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Experimental and numerical studies of micro PEM fuel cell

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Abstract A single micro proton exchange membrane fuel cell (PEMFC) has been produced using Micro-electro-mechanical systems (MEMS) technology with the active area of 2.5\,cm^{2} and channel depth of about 500 \mu m. A theoretical analysis is performed in this study for a novel MEMS-based design of a micro PEMFC. The model consists of the conservation equations of mass, momentum, species and electric current in a fully integrated finite-volume solver using the CFD-ACE+ commercial code. The polarization curves of simulation are well correlated with experimental data. Three-dimensional simulations are carried out to treat prediction and analysis of micro PEMFC temperature, current density and water distributions in two different fuel flow rates (15cm^{3}/min and 40cm^{3}/min). Simulation results show that temperature distribution within the micro PEMFC is affected by water distribution in the membrane and indicate that low and uniform temperature distribution in the membrane at low fuel flow rates leads to increased membrane water distribution and obtains superior micro PEMFC current density distribution under 0.4V operating voltage. Model predictions are well within those known for experimental mechanism phenomena.

Keywords：

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