Heat Pipe Assisted Thermal Management of an HT PEMFC Stack

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Abstract

Heat management is crucial for the satisfactory operation of high temperature PEM fuel cell cells. Current work investigates the use of heat pipes in a HT PEMFC stack consisting 24 cells, each with an active are of 300 cm². Heat pipes are known to be thermal superconductors operating on principles of efficient heat conductivity assisted by phase transition. They can transfer large amounts of heat at high speeds in both heating and cooling applications with a thermal conductivity in excess of 20,000 times the rate of a solid copper bar of same geometry. They are used extensively in the electronic industry. However, adapting them in fuel cell stacks to reject heat in order to maintain a desired temperature level comes with challenges. The thermal load a specific heat pipe can handle, amount of heat the same can transfer and the type (groove, mesh, etc.) are some of the factors to consider by choosing a suitable heat pipe. Commercially available groove type heat pipes were selected for these investigations. COMSOL Multiphysics based simulations were performed to analyze temperature profiles in transient mode during heating up of a 1 kWel HT PEMFC stack from room temperature to 160°C as well as cooling down from 160°C to room temperature. The equivalent model of the heat pipe developed with COMSOL Multiphysics was validated against the experimental results.

Figures used in the abstract

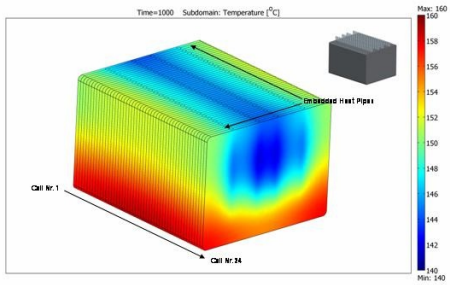

Figure 1: Fuel cell stack temperature distribution with heat pipe design.