O213 The Role of the Air Filter on the Water Transport in a Passive Direct Methanol Fuel Cell (DMFC)

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1 Introduction

In our passive DMFC, we have demonstrated that a DMFC with a novel electrode structure employing a porous carbon plate (PCP) to the anode could efficiently be operated using methanol at very high concentrations up to neat methanol [1,2]. We revealed that the passive DMFC with PCP was substantially operated as a vapor feed DMFC. We confirmed that, the vapor pressure of methanol affect the cell performance and the water transport in the cell, i.e., at very high partial pressure of methanol, the water was in deficient at the anode, and then, it reduced the cell performance [2]. Hence, in this study, we used the hydrophobic air filter at cathode chamber in order to improve the water management in the vapor feed passive DMFC. Different distance between cathode surface and air filter and also the air humidity were used to vary the water vapor at the cathode gas layer and then, the partial pressure of water was evaluated by a mass spectrometry technique [2]. The roles of air filter and the effects of distance to the atmospheric cathode gas layer and water transport were discussed on the basis of the cell performance.

2 Experimental

A Passive DMFC with a vapor feed methanol was used in this experiment either using or without the hydrophobic air filter at the cathode. Meanwhile, the distance between cathode surface and air filter was also varied by using different thickness of current collector, i.e., 1.5, 2.5, 3.5 and 6.0 mm. The cell was operated in the oven chamber at different condition of relative humidity (RH), i.e., 30%, 60% and 90%. MEA with catalyst loading was 7 to 8 mgcm^{-2} in each electrode was prepared and fabricated in the same manner as described in our previous reports [1, 2]. The passive DMFC with PCP was operated at a constant cell voltage by injecting a neat methanol solution into the reservoir. A 300 ml.min^{-1} of air was supplied at the cathode chamber using micro air pump in order to collect the water exhausted from the cathode. Otherwise, the mass spectrometer's capillary probe was located in the cathode gas layer and the water partial pressure was measured during cell operation. The methanol and water crossover, MCO and WCO, respectively, through MEA were also evaluated.

3 Results and Discussion

Figure 1(a) shows the profile of water partial pressure at the cathode gas layer, cathode gas inlet and outlet during cell operation using mass spectrometry technique. It was clear, that the water vapor pressure at the cathode gas layer was significantly depended on the distance. Meanwhile, Fig. 1(b) shows the effect of the distance on the water transport and the cell performance at RH 30%. From the figure, with the increasing of distance between cathode surface and air filter, the water exhausted from the cathode outlet and the MCO decreased while the WCO negatively increased with this distance. The operation using such a high methanol concentration used in this experiment required a water supply to maximize the activity of anode reaction. Hence, it was suggested that the air filter was necessary to reduce the water losses from the cathode. Otherwise, the proper distance between cathode surface and air filter was also important to increase the water back diffusion from the cathode to the anode and directly enhance the performance of passive DMFC.

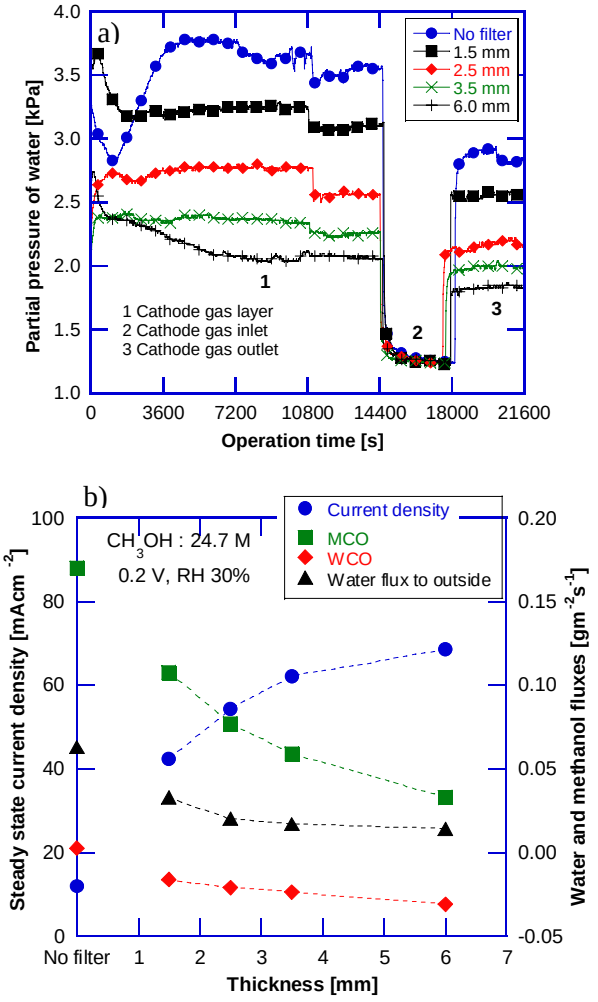

Fig. 1 Comparison of cell operation at different distance between cathode surface and air filter at RH 30%; a) Profile of water partial pressure; b) Current density, WCO, MCO and water flux to outside

References

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