



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: **Engineering Metal Oxides for (Photo)Electrochemical Oxygen Evolution/Hydrogen Evolution Reactions**

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SHORT ABSTRACT

The present thesis discussed the design of *insitu* grown metal oxides/hydroxide for (photo)electrochemical oxygen evolution reaction (OER) and hydrogen evolution reaction (HER). Herein, low cost, efficient and stable metal oxide and hydroxide such as WO_3 , Fe_2O_3 , $\text{FeO}(\text{OH})$ and $\text{FeVO}(\text{OH})$ are employed as model system to study their (photo)electrocatalytic properties. Different strategies like morphological modification, co-catalyst modification, elemental doping, and heterojunction strategies are employed to enhance the water splitting performance. The fabrication of catalyst directly onto substrate (carbon paper/ Fluorine doped tin oxide) is emphasized in this thesis.

Chapter 1 demonstrates the basic technique of (photo)electrochemical water splitting to meet global energy demands and environmental crises. The present chapter also describes the working principle of (photo)electrochemical water splitting in different electrolytic conditions. **Chapter 2** discusses the comprehensive synthetic protocols of the metal oxides/hydroxide and the co-catalysts, which were employed to show (photo)electrochemical water splitting.

In **chapter 3**, we have proposed vanadium doping and co-modification of $\alpha\text{-Fe}_2\text{O}_3$ utilizing NiFe LDH for noble metal-free electrocatalytic oxygen evolution reaction (OER), which exceeds the performance of benchmark RuO_2 under similar experimental conditions. In **chapter 4**, we have fabricated a binder-free $\text{FeO}(\text{OH})\text{-CoCeV}$ -layered triple hydroxide (LTH) bifunctional catalyst, in which the nanograin-shaped $\text{FeO}(\text{OH})$ coupled with CoCeV -LTH nanoflakes provide more electro catalytically active sites and enhanced the overall water splitting. In **chapter 5**, multi-metallic electrocatalyst $\text{FeVO}(\text{OH})/\text{Ni}_{0.86}\text{Mo}_{0.07}\text{W}_{0.07}(\text{OH})_2$ aiming at tuning the electronic structure is fabricated, giving a huge improvement in water splitting reaction kinetics. **Chapter 6** describes the design of surface reactive and noble metal-free VS_2 nanoflowers onto in situ grown WO_3 photoanode as a heterojunction strategy for efficient charge separation. Lastly, **chapter 7** include the thesis overview.