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Simulation and Experimental Study of Bipolar Plates on The Performance in PEM Fuel Cell

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This research is a simulated and experimental study on effects of bipolar electrodes of a PEM fuel cell on its power conversion efficiency. The PEM fuel cell structure consists of bipolar electrodes, proton exchange membrane with catalysts, flow channels of gases. This research used fuel cell of 49 cm^2 in active area as a research sample and the Comsol 4.4 was employed to simulate flow channels which are serpentine pattern for anode and parallel pattern for cathode. The parameters used were channel height of 0.10, 0.15 and 0.20 cm, gas pressure of 0.5, 1.0 and 1.5 atmosphere and cell temperature of 50, 60 and 70 celsius and then calculated effects of such parameters using Comsol 4.4. After the calculation has been completed, the prototype of the PEM fuel cell were fabricated using graphite plate as electrodes which had the channel height of 0.20 cm, proton exchange membrane using carbon-platinum catalyst. Finally the prototype was tested under condition of 50 celsius in cell temperature and 1.0 atmosphere in gas pressure.

In part of calculation using Comsol 4.4, it showed that the PEM fuel cell comprising anode which has serpentine pattern as gas flow channel and anode which has parallel pattern of gas flow channel and operated under 70 celsius in temperature exhibited the highest power conversion efficiency since channel width is 0.30 cm, channel separation is 0.20 cm, radius of curvature is 0.40 cm for anode and for cathode, it has 8 channels, channel width is 0.50 cm, width of channel end is 0.30 cm, channel height is 0.20 cm. further it was found that the effect of temperature on the power conversion efficiency is not severely. And for anode, the concentration of hydrogen gas was reduced 64 w% due to the reaction whereas in parallel channel of cathode the oxygen concentration was reduced by only 6 w% from 23 w% at the entrance to 17 w% at the end. The maximum power output of the prototype operated under such condition was 0.28 W/cm^2 calculated from maximum power output voltage (Vmp) of 0.70 V and maximum power output current density of 0.42 A/cm^2 which was in good agreement with that simulated using Comsol 4.4 which revealed the power output of 0.29 W/cm^2.

Author: Mr CHINNASA , pornchai (Rajabhat Mahasarakham University)

Presenter: Mr CHINNASA , pornchai (Rajabhat Mahasarakham University)

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