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Metal-insulator-metal structures for high-resolution sensing

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1. Introduction

In conventional surface plasmon resonance (SPR) sensors, a single metal layer is commonly used, but the resolution is limited because of broad resonances. In metal-insulator-metal (MIM) structures, coupling between surface plasmon polaritons (SPP) propagating at different interfaces can be achieved and a sharp resonance can be expected. Attempts have been made by a Korean group [1] to improve the resolution using MIM structures. However, their structures are not very easy to fabricate.

In this paper, we propose MIM structures which can easily be prepared. Ours results of reflectivity measurements show a sharp resonance compared to conventional SPR with single layer.

2. Experimental and simulation results

MIM structure used for the present work is schematically shown in Fig.1. It was prepared by vacuum evaporation technique. First, a 46-nm Ag film is deposited on a BK7 substrate. An insulator Cytop layer of a 267-nm thickness was coated by spin-coating on top of the Ag film. A 42-nm thick Ag film was deposited thereon to complete the MIM structures.

To measure reflectivity spectra, the sample was mounted on a rotating table and excited by a p-polarized laser beam with a wavelength of 633 nm. The reflectivity was measured as a function of the incident angle.

Figure 2 shows two resonances located at 42.5°and 50.0°, respectively. The first one is a narrow resonance which corresponds to SPP at the Ag/Air interface modified by the MIM structures. The second one is a broad resonance which corresponds to a symmetric SPP arising from

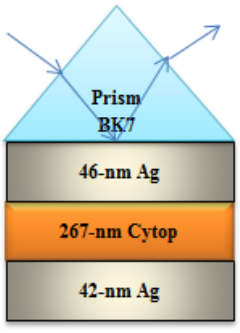

Fig.1. MIM structures

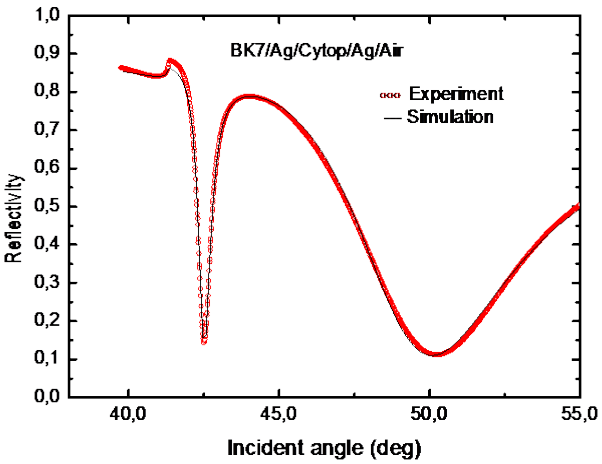

Fig. 2. Experimental and simulation results for the present MIM structures.

SPP coupling. Furthermore, we can see from the figure that the simulation result is in good agreement with the experimental one. The full width at half maximum of the sharp resonance is 25% narrower than that of conventional SPR. Detailed discussion about the sensor sensitivity will be given in the presentation.

3. Conclusion

In this paper, we described experimental results for a simple MIM structure prepared with a Cytop insulator layer. Sharp and broad resonances observed could be well reproduced by simulation. The width of the sharp resonance was found to be smaller than that of conventional SPR. The MIM structures may find potential applications in various sensing problems.

Reference

[1] Kyeong-Seok Lee, Ju Myeong Son, Dae-Yong Jeong, Taek Sung Lee and Won Mok Kim. Sensors. **10** (2010) 11390-11399.