Study of Dual Bed System for Photocatalytic Water Splitting Reaction

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The dual bed system combines an efficient hydrogen producing photocatalyst with an oxygen producing photocatalyst by an electron shuttling redox couple. For electron shuttling redox couple, the soluble redox ion pairs are employed such as Sn^{4+}/Sn^{2+}, I^-/IO_3^- or Fe^{2+}/Fe^{3+}. For oxygen producing photocatalyst, WO_3 and $BiVO_4$ are employed and WO_3 did not evolve oxygen with Sn^{4+}/Sn^{2+} redox couple as the conduction band of WO_3 was more positive than the reduction potential of Sn^{4+}/Sn^{2+} redox. For hydrogen producing photocatalyst, Rh doped $SrTiO_3$ was employed and the more negative redox potential was, the more amounts of hydrogen were produced. As the potential of valence band of Rh doped $SrTiO_3$ is more positive than the potential of oxidation of water, hydrogen producing reaction was inhibited by the small amounts of electron acceptors. For ideal operation of dual bed system, the valence band of hydrogen producing photocatalyst must be more negative than oxidation potential of water and the conduction band of oxygen producing photocatalyst must be more negative than reduction potential of redox couple.