INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study : **Ph.D.**

Thesis Title: **DESIGN STRATEGIES USING TRANSITION METAL-BASED OXIDES FOR WATER ELECTROLYSIS**

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Thesis Submitted to the Department/ Center : **CHEMISTRY**

Date of completion of Thesis Viva-Voce Exam : **25-02-2023**

Key words for description of Thesis Work : **Oxygen Evolution Reaction; Overall Water Splitting; Water dissociation; Bipolar Membranes; Electrochemical**

SHORT ABSTRACT

My PhD research primarily focused on the different strategies and methodologies employed for the development of an efficient electrocatalyst for enhanced water splitting and dissociation performances. The semiconductor materials (electrocatalysts) were mainly synthesized using solvothermal, solid-state and/or electrodeposition methods. The working electrodes were fabricated by Doctor-blade method over FTO substrates and utilized for electrochemical purposes in alkaline electrolytic medium. The ion-exchange membranes were synthesized via wet-chemical route and bipolar membrane was fabricated using the blade-casting method over glass slides and utilized for the water dissociation process.

The chosen electrocatalysts for water splitting were noble metal free transition metal-based oxides due to their redox phenomenon. For perovskite molecule, $LaMnO_3$, Sr^{2+} was doped to enhance the bulk conductivity. Different morphologies were ascribed to LSMO via transcription methodology where morphological MnO_x were utilized as template during the solid-state reaction to increase the surface-active sites for the electrocatalyst. In another work, Mn_2O_3-CuO (n-p type) heterojunction was synthesized for overall water splitting, Kirkendall effect was considered for the difference in the diffusion coefficients of Mn and Cu ions causing morphological transformation and increased surface area, and 2D material was utilized as overlayer for higher water adsorption and surface reaction kinetics. Mn_2CuO_4 was also synthesized owing to the redox cycle of Mn and Cu stabilizing the compound during the water splitting reaction and was overlayered with nickel borate to enhance the charge transfer at electrolyte interface.

For practicality of electrochemical water splitting, ion-exchange membranes were utilized separating the cathodic and anodic chambers. Bipolar membranes were fabricated with PVA fused V_20_5-ns as the catalyst for water dissociation reaction providing H^+ and OH^- ions for reduction and oxidation at cathode and anode generation H_2 and O_2 gases, respectively.