Measurement Technique of Oxygen Diffusion Resistance through Gas Diffusion Layer

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It is important to measure oxygen diffusion resistance of gas diffusion layer (GDL) and catalysis layer (CL) in order to improve performance of polymer electrolyte fuel cell (PEFC). It has been reported to measure oxygen diffusion resistance using oxygen sensor[1]. Oxygen concentration gradient of GDL and CL are very low because of their thinness. Therefore, it is difficult to measure with high precision. High oxygen concentration gradient is needed for reliable measurement in this method. In this study, a technique is developed to measure oxygen diffusion resistance with high precision. The technique uses oxygen sensor and zinc-air batteries which enhance oxygen concentration gradient.

Figure 1 shows schematic illustration of apparatus which measure oxygen diffusion resistance of a sample. The sample separates apparatus inside from atmosphere. The oxygen sensor and zinc-air batteries are located independently in apparatus inside. Zinc-air batteries are located on the circumference of the oxygen sensor, and these are connected to an electronic load. Oxygen in the apparatus is consumed by the circuit.

The oxygen sensor monitors oxygen concentration of apparatus inside, and the electronic load control oxygen consumption rate of zinc-air batteries.

An oxygen diffusion resistance is calculated by diffusion area, the oxygen consumption rate and an oxygen concentration difference between atmosphere and apparatus inside when the oxygen concentration is stable.

The oxygen sensor also consumes oxygen. However, oxygen consumption of the sensor is much less than that of zinc-air batteries. Effect of oxygen sensor's oxygen consumption can be neglected in this experiment.

Figure 2 shows measurement samples to verify precision of the technique.

Figure 3 shows measurement result of relation between diffusion distance and oxygen diffusion resistance of airspace. The solid line is calculation result using the literature value[2].

By this technique, the measured value agrees with the literature value within ±12 percent.

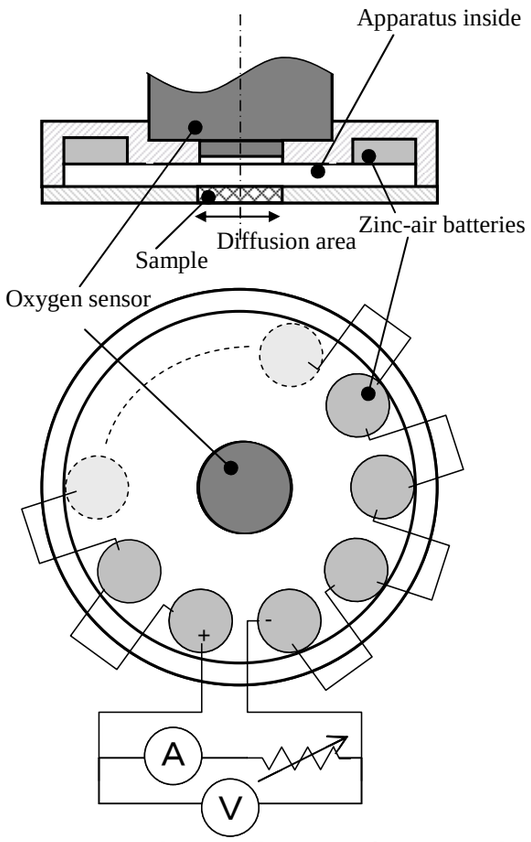

Figure 1 Schematic illustration of apparatus which measure oxygen diffusion resistance of a sample

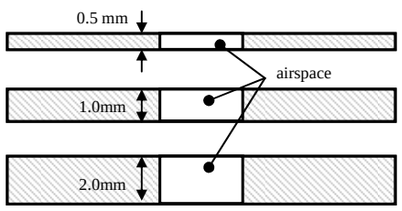

Figure 2 Measurement samples to verify precision

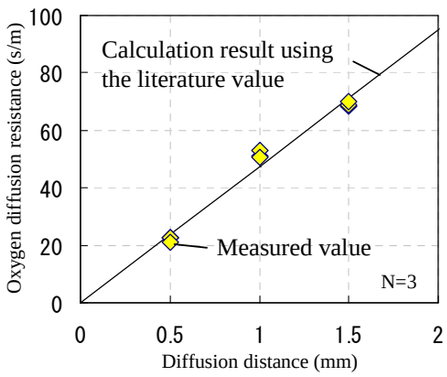

Figure 3 Relation between diffusion distance and

1) Y.Utaka, Y.Tasaki, S.Wang, T.Ishiji, S.Uchikoshi, Transactions of the JSME series B Vol.74(739) (2008), p.141-147
2) The Japan Society of Mechanical Engineering ed, JSME Data Handbook -Heat Transfer (1986), p.356