

Kitipoom Tangwongpimook 2010: Simulation of Momentum, Heat, and Mass Transfer in a Proton Exchange Membrane Fuel Cell. Master of Engineering (Chemical Engineering), Major Field: Chemical Engineering, Department of Chemical Engineering. Thesis Advisor: Associate Professor Terdthai Vatanatham, Ph.D. 144 pages.

The non-isothermal two-dimensional simulation in GDL and membrane of proton exchange membrane fuel cell was investigated for studying gas phase transport characteristics. Assuming that the thickness of catalyst can be negligible, thus the geometry consists of gas diffusion layers at anode and cathode, and electrolyte membrane with catalyst layers as interface boundaries between GDL's and membrane. The simulation was carried out under steady state condition. The non-isothermal and compressible fluid was assumed. The problem was solved by FEMLAB 3.0a and simulated under finite element method. The variables and parameters were coupled and solved at the same time. The simulation results show that the current production rate is higher at the reaction surface behind the channel rib. The hydrogen concentration near the reaction surface is higher and varies inversely with the operating voltage while the oxygen concentration at the cathode reaction surface is lower and varies with the operating voltage. The high water concentrations near upper edge of the anode rib and the lower edge of cathode gas diffusion layers are observed. Near the reaction surface, the anode water concentration is lower but the cathode water concentration is higher. The temperature distribution in the gas diffusion layer is higher near the membrane behind the flow channel and the temperature at cathode is higher than at anode. From the study of polarization curve, the activation losses vary slightly with temperature while ohmic losses vary inversely with temperature. The polarization results show that the fuel cell performance is increased with the operating temperature. The increasing of operating pressure can improve the OCV due to high hydrogen and oxygen partial pressure in the fuel cell.

Student's signature

Thesis Advisor's signature