TRANSITION METAL CHALCOGENIDE EMBEDDED TiO_2 NANOCOMPOSITES FOR HYDROGEN PRODUCTION AND PHOTO DEGRADATION OVER EXTENDED SOLAR IRRADIATION

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ABSTRACT

Systematic choice of a material with desired properties is vital for a particular application. In this regard, transition metal chalcogenide semiconductor nanostructures have gained attention due to their highly anisotropic diverse morphologies, stronger edge and quantum confinement effect. This work mainly focuses on the synthesis of cobalt disulfide (CoS_2) embedded titanium dioxide (TiO_2) nanocomposite and tin disulfide (SnS_2) embedded TiO_2 nanocomposite, and their application towards hydrogen production through water splitting and degradation of aquatic pollutants. Hydrothermal approach was utilized to synthesize CoS_2, SnS_2, TiO_2, and the CoS_2/TiO_2, SnS_2/TiO_2 nanocomposites. The photocatalytic activity of these materials was examined under extended solar irradiation. The CoS_2 embedded TiO_2 nanocomposite and SnS_2 embedded TiO_2 nanocomposite were found to be the most effective catalyst on both hydrogen productions with the rate of 2.55 mmol g^{-1} and 0.195 mmol g^{-1}, respectively, and photocatalytic degradation of methylene blue with pseudo first order rate constant of 5.110×10^{-4} s^{-1}. and 4.415×10^{-4} s^{-1}. The result from this study unveils that the metal dichalcogenides act as an effective co-catalyst and TiO_2 serves as an active site by effectively separating the photogenerated electron-hole pair. Overall, this study lays down a new approach to develop transition metal dichalcogenide embedded TiO_2 nanocomposites with significant bandgaps that can effectively harness solar energy against both pollutant degradation and hydrogen production.

Keywords: Hydrogen, water splitting, transition metalchalcogenides, TiO_2, degradation

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