A study on optical fiber surface plasmon sensor and its application to evaluation of the optical constants for aqueous solutions

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A surface plasmon resonance(SPR) sensor is capable of detecting change in optical constants in the very vicinity of a surface of the sensor. Currently, as SPR sensors in the market are expensive and bulky, their applications are limited in mostly biology and chemistry. Therefore if a portable and compact SPR sensor system were realized with reasonable price, application fields of the sensor would broaden from environmental measurement, medical care to measurement of optical constants. Purposes of this thesis work is to develop a compact and sensitive SPR sensor by using an optical fiber and to study its application to estimate the optical constants of alcoholic solutions.

A dual-color fiber optic SPR sensor has been developed. Characteristics of the sensor depend strongly on the two working wavelengths and gold film thickness. An experiment to investigate this dependence showed us that the gold film thickness of 65nm gives the highest sensitivity. A prototype of this sensor demonstrated that it can measure the refractive index range of 1.329 to 1.36 with the refractive index resolution of 2.4×10^{-4}.

Since an SPR spectrum obtained by an optical fiber SPR sensor is a function of optical constants of a medium to be measured, it is possible in principle to determine the optical constants from the wide range SPR spectrum. A new method to correct fluctuation of a lamp has been devised. From the measurement of SPR spectra of ethanol solutions with known optical constants, it was found that specifying the excitation condition of light rays launched into a transmission type sensor is very important.