The effect of water permeability of AEMs on AMFC performance

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Introduction

The alkaline Membrane Fuel Cell (AMFC) uses anion conductive polymers as the alkaline electrolyte and has emerged as an alternative to proton exchange membrane fuel cells (PEMFC)[1-3]. The high pH value in its electrolyte allows to use non-precious metal catalysts or non-platinum catalysts[1]. Its lower activation overpotential, especially for the oxygen reduction reaction (ORR) in the cathode has been pointed out[2], and good catalytic activities of such type of catalysts have been shown [4,5]. However, several major issues have been pointed out which significantly hinder the development and practical application of AMFCs. One is rapid CO_2 absorption into alkaline membranes[6]. It was reported existence of CO_2 in the air largely lowered the AMFC performance at 50°C[6]. Another is lower limitation in the operating temperature for MEAs due to the insufficient thermal stability of alkaline membrane and ionomers.
As other feature of AMFC, it had been pointed out that AMFC might make water management issue easier compared to PEMFC. It is because AMFC generates water at anode and the direction of electro-osmosis is opposite, cathode to anode. However, AMFC consumes water for oxygen reduction reaction (ORR) at cathode.
So far, it had been shown that water required for ORR was mainly supplied from anode side by measurement of net water flux across AEM[XX]. Therefore, it has to be taken into account how to supply sufficient amount of water to cathode for AMFC`s water management.
AEM is one of the key components of MEA which might affect the water behavior within operating AMFC. It is worth to study the effect of AEMs on AMFC performance.
Tokuyama Corp, Japan, has been developing alkaline membranes and ionomers for AMFC. In this study, the effect of AEM`s permeability on AMFC performance was studied with different types of developing materials.

Experimental

All membrane-electrode assemblies (MEAs) used in this study were made with anion exchange membranes and ionomers as catalyst layer binder. They are all developing materials made by Tokuyama Corp. For testing AMFC performance, hydrogen for anode, oxygen or air for cathode are used.

Results and Discussion

Several AEMs with different water permeability were tested using same catalyst layer and GDLs. Fig.1 shows the polarization curves in the case of one of the highest permeable AEMs within current developing materials of Tokuyama under different humidity of cathode. Under 100%RH of cathode at 50°C, AMFC performance was quite poor. However, it was recovered when dry gas was fed to cathode. According to their Tafel-plots, under 100%RH of cathode, there existed quite large transport loss and lowering cathode humidity seemed to mitigate it.

In the meeting, other AEMs` characteristics and AMFC testing results will be shown and the relation between permeability and transport loss is going to be discussed.

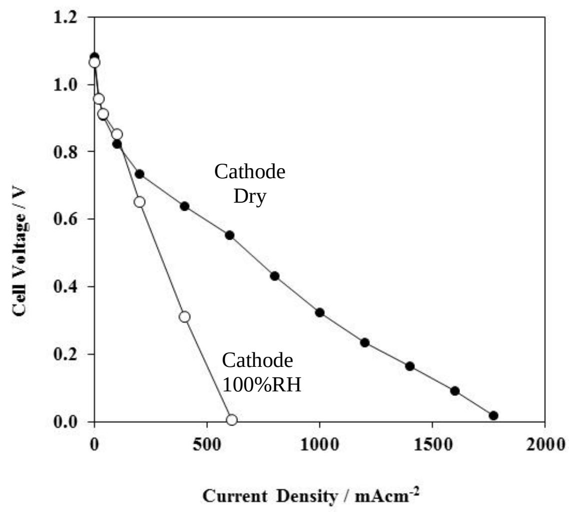

Figure 1. AMFC polarization curves at 50 °C
Anode feed: fully humidified H_2 200mLmin^{-1}, Cathode feed: fully humidified or dry O_2 200mLmin^{-1}

References

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