Assembly Mechanics and Its Effect on Performance of Proton Exchange Membrane Fuel Cell

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The safe operation and satisfactory cell performance of a proton exchange membrane fuel cell (PEMFC) depend on suitable assembly pressure. In order to obtain this, different assembly pressures and their effect on cell performance are investigated. The numerical simulation was employed to study the gas diffusion layer (GDL) deformation under different assembly pressures. The effect of assembly pressure on transportation parameters such as GDL porosity and permeability, and final influence on the performance of PEMFC, was studied to obtain optimal assembly pressure. The geometrical model of a single PEMFC channel was established. Parameters such as porosity and permeability of the GDL under different assembly pressures were calculated according to an empirical formula. Finite element analysis (FEA) was used to analyze the effect of different assembly pressures on GDL deformation. The results show that the GDL part under the bipolar plate ribs is deformed to different degrees under the compression of assembly pressure, and the degree of deformation increases as the assembly pressure increases, while the GDL part under the channel is almost not deformed. The distribution of the reactant species concentration in the single PEMFC channel and the polarization curves under different assembly pressures were computed and compared. Reactant species concentrations decrease in the flow direction under all assembly pressures for reaction in the catalyst layer. It is seen from the polarization curves that a fuel cell under an assembly pressure of between 0.5 and 1.0 MPa performs best.

Keywords: proton exchange membrane fuel cell (PEMFC), assembly mechanics, numerical simulation, gas diffusion layer (GDL), porosity

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