Abstract

Water and heat management are important issues in the design and analysis of proton exchange membrane fuel cell (PEMFC). In the present study, a computational fluid dynamic (CFD) code, CFDRC-ACE+, is used to simulate the hydrodynamic behavior of PEMFC. A single cell three dimensional model of PEMFC is built. The input values of physical and chemical parameters are determined based on the results of literature survey. The polarization curve as predicted in the present study is very closed to the experimental results and the simulated results in the related literatures . Sensitivity studies are preformed to identify the impact of major operating parameters on the polarization curve.

The results of sensitivity studies show that the water content of membrane near the channel entrance will be significant lower when dry air or pure oxygen is used in the cathode flow channel. To humidify the cathode gas flow can improve the performance of fuel cell in low current density (high voltage) portion of polarization curve. However, If has adverse effect in the high current density (low voltage) portion of polarization curve. The performance in the high current density portion is better when the gas flow in anode channel and cathode channel is in reversed direction. The performance of PEMFC can also significantly improved by increasing the pressure of cathode flow channel and by incorporating forced convection.

The condensation of water vapor in the flow channel and porous media is not considered in the present study. The CFDRC-ACE+ code has the capability to consider the phenomenon. However, the numerical scheme of the code is extremely unstable when the phenomenon is considered.