**Measurement of current and temperature distribution in a PEMFC**

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## INTRODUCTION

For the purpose of measuring the current density distribution in a proton exchange membrane fuel cells (PEMFCs), segmented single cell has been adopted.[1-3] Usually flow-field plate is divided into pieces and each segment has an area of typically the order of 1 $cm^2$ or larger, and discussions are focused mainly on the effects of changes of humidity or concentration of the reactant gas along with the gas flow.

The aim of this work is to detect spontaneous fluctuation under uniform condition. Current collector was divided into 100 segments. The area of each segment is about two orders smaller than usual. Furthermore, in order to measure the current and temperature at same points, thermocouples were set at the surface of all segments.

## EXPERIMENTAL

As shown in Figure 1, 100 anode current collector segments were arranged as triangular lattice in a circular area of ϕ 2 cm, and as a cathode current collector normal flow-field plate was used. Each anode segment is made by a sheathed thermocouple to detect temperature simultaneously, of which the surface was plated with platinum to prevent corrosion. Gas diffusion electrode (catalyst layer and gas diffusion layer) of the anode side was also divided into 100 pieces to insulate from each other electronically. This was realized by preparing 100 circular anodes with ϕ 1 mm and arranging them as the same pattern of the current collector in making a membrane-electrode-assembly (MEA). Each anode current collector segment (sheath of thermocouple) was connected to the working electrode terminal of a potentio/galvanostat by way of a current sensor. Output of 100 current sensors and 100 thermocouples is recorded by a data logger. Besides detecting spontaneous fluctuation of the current and temperature, forced current change or heat was added locally in order to investigate the causal relation between current and temperature distribution. For these experiments, a heater was attached to a specific current collector, or an additional galvanostat was inserted at a specific current sensor.

## RESULTS AND DISCUSSION

Current and temperature distribution was recorded as functions of time. Points at which current (or temperature) increase (or decrease) distribute not at random but tend to gather to form areas, which indicates that fluctuation caused by some change of condition, not noise, was detected. However, any correlations between the current and temperature distribution were not found. Figure 2 shows temperature and current distribution when a specific anode current collector was heated. The heating resulted on a temperature change about 2 degree. Simultaneously, current at and near the heat point increased. There are two possible factors affecting the effect of temperature on current: one is enhancement of catalytic activity which brings positive relationship, and the other is decrease of water content in membrane locally which brings negative relationship. The result obtained shows that totally the effect of temperature on current is positive.

## REFERENCES

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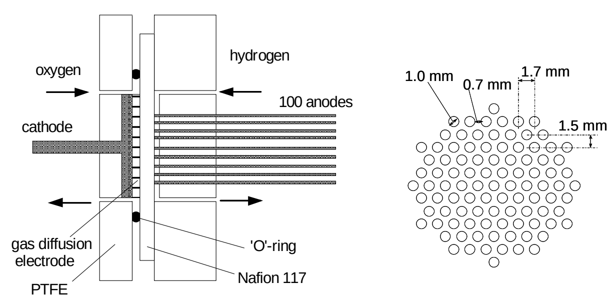


Figure 1. Schematic of the ϕ 2 cm cell with segmented anode and the layout of 100 segments.

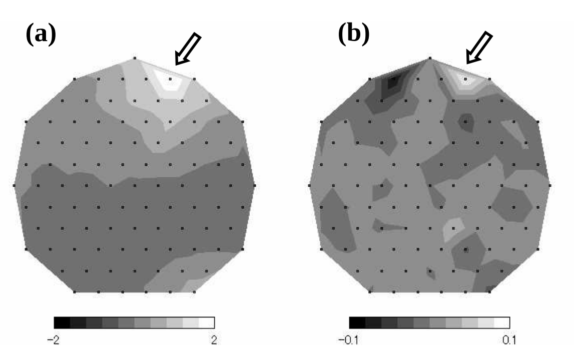


Figure 2. Mapping for (a) temperature and (b) current distribution when a specific anode (pointed with arrows) was heated. Total current was fixed at 100 mA. Temperature is indicated as increment and current as incremental ratio compared with before heating.