18a-C3-2

Determination of thickness and refractive index of thin layers using dual plasmonic Fano resonances in gold nanogrids

Ming-Yang Pan [1, 2], Kuang-Li Lee [1], Likang Wang [2], Pei-Kun Wei [1, 3, 4, *]

E-mail: pkwei@gate.sinica.edu.tw

[1]Research Center for Applied Sciences, Academia Sinica, Taipei 115, Taiwan

[2]Institute of Photonics Technologies, National Tsing Hua University, Keelung 300 Hsinchu, Taiwan

[3]Department of Optoelectronics, National Taiwan Ocean University, Keelung 202, Taiwan

[4]Department of Mechanical and Mechatronic Engineering, National Taiwan Ocean University, Keelung 202, Taiwan

Abstract

Surface plasmon resonance (SPR) sensing has been pursued for high-sensitivity biomedical applications. Many SPR studies are based on single peak-wavelength shift. However, such measurement can only provides averaged interaction signals. The two important optical parameters, the thickness of biomolecular film and the corresponding refractive index, cannot be simultaneously determined. Here, we present a dual SPR modes measurements based on two Fano modes in a gold nanogrid array with two periods on both x and y axes. Fig. 1(a) shows the schematic of the nanogrid array. The sensor consisted of 80-nm-thick, 80-nm-wide gold nanoslits with 680 nm and 815 nm periods on a plastic film. A 45° linear polarized light normally incident to the array generated two distinct Fano modes as seen in Fig. 1(b). The two Fano resonant peaks red shifted as the dielectric coating thickness or refractive index increased. The wavelength shift can be estimated by the fitted by $\Delta\lambda = S_\lambda \Delta n(1-e^{-t/d})$, where S_λ is the wavelength sensitivity for infinite surface coating, *t* is the coating thickness and *d* is the evanescent depth of the SPR wave. Fig. 1(c) shows that the lower Fano mode has a large wavelength shift than the higher one. The difference is mainly due to the shorter evanescent wave of the lower Fano mode. The *d* for 680-nm-period Fano mode is about 1.32 time higher than the 815-nm-period mode, consistent with the prediction of the equation. Using the fitting equation, the two Fano modes chip can be applied to simultaneously determine the biomolecular film thickness (*t*) and its corresponding refractive index (Δn).

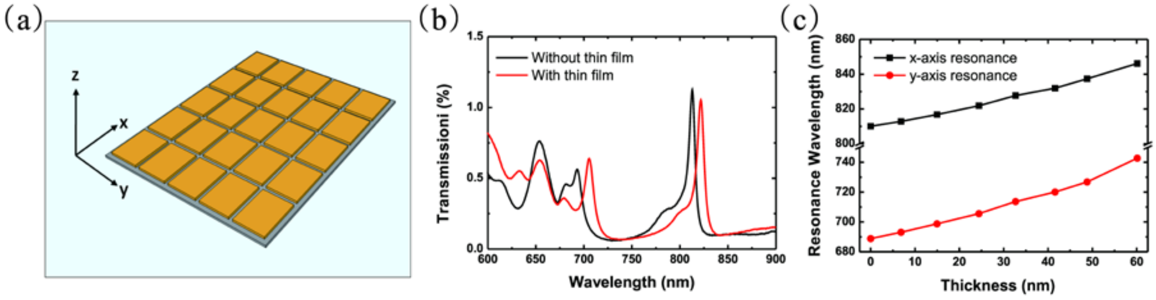

Fig1. A dual plasmonic Fano resonance sensor: (a) Schematic of a 3D sketch. (b) The transmission spectrum of sensor without/with thin dielectric film. (c) The measured resonance wavelengths versus thickness of film for both Fano resonances.