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Sensitivity Enhancement by Designing Probe Dispersion Relation in Surface Plasmon Resonance Sensor using Multimode Sensing Scheme

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ABSTRACT— In this paper surface plasmon resonance sensor has been investigated using silver and gold in its structure respectively. We calculate spectral sensitivity using multimode sensing scheme. We show that the sensitivity of this sensor can be enhanced by designing probe dispersion relation properly.

KEYWORDS: Multimode sensing scheme, Spectral sensitivity, Surface plasmon resonance sensor.

I. INTRODUCTION

Surface plasmon resonance sensor is a prominent example of refractive index sensors and is widely researched due to its high spectral sensitivity during the past years [1]. It is receiving a high degree of attention because of the need to develop simple, and low-cost detection technologies for a number of applications such as determining biological interactions, detecting chemical reactions, and medical diagnosis [2]. On the other hand, since the high spectral sensitivity of surface plasmon resonance sensor is attributed to the modal overlap or dispersion of surface plasmons studying the origin of it worth investigating [3].

Recently, there has been a number of works to study sensitivity enhancement methods for surface plasmon resonance sensors. These methods include: metal layer optimization [4], modifying the prism refractive index [5], adding a thin dielectric layer with high refractive index on top of the metal layer [6], and multimode sensing scheme [3]. Analysis of extraordinarily high spectral sensitivity has been reported using multimode sensing scheme in which silver has been considered in SPR sensor structure [3].

In this paper we report the effect of using gold instead of silver, and design the gold layer thickness, incident angle, and prism refractive index in order to observe a dip in reflectivity spectrum as a result of surface plasmon resonance. In addition we show the sensitivity enhancement by designing probe dispersion relation in SPR sensor using gold in its structure; this effect previously was studied only in the case of dielectric waveguide sensors [3].