



NRC·CNRC

## NRC Publications Archive Archives des publications du CNRC

**Numerical and experimental analysis of a solid oxide fuel cell stack**  
Beale, S. B.; Le, A. D.; Roth, H. K.; Pharaoh, J. G.; Choi, H.-W.; de Haart, L. G. J.; Froning, D.

This publication could be one of several versions: author's original, accepted manuscript or the publisher's version. / La version de cette publication peut être l'une des suivantes : la version prépublication de l'auteur, la version acceptée du manuscrit ou la version de l'éditeur.

For the publisher's version, please access the DOI link below./ Pour consulter la version de l'éditeur, utilisez le lien DOI ci-dessous.

**Publisher's version / Version de l'éditeur:**

<https://doi.org/10.1149/1.3570074>

*ECS Transactions, 35, 1, pp. 935-943, 2011-01-12*

**NRC Publications Record / Notice d'Archives des publications de CNRC:**

<https://nrc-publications.canada.ca/eng/view/object/?id=99df4783-c918-4c1e-9a3d-9bb6d46fb7a5>

<https://publications-cnrc.canada.ca/fra/voir/objet?id=99df4783-c918-4c1e-9a3d-9bb6d46fb7a5>

Access and use of this website and the material on it are subject to the Terms and Conditions set forth at

<https://nrc-publications.canada.ca/eng/copyright>

READ THESE TERMS AND CONDITIONS CAREFULLY BEFORE USING THIS WEBSITE.

L'accès à ce site Web et l'utilisation de son contenu sont assujettis aux conditions présentées dans le site

<https://publications-cnrc.canada.ca/fra/droits>

LISEZ CES CONDITIONS ATTENTIVEMENT AVANT D'UTILISER CE SITE WEB.

**Questions?** Contact the NRC Publications Archive team at

PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca. If you wish to email the authors directly, please see the first page of the publication for their contact information.

**Vous avez des questions?** Nous pouvons vous aider. Pour communiquer directement avec un auteur, consultez la première page de la revue dans laquelle son article a été publié afin de trouver ses coordonnées. Si vous n'arrivez pas à les repérer, communiquez avec nous à PublicationsArchive-ArchivesPublications@nrc-cnrc.gc.ca.



National Research  
Council Canada

Conseil national de  
recherches Canada

Canada

Numerical and experimental analysis of a Solid Oxide  
Fuel Cell stack

*A.D. Le<sup>1</sup>, S.B. Beale<sup>1</sup>, J.G. Pharoah<sup>2</sup>, H.W. Choi<sup>2</sup>, L.G.J.  
de Haar<sup>3</sup>, D. Froning<sup>3</sup>,*

<sup>1</sup> National Research Council, Montreal Road,  
Ottawa, ON K1A 0R6, Canada

<sup>2</sup> Queen's-RMC Fuel Cell Research Centre,  
Queen's University, Kingston, ON K7L 3N6, Canada

<sup>3</sup> Institute of Energy and Climate Research,  
Forschungszentrum Juelich GmbH, 52425 Juelich,  
Germany

A numerical simulation of the Juelich F-design Solid Oxide Fuel Cells (SOFC) stack is investigated by using a three-dimensional computational fluid dynamics model coupling transport and electrochemistry developed based on the open source CFD package, OpenFoam. This work was supported by Multi-Scale Integrated Fuel Cell Model (MUSIC) program with the objective to develop a fully-integrated multi-scale fuel cell modeling capability, from micro-scale through to cell, stack, and 'hotbox' levels. It is intended to share the resulting software with other parties on an open source basis. In this study, the focus of the studies is presently on SOFCs. The governing equations describe the conservation of mass and momentum, species, mass and heat transports and electrochemical process. The stack configuration, flow condition, interconnector geometries and porous electrodes properties used in the numerical model are obtained from experiments. The numerical model predicts distributions of fluid flow, species concentrations, current density and temperature, indicating the effects of channel configuration and flow field passage on the temperature profile as its uniformity reduces the stress in the SOFC materials. The results of simulations are compared with experimental data for actual short stacks.