EDS and DRS analyses were made to reveal the structure of the most efficient photocatalysts. Moreover, the detection of the conduction band electron on the surface of the catalyst was also investigated. The excellent photoactivity of the CdS-ZnS catalysts with and without modification encourages further investigations to enhance the hydrogen generation by optimization of the reaction conditions.

Keywords : H₂S, photoactivity, photocatalytic H₂ production, CdS-ZnS

Conference Title : ICHP 2020 : International Conference on Hydrogen Production

Conference Location : Amsterdam, Netherlands

Conference Dates : December 03-04, 2020