Towards integrated liquid sensor based on LSPR and SH-SAW devices using 36YX-$LiTaO_3$ substrate

Teguh Firmansyah Talam[1, 2], Gunawan Wibisono[2], Eko Tjipto Rahardjo[2], Jun Kondoh[1]
Shizuoka University[1], Universitas Indonesia[2]
E-mail: teguhfirmansyah@untirta.ac.id

1. Introduction

Localized surface plasmon resonance (LSPR) sensor has several advantages such as robust against bulk refractive index changes, vibration or mechanical noise, easy to manufacture, and small size [1,2]. Furthermore, another liquid sensor with excellent performance is the shear-horizontal surface acoustic wave (SH-SAW) sensor. SH-SAW sensor usually developed using piezoelectric material based on the 36YX-$LiTaO_3$ substrate [3,4].

As an initial stage, to combine LSPR liquid sensor with SH-SAW liquid sensor, we investigated the LSPR sensor using gold nanoparticles (AuNPs) on 36YX-$LiTaO_3$ substrate, which usually uses glass as a substrate. The effect of the 36YX-$LiTaO_3$ substrate for the LSPR sensor was investigated based on reflectance performance. Furthermore, Fig 1(a), (b), (c), and (d) show reflectance results of the LSPR sensor with thin-film, without thin-film, and it is reflectance response for ethanol, respectively.

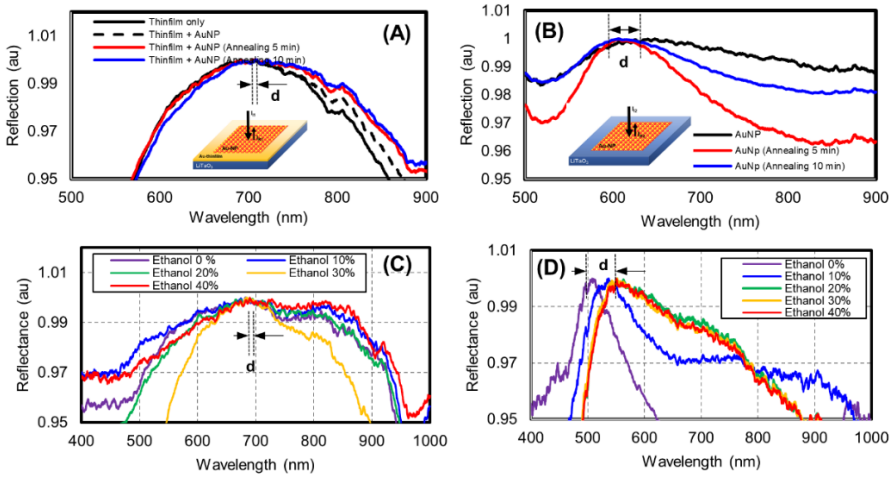

Figure 1. (a) LSPR sensor with thin-film, (b) LSPR sensor without thin-film, reflectance response for ethanol (c) with thin-film, and (d) without thin-film

2. Experimental Procedures and Result

The LSPR was fabricated on a 36YX-$LiTaO_3$ substrate, as shown in Fig. 1(a) and (b). For the LSPR with thin-film, the AuNP should be deposited on a 36YX-$LiTaO_3$ two times with different amounts. Furthermore, the optical reflection data response was taken by USB4000 UV-V is spectrophotometer (Ocean Optics, Inc., USA), and data were collected using Op-wave + software. As a result, the LSPR with thin-film generates a low Q factor/broadband spectrum with insignificant shifting, as shown in Fig 1(c). In contrast, the LSPR sensor with good Q factor and high sensitivity/shifting was successfully developed using the 36YX-$LiTaO_3$ substrate without thin-film, as shown in Fig 1(d). In future work, we will develop and investigate the interdigital transducer (IDT) to this structure. Therefore the integrated liquid sensor based on LSPR and SH-SAW will be fully implemented.

Acknowledgment
This research was subsidized by JKA through its promotion found from KEIRIN RACE.

Acknowledgment

[1] E. Kazuma, et al., Nanoscale 6, pp. 2397-2405 (2014).
[2] K. M. Mayer, et al., Chem. Rev. 111, pp. 3828-3857 (2011).
[3] K. Takayanagi, et al., Jpn. J. Appl. Phys. 57, 07LD02. (2018).
[4] A. Pohl, IEEE Trans. UFFC 47, pp. 317-332 (2000).