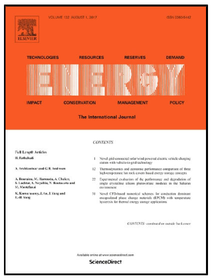
Accepted Manuscript



Modeling and analysis of short-period transient response of a single, planar, anode supported, solid oxide fuel cell during load variations

Marko Nerat

PII:	S0360-5442(17)31316-6
DOI:	10.1016/j.energy.2017.07.133
Reference:	EGY 11321
To appear in:	*Energy*
Received Date:	07 April 2017
Revised Date:	19 June 2017
Accepted Date:	20 July 2017

Please cite this article as: Marko Nerat, Modeling and analysis of short-period transient response of a single, planar, anode supported, solid oxide fuel cell during load variations, *Energy* (2017), doi: 10.1016/j.energy.2017.07.133

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.

ACCEPTED MANUSCRIPT

Modeling and analysis of short-period transient response of a single, planar, anode supported, solid oxide fuel cell during load variations

Marko Nerat*

Jožef Stefan Institute (JSI), Jamova 39, SI−1000, Ljubljana, Slovenia

*Corresponding author: Tel.: +38614773714, fax: +38614773994, e-mail: marko.nerat@ijs.si

Abstract: The main motivation for this study was to analyze transient responses of a solid oxide fuel cell (SOFC) during load variations, which can possibly cause fuel starvation within porous anode active layer and, consequently, accelerate the degradation rate of the SOFC. Simulation approach was taken into consideration. For this purpose, three-dimensional (3-D) dynamic model of a single, planar, anode supported SOFC was built. The model is also briefly presented in this paper. The paper focuses on detailed transient analysis of current density (J), power density (P), fuel utilization (FU) and electrical conversion efficiency (η) after a step change of voltage (load). The simulation results also give us valuable data about local mass fractions of fuel species that cannot be measured in realistic devices. It is shown that fuel starvation occurs when the J (load) is increased by approximately 100% and FU is above 0.85 at final value of J (when steady state is assumed). Moreover, the time-dependent profile of FU give us guideline for setting appropriate inlet flow rate of fuel to prevent fuel starvation. The results show that a SOFC with very thin (d_s = 0.1 mm) porous anode support layer is prone to fuel starvation during large load variation. Using a thicker porous anode support layer (d_s = 0.5 mm) is proposed to avoid fuel starvation and, consequently, mitigate the degradation of a realistic SOFC. The P and η of modeled SOFC are also analyzed during large load variations. The η increases with increasing the d_s from 0.1 mm to 1.0 mm. The results indicate the improvement of η by appropriate design and control of a realistic SOFC.

Download English Version:

https://daneshyari.com/en/article/5475533

Download Persian Version:

https://daneshyari.com/article/5475533

Daneshyari.com