Abstract

The present thesis, entitled “Synthesis, Characterization and Performance Analysis of Reduced Graphene Oxide Based Photocatalysts for Hydrogen Generation from Water’’ deals with efficient solar green hydrogen generation from photocatalytic water splitting using reduced Graphene Oxide (rGO) and transition metal-based powder like photocatalyst and organic alginate hydrogel encapsulated three-dimensional spherical bead like photocatalyst. The major barriers in the process of photocatalytic water splitting are slow reaction kinetics, rapid recombination of photogenerated electrons and holes, low hydrogen yield, photo-corrosion of semi-conductors, metal aggregation and metal loss, low water retention capacity of the photocatalysts. In order to address these challenges different strategies are adopted here : (a) use of rGO as an excellent electron transporter along with transition metal based nanohybrid photo-catalyst namely rGO-CdS, rGO-ZnO (b) exploration of rGO- ZnO(1:3)-WO_3 Type II heterojunction (c) exploration of Z scheme photo-catalytic system CdS-rGO-WO_3 comprising of hydrogen evolution photocatalyst CdS (HEP) and oxygen evolution photocatalyst WO_3 (OEP), having solid state mediator (rGO) involving two step photoexcitation. Forming rGO-ZnO (1:3)-WO_3 heterojunction elevates the activity to 13.2 mmol g^{-1} h^{-1} and utilization of Z scheme improves the activity of CdS-rGO-WO_3 (11.6 mmol g^{-1} h^{-1}), compared to pristine counterparts. Strategy of encapsulation of powder photocatalyst inside the nano-cage of organic alginate hydrogel resulting in 3D spherical bead like catalysts is adopted, allowing higher retention capacity of water; enhanced adsorption of confined-water improves the hydrophilicity of the core photocatalyst, remarkably enhancing the photocatalytic activity (up to 81.8 mmol g^{-1} h^{-1} (CdS-rGO-WO_3-alginate) and 90.6 mmol g^{-1} h^{-1} (ZnO-rGO-WO_3-alginate)) as well as apparent quantum efficiency. Further, inlet flow rate invariant continuous hydrogen generation is achieved using encapsulated bead like photocatalyst which implies that each bead of photocatalyst acts as a miniaturized photoreactor. Therefore, the thesis proposes environment friendly, recyclable, low cost, highly efficient alginate encapsulated rGO based heterojunction photocatalyst for enhanced continuous hydrogen generation.