Connecting of Localized Surface Plasmon Resonance and Electrochemical Impedance Spectroscopy for aqueous detection

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1. Introduction

Localized Surface Plasmon Resonance (LSPR) sensor of noble metallic nanoparticles is an impressive method for biological and chemical sensing application. It has been studied as one of the most versatile and sensitive optical methods for aqueous sensing in miniaturize system. The operation principle of LSPR is based on changes in optical response to the refractive index of the environmental[1)].

Electrochemical impedance spectroscopy (EIS) is well known as impressive method for characterizing the electrical properties of aqueous and their interfaces by electronically conducting electrodes[2)]. Connecting of LSPR sensor with different analytical methods in a compact device has challenges to obtain simultaneous sensing of several properties. Therefore, this study aimed is to develop an integration LSPR-EIS device onto a single sensor based on glass substrate for aqueous detection.

2. Experimental Procedure

A. Fabrication of LSPR-EIS sensor

The LSPR-EIS sensor was fabricated on glass substrate. The EIS sensor utilize a gold (Au)-interdigitated electrode (IDE) which conducted by using vacuum thermal evaporation technique and wet etching. Then, the Au-IDE was annealed at 400 °C to create gold nanoparticles (AuNPs) on the surface of Au-IDE structure.

B. Investigation of LSPR-EIS sensor

The LSPR spectra of the sensor was measured by the UV-Vis spectrometer. The impedance spectroscopy was recorded by the LCR meter at frequency between 1 Hz to 19M Hz. The aqueous solutions samples put in rubber pool used in order to study the optical and impedance properties of the LSPR-EIS sensor in simultaneous measurement.

3. Results and Discussion

Fig. 1 and 2 show the experimental results of the LSPR-EIS sensor to the samples 0wt%, 10wt%, 30wt%, and 50wt% glycerin concentrations. Further, the impedance experimental results of the samples compare with theoretical calculations by using an equation for equivalent circuit of LSPR-EIS sensor. The LSPR peak spectra of the sensor are correlated with changes the concentration of samples[3)]. The change in impedance as a result the conductivity change [4)].

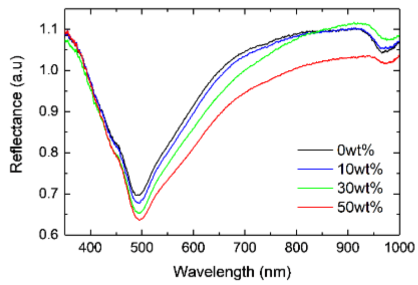

Fig. 1. Plot LSPR spectra on reflective measurements

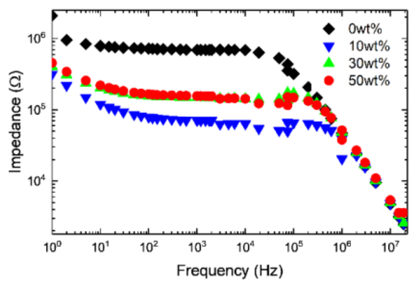

Fig. 2. Plot correlation frequency vs impedance

4. Conclusion

The LSPR-EIS sensors were fabricated on the IDE structure. This research was the feasibility study for simultaneous measurements of the refractive index and impedance of the aqueous samples. These results open up strongly high promising to combining LSPR-EIS sensor in one chip for aqueous detection.

Acknowledgement

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