

Pd修饰对Cd_{0.8}Zn_{0.2}S/SiO₂光催化甘油水溶液制氢性能的影响

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Effect of Pd-modification on photocatalytic H₂ evolution over Cd_{0.8}Zn_{0.2}S/SiO₂ for glycerol

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摘要 用等体积浸渍法制备了不同Pd负载量的Pd/Cd_{0.8}Zn_{0.2}S/SiO₂光催化材料,采用XRD、H₂-TPR、XPS、UV-vis DRS催化反应评价等方法对光催化材料的表面结构、光吸收性能以及光催化甘油水溶液制氢反应性能进行了考察。研究结果表明与CdS在SiO₂表面形成了Cd_{0.8}Zn_{0.2}S固溶体,金属Pd负载未对固溶体Cd_{0.8}Zn_{0.2}S/SiO₂的结构造成影响;金属Pd修饰明显提高了原固溶体的光响应性能,拓展了其吸光域,增强了吸光效率。金属Pd修饰后,Cd_{0.8}Zn_{0.2}S/SiO₂的光解甘油水溶液产氢速率显著提高,Pd负载量为0.5%的Pd/Cd_{0.8}Zn_{0.2}S/SiO₂具有最佳的光催化甘油水溶液制氢性能,其在紫外光照射下的氢气生成速率为831 μmol/h,较未负载时提高了近四倍;模拟太阳光下为153 μmol/h,较未负载时提高了近两倍。

关键词: Pd修饰 Cd_{0.8}Zn_{0.2}S固溶体 光催化 甘油水溶液 制氢

Abstract: A series of Pd/Cd_{0.8}Zn_{0.2}S/SiO₂ photocatalysts were prepared by incipient wet impregnation. The photocatalysts were characterized by XRD, H₂-TPR, XPS, and UV-vis DRS and used in the photocatalytic evolution of H₂ from glycerol and water mixture; the effects of Pd loading on the surface structure, photo absorption and H₂ evolution rate were investigated. The results showed that the chemical interaction between ZnS and CdS results in the formation of Cd_{0.8}Zn_{0.2}S solid solution on the surface of SiO₂; after the modification with Pd, the light absorption region of Cd_{0.8}Zn_{0.2}S/SiO₂ is expanded and the photo absorption efficiency is enhanced obviously. The loading of Pd exhibits significant influence on the rate of photocatalytic H₂ evolution; over 0.5%Pd/Cd_{0.8}Zn_{0.2}S/SiO₂ with a Pd loading of 0.5%, the maximum hydrogen production rate under UV light irradiation and under solar-simulated light irradiation reach 831 μmol · h⁻¹ and 153 μmol · h⁻¹ respectively, which are almost 4 times and 2 times higher than those obtained over unmodified Cd_{0.8}Zn_{0.2}S/SiO₂ under UV and solar-simulated light irradiation, respectively. The superior photocatalytic performance of Pd/Cd_{0.8}Zn_{0.2}S/SiO₂ can be partly related with the improvement of photo absorption, the enhancement in chemisorption and activation of H₂O and the increase in separation efficiency of photo-induced electron-hole arising from the Pd modification.

Key words: Pd-modified Cd_{0.8}Zn_{0.2}S solid solution photocatalysis glycerol solution H₂ production

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