A Novel Passive-DMFC Available with Conc. Methanol

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We have proposed a novel type of DMFC that is passively operated by using porous carbon plate as support. The novel DMFC has anode/electrolyte/cathode layers on the surface of the porous carbon plate as shown in Figure 1. The porous carbon plate sucks methanol solution into it and simultaneously plays roles of backing plate of the anode and current corrector. This is expected as another type of passive DMFC that provides high specific electrode area and is suitable for small fuel cells. We have proved the concept by showing that a test cell with a porous carbon plate actually was operated by sucking methanol solution by the osmotic action and breathing air by diffusion[1,2]. At the same time, we found this DMFC showed superior performances at high concentrations unusual to the conventional operating conditions. In this study, the effect of the methanol concentration on the cell performance for the novel DMFC was investigated in detail.

EXPERIMENT

A porous carbon plate (10 x 25 x 2 mm) supplied from Mitsubishi Pencil Co., LTD was used as the support. On one of the surfaces, catalyst ink containing Pt-Ru/C catalyst was applied, and then it was used as the anode. An electrode with carbon paper with Pt/C was used as the cathode. Nafion 112 and 117 were used as the electrolyte membrane. The MEA were fabricated by sandwiching the membrane between the porous carbon plate of the anode and the carbon paper of the cathode and hot pressing them. The MEA with a porous carbon support was set on a plastic holder, as shown in Figure 2, which had a methanol tank and fixed with a cover of a plate with a window for air breathing by using the rubber sheets for sealing. Using Pt wire connected to the Pt mesh sheeted under the carbon support and Pt felt pressed on the cathode surface through the window as terminals, measurement of the cell performance was carried out.

RESULTS AND DISCUSSION

Figure 3 shows the typical result of the i-V performances obtained with different methanol concentrations. It was shown that the performance increased with increasing the concentration of methanol and reached maximum at 17M (50mol%) that correspond to the stoichiometric ratio of the ideal anode reaction. For the conventional DMFCs, a maximum performance is usually obtained at rather low concentrations between 1M and 3M because of the methanol crossover. This result suggests that a mechanism to control the methanol crossover is concealed there. Vaporization of methanol at the anodic catalyst layer may be related to the reduction of the methanol crossover[3]. Possible mechanism for the mass transport including the methanol crossover at the porous carbon support will be discussed.

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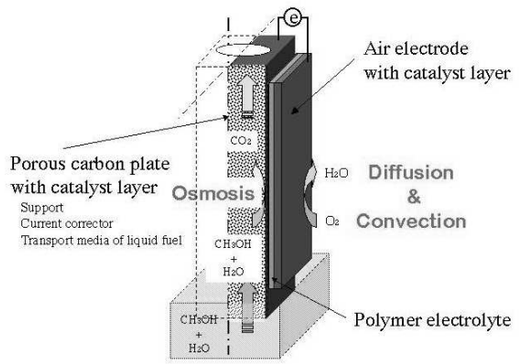

Figure 1 Concept of spontaneous power generation for the DMFC with porous carbon plate as support

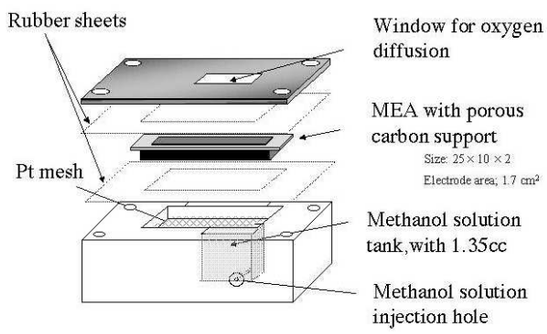

Figure 2 Test cell prepared for the performance measurement of the spontaneous DMFC with porous carbon plate as support

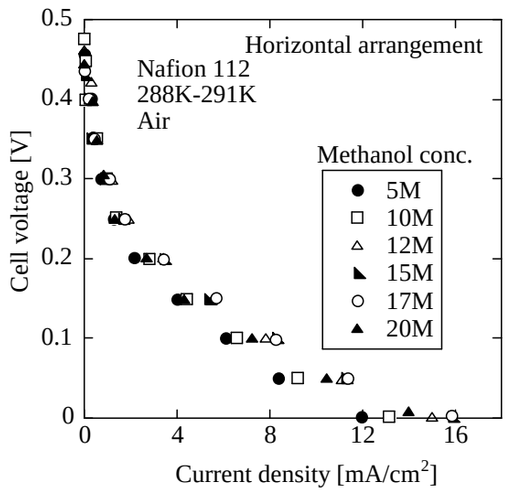

Figure 3 Effect of methanol concentration on the i-V performance of the test cell for the spontaneous DMFC with porous carbon plate as support