Impact of Cathode Fabrication on MEA Performance

Toshihiro Tanuma and Shinji Kinoshita
Asahi Glass Co., Ltd., Research Center
1150 Hazawa-cho, Kanagawa-ku, Yokohama-shi,
Kanagawa 221-8755, Japan

We reported (1, 2) that the MEA employing a hydrophilic microporous layer (MPL) for the cathode GDL (Ca-GDL) exhibits much better performance than that employing a conventional hydrophobic MPL, especially under low humidity conditions. When operating an MEA, it usually needs to be humidified in order to maintain conductivity of the membrane. However, operation without humidification is critical to the commercialization of PEFCs for backup power and automotive applications. We, therefore, evaluated MEAs at 60 ºC, at the H_2/air stoichiometric ratio of 1.4/5.0, without humidification, in addition to the normal conditions of 80 ºC, 100 & 30 %RH.

First, we investigated the impact of cathode fabrication on MEA performance. Table 1 shows the composition of the MEAs using three differently fabricated cathodes and a decal-transferred anode. There is no significant difference in performance among the three MEAs under the wet condition of 100%RH as indicated in Fig.1. Under a very dry condition, however, the MEA employing a GDE method exhibited much better performance than others as shown in Fig.2, especially at low current densities. We think that the interface between the cathode and the MPL plays a crucial role in the MEA performance under the dry condition.

Next, we examined the effect of the solid content of the cathode ink on MEA performance. Cathode GDEs were prepared by using three (solid contents: 6, 10, and 14 wt%) cathode catalyst inks. Although no significant difference was observed at 80 ºC, 30%RH as shown in Fig.3, Fig. 4 indicates that the MEA performance deteriorates when catalyst inks of lower solid content were used for the GDE fabrication. SEM/EDX analysis of the GDEs showed that the lower solid content, the smaller ionomer/catalyst ratio in the catalyst layer.

Table 1 MEAs prepared by different processes

MEA No.	Cathode	Anode
MEA-1	Gas diffusion electrode	Decal transfer to the membrane
MEA-2	Direct coating to a membrane	↑
MEA-3	Decal transfer to a membrane	↑

cathode GDL: inhouse GDL with a hydrophilic MPL
anode GDL: commercially available GDL with a hydrophobic MPL
MEA fabrication: hot press to a 25 μm membrane

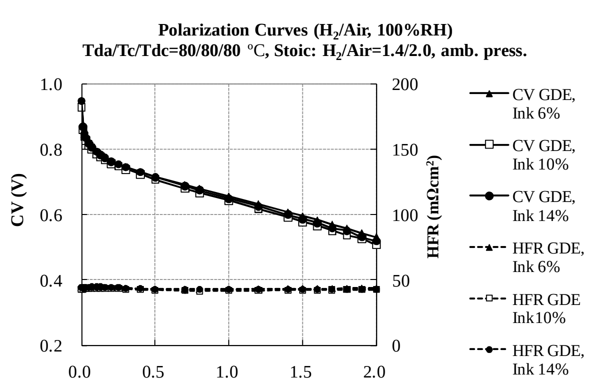

Fig.1 Polarization curves of MEAs (100%RH) using a hydrophilic MPL and various cathodes:
GDE: Gas diffusion electrode (MEA-1)
Mem Coat: Direct coating to the membrane (MEA-2)
Decal: Decal transfer to the membrane (MEA-3)

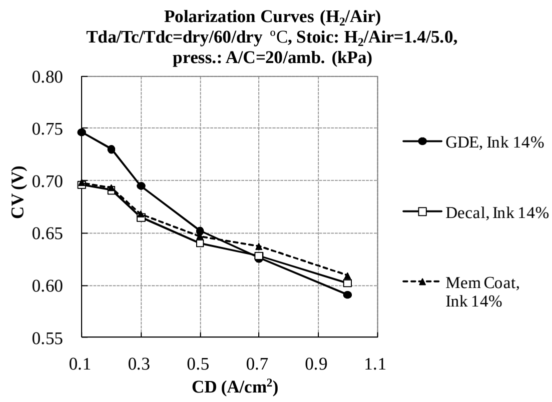

Fig.2 Polarization curves of MEAs 1-3 at 60 ºC, using dry H_2 and air (Stoic.:H_2/Air=1.4/5.0) without humidification.

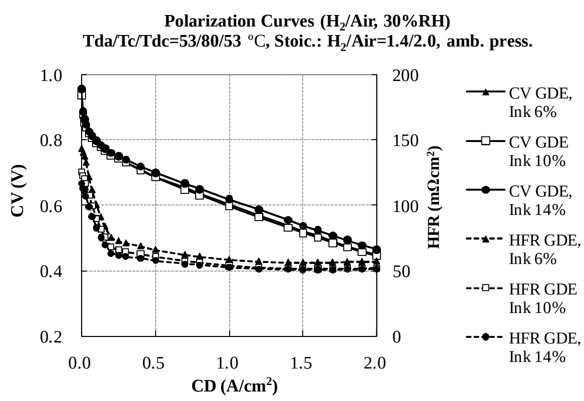

Fig.3 Effect of the solid % of cathode ink on GDE-MEA performance at 80 ºC, 30%RH.

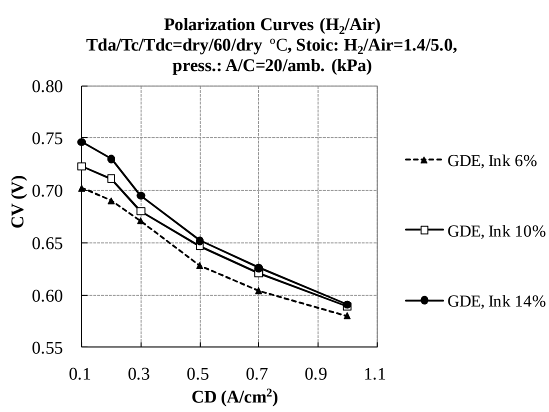

Fig.4 Effect of the solid % of cathode ink on GDE-MEA performance, using dry H_2 and air (Stoc.:H_2/Air=1.4/5.0) without humidification.

References

1. T. Tanuma, *J Electrochem Soc*, **157**, 5 (2010).
2. T. Tanuma and S. Kinoshita, *J Electrochem Soc*, **159**, B150 (2012).