Liquid Sensor in Multi-Functional Integrated Circuit

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In this paper, we present the results of a basic study on fabrication technology of integrated sensors circuit, in which the various sensors based on the mass loading effect, a conductive change, and photo-luminescence methods are integrated on piezoelectric substrate. We take up a glucose sensor as a liquid sensor, which is contained in the integrated sensing system. The Glucose concentration in liquid is characterized by measurement of impedance changes. The experimental results show that the Glucose sensor has a high resolution.

A development of the biosensor is necessary for healthy maintenance of environmental preservation and a human body. The importance of technical development is increasing and research of μ-TAS (Micro Total Analysis System) which integrated channel structure, a fluid control element, a detector for sensing, etc. is done widely. Especially, examination towards utilization, such as improvement in response speed, a measure against mixing of air bubbles, and reduction of leak flux, is also made from the proposal of basic structure as a trend in connection with minute fluid control technology.[1-5]

Figure 1 shows a typical illustration of multi-functional liquid sensors. In integrated liquid sensors, a system configuration changes what carries out direct sensing of the sample, such as by mass, impedance changes, optical sensing of reaction, and so on. It is desirable to consist of multi-functional sensing systems so that it can respond to every inspection system.

As one of biosensor, we examined the capacitance changes of Au-Inter-digital transducer (IDT) electrode as a function of Glucose concentrations. The device is shown in Fig. 2. The size of Au-IDT electrode is 4 μm pitches of line & space.

We examined a Glucose sensor as a liquid sensor. This sensor will be equipped with alarms to give warnings of impending hypoglycemia and hyperglycemia. The electrode is treated to immobilize oxidases enzyme as shown in Fig. 3. The chemical reactions between enzyme of Glucose oxidases and Glucose occurs a difference of the dielectric constant in a solution.

Figure 4 shows the capacitance characteristics of Au-IDT electrode with immobilized oxidases with respect to the concentration of Glucose in water. The experiment was carried out to add 10 mM Glucose solution in 30μl water.

The experimental result shows that Au-IDT electrode with immobilized oxidases is suitable for sensing Glucose concentration. Since the feature of IDT electrode is planner on a glass substrate, it is able to connect micro chamber easily. This implies that the Au-IDT electrode is suitable for a biosensor in integrated sensors.

In order to realize a multi-functional integrated sensors, we examined the characteristics of the Glucose sensor. The experimental results are indicated that the sensor have high- sensitively as a function of the Glucose concentration. This implies that IDT electrode is suitable for realizing a integrated circuit which is containing liquid sensor. Also, we examined the fabrication of a micro-pump for liquid transfer.

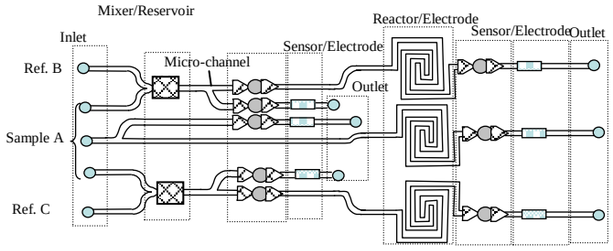

Figure 1 Schematic of integrated functional sensing system.

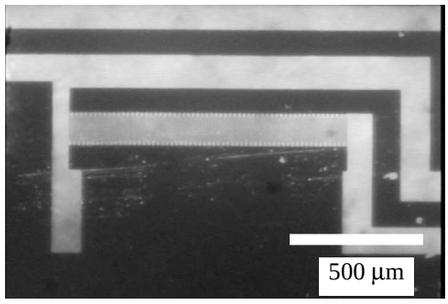

Figure 2 Device feature of IDT sensor.

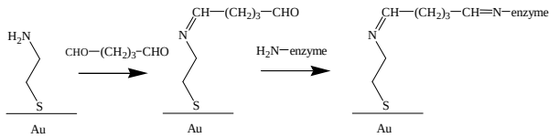

Figure 3 Schematic illustration of Au-IDT electrode with immobilized ozidases.

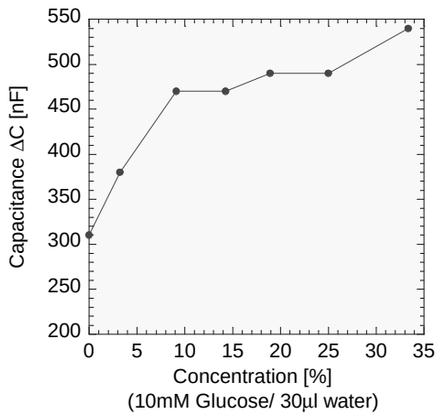

Figure 4 Capacitance characteristics of electrode.