

## In-situ Evaluation of Sulfide Contaminants Crossover through Electrolyte Membrane of PEMFC

Y. Oono, K. Kobayashi, M Hori

Fuel Cell Research Center, Daido University  
10-3 Takiharuru-cho, Minami-ku, Nagoya, 457-8530 Japan

### 1. Introduction

Most urgent issue to accelerate the commercialization of PEMFC residential co-generation systems is to reduce the cost of system equipments or piping which accounts for a large part of system cost. However, to use low cost materials for system equipments or piping results in exhausting many kinds of impurities from such a system. Most of the impurities have a high possibility to reduce the cell voltage by their absorption onto both the anode and cathode catalysts, which is amplified by the crossover of such contaminants through electrolyte membrane.

In this study, focusing especially on  $\text{SO}_2$  as a typical example of sulfuric contaminant, an in-situ poison evaluation method was established to evaluate the contaminant crossover through an electrolyte membrane and to estimate the catalyst surface coverage rate due to the contaminant during power generation with cyclic voltammetry. In fact, the established method was applied to estimate the effective surface area of the anode catalyst which is actively used for the electrode reaction.

### 2. Experimental

Two membrane electrode assemblies (MEAs) with active area of  $3\text{cm} \times 15\text{cm}$  were prepared. Fluorine-based electrolyte membranes, carbon-supported Pt-Ru anode and Pt-Co cathode catalysts were used for the MEAs. The loadings of both the Pt alloys were  $0.4 \text{ mg/cm}^2$ . The MEAs were sandwiched between a pair of carbon bi-polar plates with the flow patterns consisting of 16 straight gas channels and 15 straight ribs.

Power generation tests were performed on two single cells with the MEAs at a cell temperature of  $80^\circ\text{C}$  with a current density of  $0.2 \text{ A cm}^{-2}$  while supplying pre-humidified pure hydrogen and air to anode and cathode sides, respectively. The respective utilizations were 70% and 40%, and 1 ppm  $\text{SO}_2$  was mixed into cathode sides of both the cells from the middle of their power generation.

The power generation of one single cell was stopped at the moment the second cell voltage drop started, and then the cyclic voltammetry (CV-1) was measured for anode and cathode sides with increasing stepwise the potential ranges. On the other hand, the power generation of the other single cell was stopped after the second cell voltage drop finished falling, and then the cyclic voltammetry (CV-2) was similarly measured.

### 3. Results

Figure 1 shows the chronological change of cell voltage after mixing 1ppm  $\text{SO}_2$  into oxidant and the timings of CV measurement. The first and second cell voltage drops shown in the figure were due to cathode and catalyst poisons, respectively.

Figure 2 shows the cyclic voltammetry measured for anode and cathode sides at "CV-1" of Figure 1. Figure 3 shows the change of each ECSA residual rate of anode and cathode catalysts with increasing potential ranges. As shown in the figure, cell voltage was not dropped, that is to say, anode overpotential was not increased until about 95% of the anode catalyst surface was covered by sulfur.

Figure 4 shows the cyclic voltammetry measured for anode and cathode sides at "CV-2" of Figure 1.

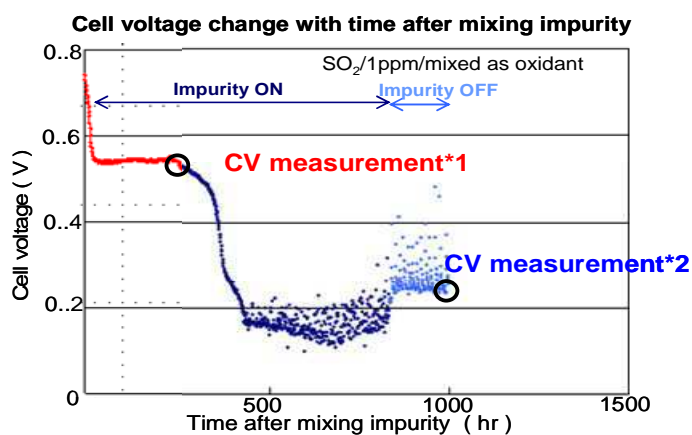


Figure 1. Chronological change of cell voltage after mixing 1ppm  $\text{SO}_2$  into oxidant and the timings of CV measurement

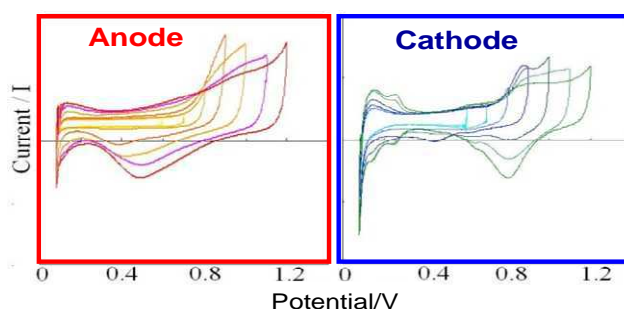


Figure 2. Cyclic voltammetry measured for anode and cathode sides with increasing potential ranges at "CV-1".

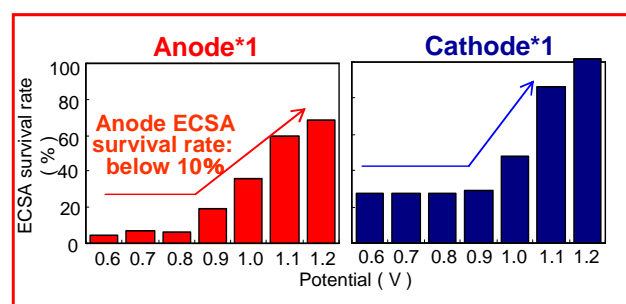


Figure 3. Change of each ECSA residual rate of anode and cathode with increasing potential ranges at "CV-1".

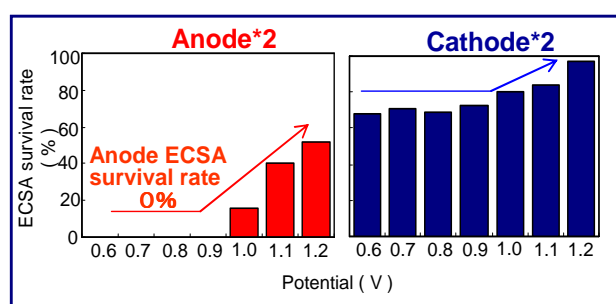


Figure 4. Change of each ECSA residual rate of anode and cathode with increasing potential ranges at "CV-2".

### Acknowledgement

This research was performed under a grant from the Cell Evaluation Project of the New Energy and Industrial Technology Development Organization (NEDO).