論　文　要　旨
Thesis Abstract

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※報告番号	乙第 89 号	氏　名 (Name)	Marcin Moździerz

主論文題名　（Title）

Multiscale modeling of Solid Oxide Fuel Cell stack

内容の要旨　（Abstract）

Solid oxide fuel cells (SOFCs) are one of the most promising energy conversion devices for the future. Among their advantages, there are: good scalability and high energy conversion efficiency in all scales, low emission of greenhouse gases, no emission of toxic substances, fuel flexibility and the possibility of use in combined heat and power systems. However, several issues slow down commercialization of SOFCs, such as thermal management problems. Moreover, the electrochemical processes in the solid oxide fuel cells are strongly dependent on the complex microstructure of the porous electrodes. To reveal these relations, mathematical modeling is an useful tool. Most of the published mathematical models of SOFCs are limited to micro- or macro-scale. Therefore, in this thesis, a novel multiscale model of SOFC, which combines a possibility to analyze mass and heat transfer in the single cell or the stack of solid oxide fuel cells with the detailed analysis of transport phenomena in the porous microstructure is proposed. The numerical model, built from the mathematical model, uses advanced numerical techniques to resolve the governing equations. To confirm the model validity, an unique set of experimental data from the electrochemical tests of the short stack was collected. The microstructure of the SOFC was obtained by the direct observation using the focused ion beam - scanning electron microscope (FIB-SEM) method. The model was adopted to the single cell simulation and the simulation of a new type of the SOFC stack. The discussion of the mechanism of the current generation in the SOFC is presented. The results show the relationship between the microstructure of the electrodes and cell performance, regarding the current production and the temperature rise. Furthermore, the analysis of the impact of various operation parameters on the stack performance was performed

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