

Enhancing Photocatalytic Hydrogen Production Modification of TiO₂ by coupling with CdS Nanoparticles

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Abstract : Photocatalytic water splitting to produce hydrogen (H₂) has obtained significant attention as an environmentally friendly technology. This process, which produces hydrogen from water and sunlight, represents a renewable energy source. Titanium dioxide (TiO₂) plays a critical role in photocatalytic hydrogen production due to its chemical stability, availability, and low cost. Nevertheless, TiO₂'s wide band gap (3.2 eV) limits its visible light absorption and might affect the effectiveness of the photocatalytic. Coupling TiO₂ with other semiconductors is a strategy that can enhance TiO₂ by narrowing its band gap and improving visible light absorption. This paper studies the modification of TiO₂ by coupling it with another semiconductor such as CdS nanoparticles using a reflux reactor and to form a core-shell structure. Characterization techniques, including TEM and UV-Vis spectroscopy, confirmed successful coating of TiO₂ on CdS core, reduction of the band gap from 3.28 eV to 3.1 eV, and enhanced light absorption in the visible region. These modifications are attributed to the heterojunction structure between TiO₂ and CdS. The essential goal of this study is to improve TiO₂ for use in photocatalytic water splitting to enhance hydrogen production. The core-shell TiO₂@CdS nanoparticles exhibited promising results, due to band gap narrowing and improved light absorption. Future work will involve adding Pt as a co-catalyst, which is known to increase surface reaction activity by enhancing proton adsorption. Evaluation of the TiO₂@CdS@Pt catalyst will include performance assessments and hydrogen productivity tests, considering factors such as effective shapes and material ratios. Optimizing photoreactor design for efficient photon delivery and illumination will further enhance the photocatalytic process. These strategies collectively aim to overcome current challenges and improve the efficiency of hydrogen production via photocatalysis.

Keywords : photocatalysis, water splitting, hydrogen production, heterojunction photocatalysts, band gap, nanoparticles

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