

**PERFORMANCE OF LIQUID-FEED
DIRECT METHANOL FUEL CELL
AT ROOM TEMPERATURE**

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The Direct Methanol Fuel Cell (DMFC) is a very attractive power source for portable applications because of the specific advantages over hydrogen-based fuel cell systems. A liquid-feed proton exchange membrane fuel cell would help to alleviate some of the issues surrounding fuel storage and processing for fuel cells in automobile and portable applications. However, the power density and efficiency are significantly lower than those of a hydrogen-based PEMFC system. We evaluate the performance of the liquid-feed DMFC system under the conditions close simulating actual use for mobile applications.¹⁾

The catalysts for the anode and cathode were Pt-Ru/C and Pt/C (Tanaka Precious Metals), respectively. Both the anode Pt-Ru loading and the cathode Pt loading were 2.0 mg/cm². The membrane electrode assembly (MEA) was prepared by hot-pressing the electrodes onto a Nafion117 membrane (DuPont) at 398 K with 10 MPa for 2 min. The effective area of the electrodes was 6.25 cm². The methanol solution of various concentrations (0.5 - 3 mol/L) was fed into the anode at a flow rate of 0.1 - 10 mL/min. Oxygen was fed to the cathode at 150 mL/min without humidification.

Figure 1 shows the cell performance at 300 K and that at 353 K for comparison. The methanol flow rate was varied from 0.1 to 10 mL/min. The performance of the DMFC system dropped at 300 K for all flow rates in comparison with 353K. The lower flow rate showed a slightly better performance. At 353 K, both the open circuit voltage and the current density at 0.4V decreased with increasing flow rate. Although a similar tendency was observed at 300 K, the dependence of the methanol flow rate on the DMFC performance was small because of the low temperature.

Figure 2 shows the cell performance at 300 K at different methanol concentrations with the flow rate of 0.1 mL/min. The open circuit voltage decreased with increasing the methanol concentration to 3 mol/L, because the crossover of methanol formed a mixed potential. In case of the methanol concentration of 1.5 mol/L, The current density seemed to approach a limiting value due to a mass transport limitation. Typical Cole-Cole plots of anode impedance are shown in Fig. 3 as the result of the constant current AC impedance measurement at 300 K. The low-frequency arc of the Cole-Cole plots due to the mass transfer resistance became larger with increasing the methanol concentration.

1)K. Okajima, M. Suetake, K. Furukawa and M. Sudoh
Electrochemistry, **74** 186 (2002).

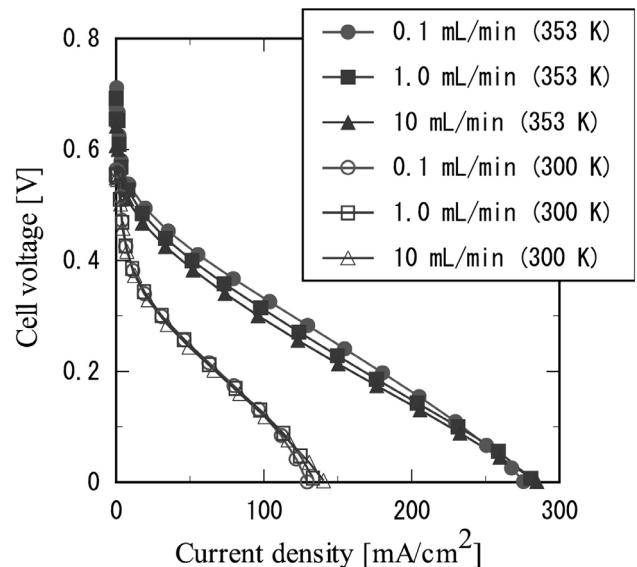


Fig. 1 Effect of temperature and methanol flow rate on I-V curves of liquid-feed DMFC system with methanol solution concentration of 1.5 mol/L.

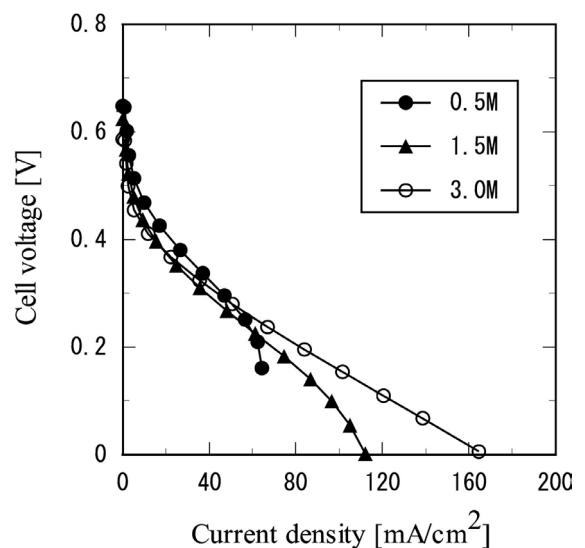


Fig. 2 Effect of methanol concentration on I-V curves of liquid-feed DMFC system, Temp.: 300 K, Flow rate: 0.1 mL/min.

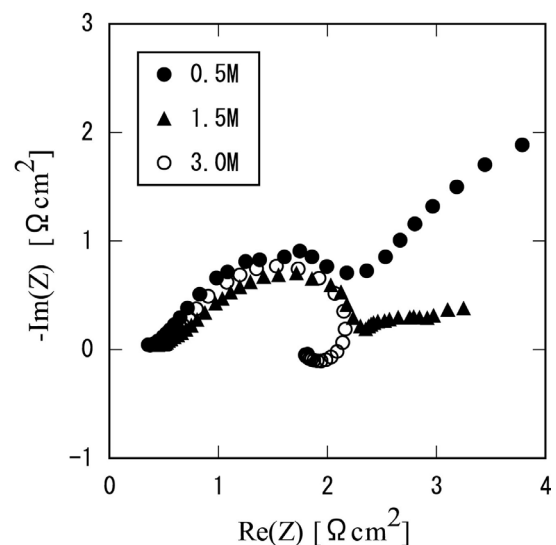


Fig. 3 Effect of methanol concentration on Cole-Cole plots of DMFC anode impedance, Temp.: 300 K, Flow rate: 0.1 mL/min, Bias current: 40 mA/cm².