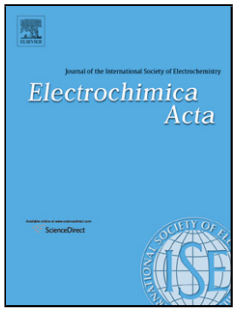

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Author: Ranoo Pathak Suddhasatwa Basu

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Mathematical Modeling and Experimental Verification of Direct Glucose Anion Exchange Membrane Fuel Cell

Ranoo Pathak and Suddhasatwa Basu

Department of Chemical Engineering,

Indian Institute of Technology Delhi, New Delhi 110016

Abstract

A mathematical model for anode and cathode together with anion exchange membrane (AEM) is developed to predict the performance of AEM based direct glucose fuel cell (DGFC). The model considers the mass transport of glucose through the anode, AEM and oxygen transport through cathode, together with reaction kinetics and ohmic resistance effects of the catalyst layer and AEM electrolyte. Dusty fluid model from literature is used for prediction of hydroxyl ions conductivity in AEM. Experiments were conducted with prepared Pt-Bi/C anode, Pt/C cathode and AEM (Fuma-Tech) as electrolyte to operate an AEM based DGFC and measure current density-cell potential characteristics. The model predicts well the experimental data and that available in literature. The influence of different parameters and operating conditions such as anionic conductivity, catalyst surface area, glucose concentration, KOH concentration on DGFC performance is investigated. The results show that increase in anionic conductivity of ionomer phase, glucose and KOH concentration within certain limit, increases the DGFC performance. Diffusive and convective transport of glucose within the catalyst layer equally dominates at low current density, but only convective transport of glucose dominates at higher current density. The anodic overpotential is large compared to cathodic and ohmic overpotentials due to complex kinetics of the glucose electro-oxidation. The excessive increase in specific surface area of catalyst may not lead to decrease in activation overpotential or increase in DGFC performance in the region of limited glucose flux in the catalyst layer.

Keywords: alkaline fuel cell, glucose fuel cell, fuel cell modeling, overpotentials

*corresponding author, e-mail: sbasu@iitd.ac.in; tel 91 11 26591035; Fax 91 11 26581120