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※支援課題名（日本語） : 多偏光スペクトル積算方法を用いた SPR センサーの開発

※Program Title（in English） : Surface plasmon sensor using a multi-polarization spectral integration method

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※概要（Summary ）:

Surface plasmon resonance (SPR) sensing is a key technique for real-time and label-free detection of molecular interactions on a gold surface. Here, we demonstratd a multi-polarization spectral integration method to increase the refractive index detection limit of gold nanostructure-based SPR sensor.

※実験（Experimental）:

Nanostructure arrays on a silicon substrate in which the substrate was used as a silicon template for imprinting were fabricated using electron beam lithography and a reactive ion etching method. Metallic nanostructures were fabricated on a polycarbonate (PC) substrate using a thermal annealingassisted template stripping method. A 50-nm-thick gold film was deposited at a slow deposition rate (0.1 nm/s) on the clean silicon template using an electron gun evaporator. A 178- μ m-thick PC film was placed on the gold coated template. The template and PC substrate was placed on a heating plate. It was heated at a temperature of 170 ° C to soften the PC substrate. After peeling off from the template and PET thin film, the PC substrate with gold nanostructures was made.

※結果と考察（Results and Discussion）:

Fig.1(a) shows the FE-SEM image of the nanogrid arrays made by the thermal annealing-assisted template stripping method. We measured transmission spectra of dualperiod nanogrid arrays in water for various polarization angles of normally-incident light. The periods of nanogrid arrays were 600 and 590 nm in x-axis direction and in y-axis direction, respectively. The LSPR occurring within the nanoslit plays a role as the broad resonant state. We further analyzed the measured results using the multipolarization spectral integration method. The noise level is reduced or the sensitivity is increased by incorporating more information contained in the spectra with various polarized incident light. We experimentally compared the sensing capabilities of gold nanogrid arrays using the intensity measurement, spectral integration approach and the proposed method. For a dual-period nanogrid structure, the proposed multi-polarization method increased signal-to-noise ratio (SNR) and refractive index detection limit about 8 times larger than the simple intensity method. We attributed the low detection limit of dual-period nanogrid structures to the increase of SPR peaks over the integration wavelength. If the nanostructures can be made with more SPR wavelengths in different polarization directions, the introduction of polarization in the spectral integration method can increase the SNR and reduce the detection limit more efficiently. Currently, the dual-period nanogrids can reach a detection limit of 1.92×10^{-6} RIU if the intensity stability is 0.2%. Such detection limit value by the proposed simple integration method would be comparable with the bulky ATR sensors using complicated angular detection method.

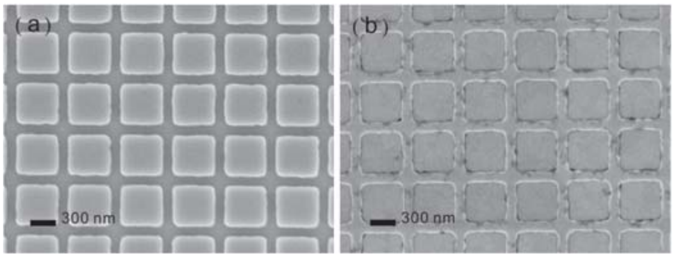

Fig. 1 SEM images of the fabricated silicon template of nanogrid structures a) and template-stripped nanogrid arrays b). The slit width is 110 nm for both structures.

※その他・特記事項（Others）:

The design of gold nanostructures will be optimized to improve the detection limit for SPR sensor using reflactive index change.

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論文・学会発表（Publication/Presentation）:

[1] K.-L. Lee, M.-J. Chih, X. Shi, K. Ueno, H. Misawa, P.-K. Wei, *Adv. Mater.*, **24**, 35, 253-259 (2012).

関連特許（Patent）: なし