Internal steam reforming in solid oxide fuel cells: Status and opportunities of kinetic studies and their impact on modelling

Internal steam reforming in solid oxide fuel cells (SOFC) systems with internal steam reforming have the potential to become an economically competitive technology for cogeneration power plants, exploiting its significantly higher electrical efficiency compared to existing technologies. Optimal design and operation of such a system require SOFC models that include accurate description of the steam reforming rate. The objective of this article is to review the reported kinetic expressions for the steam reforming reaction. Extensive work has been performed on traditional catalysts for steam reforming. Because of differences in operating conditions, catalyst support material and structure it is critical to transfer this knowledge directly to internal reforming in SOFCs, which is discussed in further detail in this article. There are big differences in the reported kinetic expression for steam reforming over both industrial Ni catalysts and SOFC anode materials. Surprisingly, there is a good agreement between measured rates pr. geometric anode area at high operating temperatures, even for very different anodes. Detailed experimental data on the intrinsic steam reforming kinetics of Ni-YSZ are necessary for micro structure SOFC modeling, such expression are however lacking, but it may be viable to use measurements on industrial steam reforming catalysts instead. Nevertheless there is a further need for experimental studies on determining the exact steam reforming kinetics for SOFC anodes.

General information
Publication status: Published
Organisations: CHEC Research Centre, Department of Chemical and Biochemical Engineering, Electroceramics, Fuel Cells and Solid State Chemistry Division, Risø National Laboratory for Sustainable Energy, Karlsruhe Institute of Technology, Haldor Topsoe AS
Contributors: Mogensen, D., Grunwaldt, J., Hendriksen, P. V., Dam-Johansen, K., Nielsen, J.
Pages: 25-38
Publication date: 2011
Peer-reviewed: Yes

Publication information
Journal: Journal of Power Sources
Volume: 196
Issue number: 1
ISSN (Print): 0378-7753
Ratings:
BFI (2011): BFI-level 1
Scopus rating (2011): CiteScore 5.13 SJR 2.227 SNIP 2.159
Web of Science (2011): Impact factor 4.951
ISI indexed (2011): ISI indexed yes
Web of Science (2011): Indexed yes
Original language: English
Keywords: Solid Oxide Fuel Cells, Fuel Cells and Hydrogen
DOIs:
10.1016/j.jpowsour.2010.06.091
Source: orbit
Source ID: 268193
Research output: Contribution to journal › Journal article – Annual report year: 2010 › Research › peer-review