

Performance Evaluation of a Fuel Cell Membrane Electrode Assembly Prepared from a Reinforced Proton Exchange Membrane

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Abstract : A fuel cell is a device that produces electric power by reacting fuel and oxidant electrochemically. There is no pollution produced from a fuel cell if hydrogen is employed as the fuel. Therefore, a fuel cell is considered as a zero emission device and is a source of green power. A membrane electrode assembly (MEA) is the key component of a fuel cell. It is, therefore, beneficial to develop MEAs with high performance. In this study, an MEA for proton exchange membrane fuel cell (PEMFC) was prepared from a 15-micron thick reinforced PEM. The active area of such MEA is 25 cm². Carbon supported platinum (Pt/C) was employed as the catalyst for both anode and cathode. The platinum loading is 0.6 mg/cm² based on the sum of anode and cathode. Commercially available carbon papers coated with a micro porous layer (MPL) serve as gas diffusion layers (GDLs). The original thickness of the GDL is 250 μm. It was compressed down to 163 μm when assembled into the single cell test fixture. Polarization curves were taken by using eight different test conditions. At our standard test condition (cell: 70 °C; anode: pure hydrogen, 100%RH, 1.2 stoic, ambient pressure; cathode: air, 100%RH, 3.0 stoic, ambient pressure), the cell current density is 1250 mA/cm² at 0.6 V, and 2400 mA/cm² at 0.4 V. At self-humidified condition and cell temperature of 55 °C, the cell current density is 1050 mA/cm² at 0.6 V, and 2250 mA/cm² at 0.4 V. Hydrogen crossover rate of the MEA is 0.0108 mL/min*cm² according to linear sweep voltammetry experiments. According to the MEA's Pt loading and the cyclic voltammetry experiments, the Pt electrochemical surface area is 60 m²/g. The ohmic part of the impedance spectroscopy results shows that the membrane resistance is about 60 mΩ*cm² when the MEA is operated at 0.6 V.

Keywords : fuel cell, membrane electrode assembly, proton exchange membrane, reinforced

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