Fabrication of Self-humidified Composite Membrane for PEMFC

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In PEMFC, ionic conductivity of the membrane based on perfluorosulfonic acid is easily influenced according to its humidification levels. Many trials have been performed to manage the water in this field. Attempts to introduce self-humidification to the fuel cell led to the introduction of a special membrane which was recast form soluble polymer electrolyte in the presence of SiO_2 or TiO_2.[1] In 1996, Watanabe et. al. impregnated Pt inside the membrane to fabricate the self-humidification membrane and some researchers modified this concept to increase humidification levels.[2] Another approach was to fabricate the microporous layer on the carbon paper or cloth.

This paper suggests the composite membrane consisted of Nafion and cloth-wick as a self-humidification membrane. The characterization of this composite membrane was performed with several techniques. The thickness and humidification level of the membrane were controllable with the kind of wick materials. Water can diffused from the outside to inside of MEA (membrane and electrode assembly) through the wick. In addition, it has an ability to store the produced water during the fuel cell operation. The maximum humidification level of the membrane is controlled by the water retention ability of the cloth-wick. This is located on near anode side unsymmetrically in order to prevent the water drain in anode side during the operation. Fig. 1 showed the I-V polarization curves according to the operation time at 60 °C cell temperature and in non-humidification condition. After hot-pressing the MEA, the pre-humidification did not performed, so the initiation OCV was below 0.1 V. However, when some water was supplied through the wick, the OCV increased about 0.98 V. The initial performance was saturated after 2 hours operation because the MEA was activated during the operation. Fig. 2 showed the I-V polarization curves in humidification and non-humidification conditions. There was little difference of these two conditions. It can conclude that the composite membrane can be used as a self-humidification membrane.

Reference

1. M. Watanabe, H. Uchida, M. Emori. *J. Electrochem. Soc.*, **145**, 1137 (1998).
2. M. Watanabe, H. Uchida, Y. Seki, M. Emori, P. Stonehart, *J. Electrochem. Soc.*, **143** , 3847 (1996).

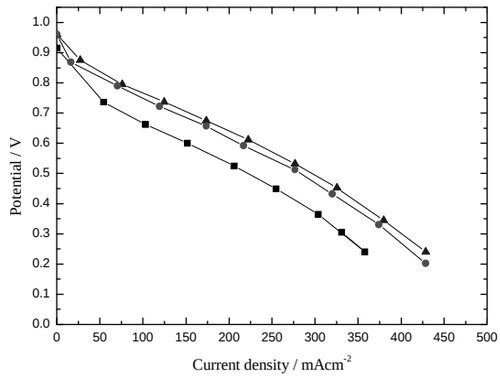

Fig. 1. I-V polarization curves according to the operation time. (60 °C, non-humidification conditioin)

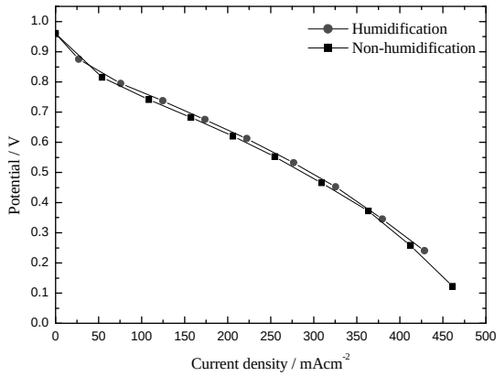

Fig. 2. I-V polarization curves according to the operation conditions.