Two-dimensional numerical study of solid oxide fuel cell with direct internal reforming

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In this work, a two-dimensional numerical model of a solid oxide fuel cell (SOFC) is presented by focusing on reactions and species distribution within cell. The SOFC is commonly operated at high temperature for some benefits, so it has a diversity of fuel. If direct internal reforming (DIR) using methane is used, it shows multi-species transport within the anode of SOFC and the endothermic reforming reaction could help keep the heat balance in the cell. To consider such phenomena in the cell, the velocity in porous medium was calculated by Darcy's Law, and the multi-species, energy and charge transport equations were numerically computed by taking into account chemical and electrochemical reactions. The detailed studies were performed under different load conditions to predict the performance of SOFC, and the results validated with reference data. The predicted results showed that the cell exhibited some temperature gradient at high current density, and these were compared with case of non-DIR SOFC.
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