

Passive Heat Exchanger for Proton Exchange Membrane Fuel Cell Cooling

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Abstract : Water produced during electrochemical reaction in Proton Exchange Membrane (PEM) fuel cell can be used for internal humidification of reactant gases; hydrogen and air. On such a way it is possible to eliminate expensive external humidifiers and simplify fuel cell balance-of-plant (BoP). When fuel cell operates at constant temperature (usually between 60 °C and 80 °C) relatively cold and dry ambient air heats up quickly upon entering channels which cause further drop in relative humidity (below 20%). Low relative humidity of reactant gases dries up polymer membrane and decrease its proton conductivity which results in fuel cell performance drop. It is possible to maintain such temperature profile throughout fuel cell cathode channel which will result in close to 100 % RH. In order to achieve this, passive heat exchanger was designed using commercial CFD software (ANSYS Fluent). Such passive heat exchanger (with variable surface area) is suitable for small scale PEM fuel cells. In this study, passive heat exchanger for single PEM fuel cell segment (with 20 x 1 cm active area) was developed. Results show close to 100 % RH of air throughout cathode channel with increased fuel cell performance (mainly improved polarization curve) and improved durability.

Keywords : PEM fuel cell, passive heat exchange, relative humidity, thermal management

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