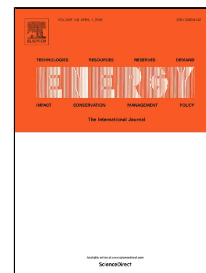


Accepted Manuscript

Thermal and Electrochemical Performance Assessment of a High Temperature PEM Electrolyzer

S. Toghyani, E. Afshari, E. Baniyadi, S.A. Atyabi, G.F. Naterer



PII: S0360-5442(18)30549-8
DOI: 10.1016/j.energy.2018.03.140
Reference: EGY 12598
To appear in: *Energy*
Received Date: 31 August 2017
Revised Date: 20 March 2018
Accepted Date: 24 March 2018

Please cite this article as: S. Toghyani, E. Afshari, E. Baniyadi, S.A. Atyabi, G.F. Naterer, Thermal and Electrochemical Performance Assessment of a High Temperature PEM Electrolyzer, *Energy* (2018), doi: 10.1016/j.energy.2018.03.140

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Thermal and Electrochemical Performance Assessment of a High Temperature PEM Electrolyzer

S. Toghyani¹, E. Afshari¹, E. Baniasadi^{1*}, S. A. Atyabi¹, G. F. Naterer²

¹*Department of Mechanical Engineering, Faculty of Engineering, University of Isfahan, Hezar Jerib Ave., Isfahan, Iran, Postal Code 81746-73441*

²*Department of Mechanical Engineering, Memorial University, 240 Prince Phillip Drive, St. John's, Newfoundland, A1B 3X5, Canada*

*Email: e.baniasadi@eng.ui.ac.ir

Abstract

In this paper, detailed effects of operating conditions and design parameters including temperature, pressure, gas diffusion layer (GDL) thickness, membrane thickness and GDL porosity on the performance of a high temperature proton exchange membrane electrolyzer cell (PEMEC) are studied. A CFD analysis is carried out using a finite volume method based on a fully three-dimensional model. The model is verified against experimental data and the realistic effects of varying operating conditions are considered. The results indicate that decrease of operating temperature from 403 K to 373 K results in reduction of hydrogen concentration at the membrane-catalyst interface from 2.2×10^{-4} to 1.9×10^{-4} mol/m³. The temperature and hydrogen concentration under rib area of channel are relatively higher due to the accumulation of water under this area that leads to higher electrochemical rate. An increase of GDL thickness from 0.2 mm to 0.5 mm at a voltage of 1.65 V leads to reduction of current density from 0.426 A/cm² to 0.409 A/cm². The porosity of the GDL has no significant effect on the polarization curve. The current density of the PEMEC for a membrane thickness of 50 μ m at voltage of 1.6 V is 48% higher than a membrane thickness of 200 μ m.

Keywords: Proton exchange membrane electrolyzer; Three-dimensional model; CFD simulation; High temperature electrolysis; Membrane; Gas diffusion layer

1. Introduction

There is a rising global demand for renewable and clean energy resources as an alternative to fossil fuels. Renewable energy resources such as solar and wind energy are expected to increasingly

Download English Version:

<https://daneshyari.com/en/article/8071661>

Download Persian Version:

<https://daneshyari.com/article/8071661>

[Daneshyari.com](https://daneshyari.com)