INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Surendra Singh Gaur
Roll Number	:	156107017
Programme of Study	:	Ph.D.
Thesis Title:		Studies on Biopolymer based Solid Electrolyte Membrane and Electro-catalysts for Direct Methanol Fuel Cells
Name of Thesis Supervisor(s)	:	Prof. Vimal Katiyar and Dr. Amit Kumar
Thesis Submitted to the Department/ Center	:	Chemical Engineering
Date of completion of Thesis Viva-Voce Exam	:	May 24, 2021
Key words for description of Thesis Work	:	Direct methanol fuel cell, polymer electrolyte membrane, electrocatalyst, ion transport, MD simulation

SHORT ABSTRACT

Direct methanol fuel cell (DMFC) has been viewed as one of the emerging technologies and it can play vital role in future for cleaner and greener energy conversion. In DMFCs methanol is used as fuel, which can be produced from agricultural waste and other waste biomass, making it a sustainable source of energy. At the same time DMFC only produces CO_2 as byproduct, maintaining the carbon cycle without increasing the carbon footprint. Existing problems of high methanol crossover, slower reaction kinetics, high cost of electro-catalyst and solid electrolyte materials and catalyst poisoning in acidic type of DMFCs have made researchers to focus on its alternatives. Alkaline type DMFCs have shown to be best alternative of it by addressing several of these issues. Possibility to utilize low cost non-noble metal catalyst, low corrosive environment, faster electrochemical reaction kinetics, lower methanol permeation, lower flooding problem and less impact of poisoning species on electrocatalysts are the major advantages of the alkaline type DMFCs. But use of synthetic polymers as electrolyte and unstable nature of electroctalysts have been the major roadblocks for commercialization of alkaline type DMFCs. The current thesis work is focused on bringing sustainability along with addressing the issues of stability of electrolyte and electrocatalyst material utilized in alkaline DMFCs. Low-cost materials from bio-wastes/

bio-resources such as cellulose and human hair have been synthesized and their application as suitable ion-conductive material with equivalent performance to commercial synthetic polymeric membranes has been demonstrated. How these bio-based materials work as ion conductive source has also been investigated and possible mechanism of ion transfer has been proposed by MD-simulation studies. Fabrication of stable and low-cost anode and cathode electrocatalysts using bio-based materials and their successful demonstration in alkaline DMFC application has been carried out. As an overall, in the current thesis a different set of materials have been developed to make already deemed green fuel cell technology cheaper, greener and sustainable.