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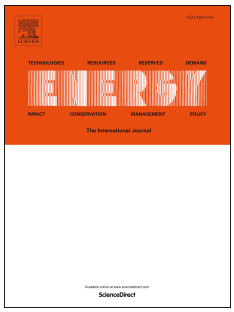

Asymptotic analysis of anode relative humidity effects on the fastest voltage decay single cell in a stack

Yongfeng Liu, Na Wang, Pucheng Pei, Shengzhuo Yao, Fang Wang

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Asymptotic analysis of anode relative humidity effects on the fastest voltage decay single cell in a stack[1]

LIU Yongfeng[a] WANG Na[a] PEI Pucheng[b] YAO Shengzhuo[a] WANG Fang[a]
(a. Beijing Key Laboratory of Performance Guarantee on Urban Rail Transit Vehicles, School of Machine-electricity and vehicle Engineering, Beijing University of Civil Engineering and Architecture, Beijing 100044 China;
b. State Key Laboratory of Automotive Safety and Energy, Tsinghua University, Beijing 100084 China)

Abstract: An anode relative humidity (ARH) model is set up to analyze the effects of anode relative humidity on the fastest voltage decay single cell in a stack. In the ARH model, the saturation pressure related to relative humidity is established by anode pressure drop instead of using conventional empirical equation in Fluent model. First, a three dimensional (3D) model incorporating geometry and grids is established. Second, experiment is conducted including a 10-cell stack, single cell distribution and test schematic. Third, both experiment and simulation results are discussed in detail. Furthermore, for the fastest voltage decay single cell, a comparable analysis among ARH model, Fluent model and experiment is carried out at the different anode relative humidities (55%, 70%, 85% and 100%). The results show that FC10 (the furthest distance single cell from gas inlet) voltage decay is the fastest in the stack. ARH model applied to FC10 voltage decay shows good agreement with Fluent model and experiment. ARH model accuracy increases by 47% compared to Fluent model. And the error between ARH model and experiment is reduced to 3% at 350 mA/cm^2 for 100% anode relative humidity. FC10 species molar concentration distributions inside fuel cell in each case are non-uniform.

Key words: PEM fuel cell; anode relative humidity; voltage decay; simulation

Introduction

A series of environmental problems like air pollution, global warming and haze have aroused great interest from the public to utilize clean energy. The proton exchange membrane (PEM) fuel cell as a clean energy device has a lot of advantages such as high energy conversion efficiency (up to 85% theoretically), noiseless performance, environment friendly, starting fast at low temperature and high energy density. However, voltage decay of PEM fuel cell continues to be a barrier that impedes PEM fuel cell performance improvement. The fastest voltage decay single cell is responsible for improving the stack performance to some extent because the stack is comprised of connected series of single cells and its performance depends on

[1] Corresponding author.
E-mail: pchpei@tsinghua.edu.cn (Pucheng PEI)