Enhanced Photocatalytic Hydrogen Production of Fe₂O₃ Decorated TiO₂ Nanorods: Optimization of Hydrothermal Temperature

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We developed a nanocomposite of Fe₂O₃ and TiO₂ nanorods (NRs) as a photocatalyst in a photoelectrochemical hydrogen production system through two steps hydrothermal technique. The influence of hydrothermal temperature (100, 120, 150, 180, and 200°C) was investigated on the physicochemical and photoelectrochemical properties and solar hydrogen production of all photocatalysts by various characterization techniques. At low temperatures, nanorods grow irregularly with low concentration due to the insufficient heat however the samples completely peeled off and nanorods were not detected on the glass substrate at temperature 200°C. The photocatalyst with the hydrothermal temperature of 150 °C produced the maximum amount of hydrogen (171.6 mmolcm⁻²) under visible light with external potential of 0.7 V in 1M KOH and 5 vol.% methanol solution. Electron Impedance spectroscopy (EIS) results show that this photocatalyst had a reduction in charge transfer resistance and charge carrier recombination rate due to small inner surface area with low reaction sites. Also, its Mott–Schottky data revealed a more negative flat band potential of -0.9 V with profound ability of proton (H⁺) reduction to H₂ and a high donor density of 8.45 × 10²⁰ cm⁻³ with a great photocurrent density.

Keyword: Fe₂O₃; TiO₂ Nanorod; Hydrogen; Heterostructure; Photoelectrochemical cell

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