Durability of Asahi Kasei Aciplex membrane for PEM fuel cell application

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INTRODUCTION

In the last several years it has been conducted to improve the durability and performance of PEFC all over the world. In the meantime, polymer electrolyte membrane is more being paid attention on the earlier degradation in the lower humidified condition [1]. Asahi Kasei started to develop the new membrane suitable for higher cell temperature operation up to 120℃ and also lower humidified condition in NEDO project since 2001 [2]. In this paper we focus on the durability of membrane when keeping the fuel cell at open circuit voltage (OCV). The following OCV tests were conducted in several operational conditions such as humidity and cell temperature in order to know what condition is crucial for the membrane degradation.

EXPERIMENTAL

Asahi Kasei conventional membrane, so called Aciplex S1002, was used for OCV tests as follows. A membrane sample was sandwiched by two E-TEK ELAT electrodes with 0.4mg/cm^2 Pt in the single cell. The cells were run at OCV. Pure hydrogen gas was fed into the anode and pure oxygen or nitrogen was fed into the cathode, with or without humidification.

After every operation, the cells were released from the test station in order to measure H_2 gas permeability. Measurements of H_2 gas permeability are made using GTR-100FA (GTR TEC CO.) based on gas chromatography [3].

RESULTS AND DISCUSSION

Fig.1 shows the influence of operational condition on membrane durability at OCV test. In case of 30℃ humidification, H_2 gas permeability begins to increase around 100 hours and reached approximately ten times higher after 180 hours than the initial value. Without humidification the permeability is going up at the shorter operation time than with low humidification. At 90℃ humidification the initial permeability is higher than at low humidification because of the higher water content, as reported [4]. Nevertheless the permeability keeps stable at high humidification for 200 hours. When nitrogen was fed into the cathode instead of oxygen, the permeability is stable even at the low humidification. From these results it can be assumed that cross-leaked H_2 reacts with oxygen on platinum catalyst to produce the combustion heat, which leads to the gradual damage to the membrane. With high humidification surplus liquid water may cool the combustion heat to avoid the membrane degradation.

In Fig.2 the influence of cell temperature on membrane is shown at the same humidification condition. This result definitely reveals that the permeability is going up faster at higher cell temperature.

In addition, Asahi Kasei is developing the novel membranes such as thermo-stable membrane, highly durable membrane and so on. We are conducting OCV tests on these developed membranes and getting the promising results at present. Thus, the durability of these developed membranes will be also presented in the meeting.

ACKNOWLEDGEMENT

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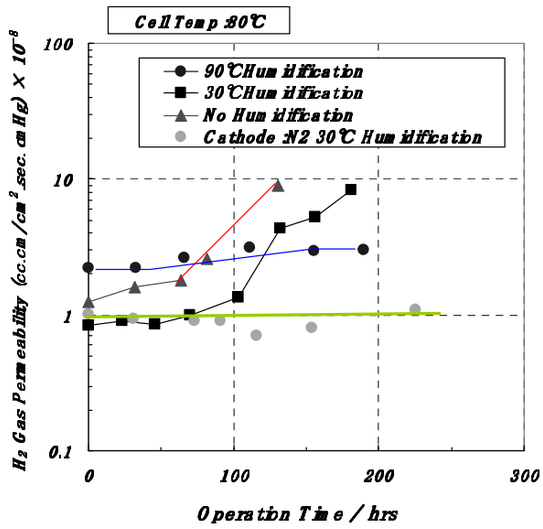

Fig.1 Influence of Operational Condition on Membrane Durability at OCV test

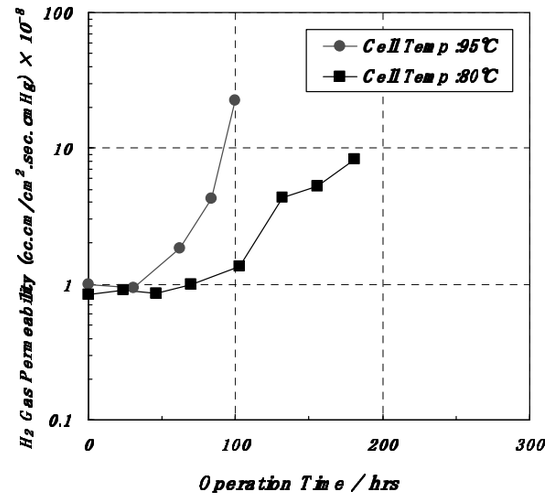

Fig.2 Influence of Cell temperature on Membrane Durability at OCV test