課題番号　　:F-14-HK-0064
利用形態　　:共同研究
利用課題名（日本語）　:
Program Title (English)　:Surface-enhanced Raman scattering of crystal violet induced from gold nanocylinder arrays
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1. 概要（Summary）

We are collaborating with Hokkaido University' group to fabricate a surface-enhanced Raman scattering (SERS) active substrate showing strong enhancement of electromagnetic field due to localized surface plasmon resonance. In this study, The largest SERS enhancement factor was obtained when the excitation wavelength accordanced with the localized surface plasmon resonance band. These results demonstrated that the periodic gold nanostructures are effective SERS active substrate for the measurement of small amount of molecules.

2. 実験（Experimental）

・Apparatus

Ultra-precision electron beam lithography system, Helicon sputtering system, Scanning electron microscope

·Method

The ordered array of gold nanostructures with a small nanogap was fabricated on a glass substrates by electron beam lithography (EBL) and lift-off techniques. The gold nanostructured glass substrate was immersed in an aqueous solution of crystal violet (10^{-4} mol/L) for 15min. The Raman scattering spectrum of the crystal violet molecules with gold nanostructures was characterized by FT-IR.

3. 結果と考察（Results and Discussion）

Figure 1(a) shows a schematic illustration of gold nanostructures array conjugated with crystal violet molecules. The gap between two adjacent structures was estimated to be 6.3 nm. The diameter and thickness of each nanostructure is 121 nm and 34 nm, respectively. Figure 1(b) shows the electromagnetic field intensity distribution of gold nanostructures array with a nanogap. Electromagnetic field enhancement as high as 1400 was clearly observed at nanogap position. We measured extinction spectrum of the gold nanostructures. We have found that the plasmon resonance spectrum is peaking at the wavelength of 769 nm. The spectrum was also reproduced by FDTD simulation. In this study, we measured SERS spectrum of the crystal violet under the low concentration conditions to pursue a single molecule level and compared Raman scattering intensity without gold nanostructures to obtain enhancement factor. Figure 1(c) indicates the enhancement factor as a function of incident light. The spectrum of SERS enhancement factor measured using various incident wavelengths is almost accordance with LSPR spectrum. This indicates that SERS intensity is highly corresponding to the plasmonic near-field enhancement.

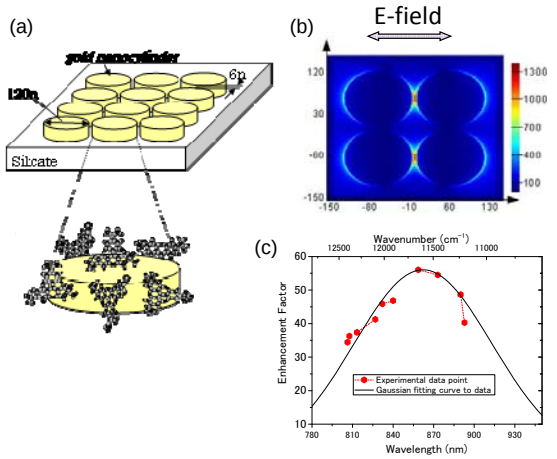

Figure 1(a) A schematic illustration of gold nanostructures array conjugated with crystal violet molecules. (b) Electromagnetic field intensity distribution of gold nanostructures with a small nanogap by FDTD simulation, (c) SERS enhancement factor as a function of incident wavelength.

4. その他・特記事項（Others）

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5. 論文・学会発表（Publication/Presentation）：Nothing

6. 関連特許（Patent）：Nothing