Abstract #130, 223rd ECS Meeting, © 2013 The Electrochemical Society

The Optimization Method of Gaskets for HTPEM Fuel cells

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Conventional PEM fuel cells require gaskets between each side of bipolar plate and membrane electrode assembly (MEA) to prevent leakage and to control the compression ratio of gas diffusion layer (GDL). These properties of gaskets have effects on the performance and long-term durability of fuel cell stack. For instance, loose clamping may cause sealing problems, while hard clamping may result in mass transport loss due to excessive compression of GDL. In case of high temperature PEM fuel cell, hard compression of stack may cause to squeeze MEA and increase loss of phosphoric acid within MEA. Thus, optimization of material properties of gaskets and clamping force are necessary to achieve higher performance and longer life-time of stacks.

In this study, Short stacks prepared with different gasket thickness and properties, and clamping pressure were evaluated through accelerated lifetime test. During accelerated lifetime test, cell behaviors were analyzed by electrochemical impedance spectroscopy (EIS). By comparing an equivalent circuit model, four resistance terms – ohmic resistance, proton resistance, charge transfer resistance and capacitance - were separated from EIS results. Figure 1 shows stress distributions which were measured with several combinations of different gaskets and clamping pressures. From the stress distribution measurements, the optimum gasket thickness and clamping pressure were determined. Correlation between compression pressure and lifetime of stack was evaluated through accelerated lifetime test. The voltage change of cells with compression condition is shown in Figure 2. EIS measurements were conducted to monitor electrochemical changes in each MEA during operation. Figure 3 shows changes in ohmic, charge transfer and proton transport resistances during lifetime test. By comparing and analyzing each term of resistances and cell test results, correlation between gasket properties and impedance component can be attained. In this study, transient voltage response of stack and experimental based simulation results will be discussed.

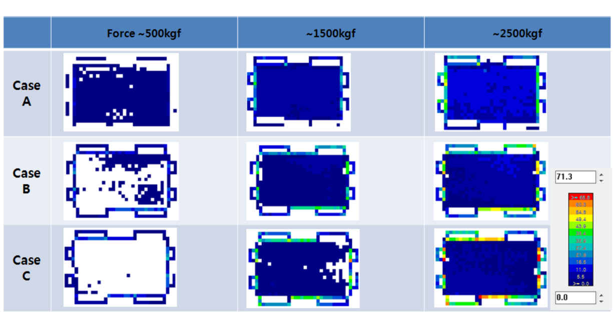

Figure 1. Stress distribution on MEA and gasket.

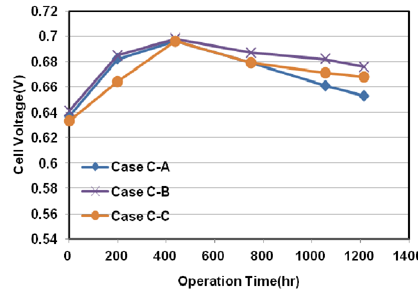

Figure 2. Voltage changes of cells with different compression conditions (Accelerated Lifetime test).

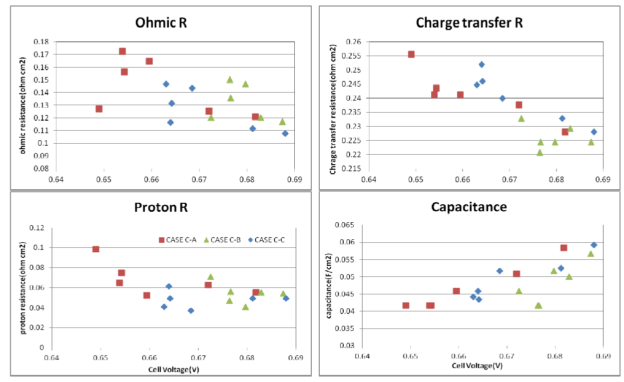

Figure 3. Ohmic resistance, proton resistance, charge transfer resistance and capacitance terms separated from EIS analysis.