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Numerical Study of Fluid Dynamics and Heat Transfer in a PEM Fuel Cell Stack

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ABSTRACT

In this research, a numerical study of fluid dynamics and heat transfer in the flow distributor of a PEM fuel cell is presented. The aim of this work is focused on studying the pressure drops and temperature variations presented by stacks with serpentine channels. Different fuel cells with flow fields of 1, 2 and 3 parallel channels; active areas of 5, 10 and 25 cm^2; and stacks with 2, 3 and 5 assemblies were evaluated. From simulation results, it was found that the use of parallel channels improves the gas distribution inside of the fuel cell, increasing of this way the utilization of fuel and oxidant. In addition, it was observed that the relationship between the channel width and the active area of the fuel cell is considered as an important factor in the design of the flow field. If this relationship is not taken into account, the pressure drops that occur in the flow channels will affect the overall performance of the stack. Moreover, based on the heat transfer study were identified the spots with more temperature variation in fuel cell. From the simulation results, different solutions are proposed to obtain a more uniform temperature distribution in the bipolar plates. These solutions include changes in the plates design, modifications on flow field and the way of supply the gases to the fuel cell.

Keywords: Fluid Dynamics; Heat Transfer; PEM Fuel Cell