SH-SAW Biosensors for One Step Test

Hiromi Yatsuda[1,2], Takashi Kogai[2], Mikihiro Goto[2], Naoyuki Yoshimura[2]

[1]OJ-Bio Ltd., Newcastle upon Tyne/UK
[2]Japan Radio Co. Ltd., Fujimino-shi, Saitama/Japan

Email: yatsuda.hiromi@oj-bio.com

This paper describes an immunoassay-based shear horizontal surface acoustic wave (SH-SAW) biosensor for the measurement of a variety of biomarkers (protein, hormone, virus, bacteria) in various sample types (nasal swabs, serum, whole blood, urine, saliva). The SH-SAW biosensor can provide portable, ease of use, reasonable cost per test and wireless connectivity and then can be suitable for one step test in hospital, home, rural and field.

Conventional SH-SAW biosensors are generally based on flow-system which uses a pump, tube and a fragile liquid cell. Although they have some advantages, they cannot be suitable for point-of-care or home-use applications. On the other hand, our SH-SAW biosensors are designed for one step test. The SH-SAW sensor device has unique air-cavities which are composed of epoxy walls that surround the interdigital transducers (IDTs) and a glass lid. Since the IDTs are protected from liquids, the sensor devices can be directly dipped into a liquid and a liquid can be directly applied onto the surface of the sensor device.

In this paper, 250MHz and 380MHz delay-line SH-SAW sensor devices are designed on 36Y-90X quartz substrate and fabricated. The sensitivities of the both sensor devices are evaluated using different concentrations of glycerol mixtures. The experimental results are compared with the calculated results that are obtained using a numerical calculation method for SH-SAW propagation characteristics which is modified Campbell and Jones method involving the effect of liquid viscosity. Very good agreements are obtained.

On the other hand, three attractive design techniques for SH-SAW biosensors are presented. The first is a reflection type design technique to reduce the device size. The reflection type sensor device has one input/output IDT and a grating structure at the end of the device. The SH-SAW which is generated at the input/output IDT propagates to the grating structure and reflects there. The second is a reference channel design technique to compensate temperature drifts and viscosity variations of the liquid samples. The experimental results of antigen-antibody reaction using C-reactive protein sample liquids with different temperatures are shown. The third is a technique using "membrane" such as paper or nitrocellulose on the sensor surface of the SH-SAW device. Although a membrane is placed on the surface of the sensor device directly, the sensor device can work as well as a conventional sensor device without membranes. The membrane techniques can provide some attractive functions, such as keeping sample solutions on the sensor surface, filtering the specimen (etc. separation of blood plasma) and having gold conjugated-antibodies inside. Figure 1 shows a two-channel reflection-type SH-SAW biosensor device with a membrane.

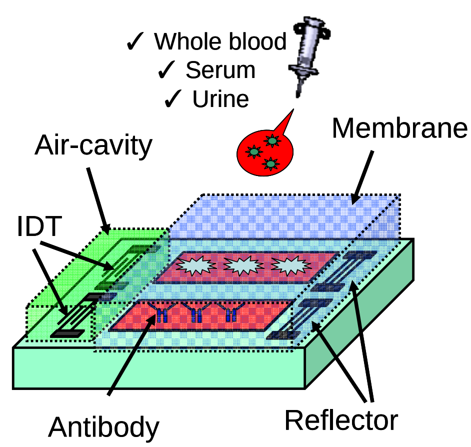

Fig.1 SH-SAW biosensor device.