INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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SHORT ABSTRACT

This thesis deals with improvement in photocatalytic efficiency of perovskite oxide photocatalysts by modulating their electronic structure and charge transport. Different oxidation states of the constituent elements and crystal phases of perovskite oxides have been examined. We have found significant enhancement in photocatalytic activity by doping different metal ions into perovskite oxide lattice and employing electron-transporting materials. Ru doping in the 'B' site of $LaMnO_3$ modify the crystal structure and electronic properties of $LaMnO_3$ and due to the lowest band gap and optimal presence of 80% cubic and 20% rhombohedral phase, $LaMn_{0.7}Ru_{0.3}O_3$ shows the highest efficiency in O_2 production (at a rate of 4.73 mmol/h/g, with ~7.5% of apparent quantum yield (AQY)) and methyl orange (MO) dye degradation among all synthesized $LaMn_{1-x}Ru_xO_3$ (x = 0.0 – 0.4) compounds. In another work, we have doped Sr in the 'A' site of $LaMnO_3$. As $La_{0.7}Sr_{0.3}MnO_3$ photocatalyst has lowest resistivity among all $La_{1-x}Sr_xMnO_3$ (x = 0.0 – 0.5) photocatalysts, it gives highest amount of O_2 evolution from water oxidation (3.398 mmol/h/g, AQY ~ 7.2%). A blending of graphene oxide (GO) with $La_{1-x}Sr_xMnO_3$ (x = 0.0 – 0.5) shows further enhancement in photocatalytic oxygen evolution from water due to the good charge carrier transport property of GO and $La_{0.7}Sr_{0.3}MnO_3$ – GO shows highest photocatalytic activity in oxygen production at a rate of 3.707 mmol/h/g with ~ 8% of AQY. The effects of Ce doping, oxygen vacancies and structural disordered states in efficient hydrogen production of $BaZr_{1-x}Ce_xO_3$ (x = 0.0 – 0.04) have been studied. In this study, $BaZr_{0.97}Ce_{0.03}O_3$ shows the highest efficiency (823 µmol/h/g, AQY ~ 6%) in photocatalytic H_2 production among all five synthesized samples. In another approach, the effect of carbon dots (CDs), presence of oxygen vacancies and structural disordered states on the photocatalytic properties of hydrothermally synthesized $BaZrO_{3-\delta}$ (BZO) hollow nanospheres in photocatalytic H_2 evolution and methylene blue (MB) dye degradation have been studied. In this study, 3 wt% CD_BZO (3C_BZO) shows the highest efficiency in photocatalytic H_2 production (670 µmol/h/g, AQY ~ 4%) and dye degradation among all five synthesized samples with a different loading percentage of CDs. The synergistic effect of enhancement of light absorption along with high photogenerated charge carrier transfer efficiency in the presence of CDs and the presence of oxygen vacancies are the reasons behind the enhanced photocatalytic efficacy of x wt. % CDs_BZO (x = 0 – 4) under UV-visible light.