CONTINUOUS MEASUREMENT WITH A CHEMICAL SENSOR AND A SEMIPERMEABLE HOLLOW FIBER USING THE NULL METHOD

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Long-term continuous monitoring of the chemicals in tissues and blood is required in many fields. For example, an artificial pancreas for treating diabetes needs continuous monitoring of the blood glucose concentration in order to supply adequate amounts of insulin. For this purpose, long-term continuous monitoring of the glucose concentration has been tested with a microdialysis probe inserted subcutaneously and a glucose sensor. However, the performance of the microdialysis probe decreased after the probe was inserted. The sensor also showed drift and decreased sensitivity [1].

Here, we applied the null method to such a measurement system. Reference solutions with high and low concentrations, a bypass allowing the reference solutions to reach the sensor directly without perfusing the hollow fiber, and a 3-way valve were added to the system (Fig. 1).

The flow of the reference solutions met before the 3-way valve and then perfused the bypass and hollow fiber alternately before reaching the sensor. If the sensor output for the solution perfusing the bypass was higher than that of the hollow fiber, the proportion of the low-concentration reference solution was raised, and *vice versa*. This was repeated until the difference between the two paths became smaller than a given threshold. Then, the concentration of the solution perfusing the bypass calculated from the ratio of the reference solutions was regarded as the concentration of the object solution.

This method was used to measure the glucose concentration *in vitro* using a system consisting of a dialysis probe with a bundle of semipermeable cuprammonium rayon hollow fiber and a glucose senso. The glucose sensor consisted of glucose oxidase, a mediator (ferrocenecarboxaldehyde), platinum and stainless steel electrodes, and polyurethane cover. The performance of the dialysis probe was declined artificially by isolating some portion of the hollow fiber from the objective solution. Effect of the drift of the sensor output was also evaluated.

The glucose concentration of the object solution was measured precisely, even when the performance of the probe declined or the glucose sensor showed drift.

[1] SHICHIRI M, et al. Artif Organs, 22,32(1998).

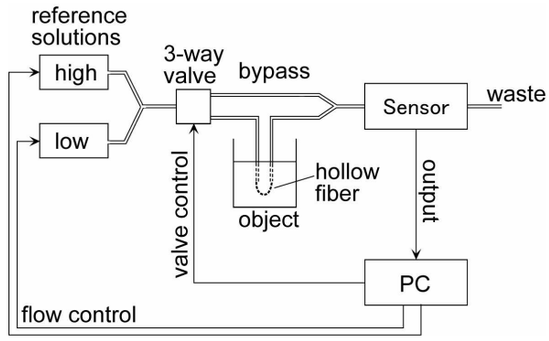

Fig. 1 Schematic diagram of the measurement system.