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Program Title (English) : Optical trapping of micelles using plasmonic nanostructures
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1. 概要（Summary）

Due to localized surface plasmon resonance phenomena, gold nanostructures can be used to induce large enhancement of the electric field on a nanoscale. Consequently, gold nanostructures can be used to optically trap nanomaterials. However, the excitation of plasmonic resonances also induce the local heating of the gold nanostructures, which can be detrimental for optical trapping applications. In this work, we design, fabricate, and use plasmonic nanostructures that focuses the incident laser light into a few-nanometer-large gap. The purpose of this work is to optically trap and assemble micelles using the locally enhanced optical gradient force in the vicinity of the nano-gap.

2. 実験（Experimental）

【利用した主な装置】

超高精度電子ビーム描画装置 125kV、ヘリコンスパッタリング装置、高分解能電界放射型走査型電子顕微鏡、超高分解能走査型電子顕微鏡

【実験方法】

Gold dimer nanostructures composed of two triangles separated by a nanogap (10-20 nm) were fabricated on glass substrates by electron-beam lithography, gold sputtering, and lift-off processes. Microemulsions containing micelles (estimated diameter smaller than 40 nm) were prepared by mixing a small amount of xylene solution containing fluorescent dye molecules (1,4-bis(4-diphenylaminophenyl)-2,1,3-benzothiadiazole) (0.1 mL, 10^{-3} mol/L） with an aqueous solution of sodium dodecyl sulfate (SDS) (5mL, 1.7×10^{-1} mol/L). A small amount of 1-pentanol (0.05mL) was added to stabilize the (micro)emulsion. Micelles were obtained by ultrasonication. Experiments were conducted by focusing a laser beam (CW, wavelength: 1064 nm) onto gold nanostructures immersed in the prepared solution. The nanostructures were observed using an SEM after each experiment.

3. 結果と考察（Results and Discussion）

Using a laser intensity of 6.4mW/μm², a fluorescent spot appeared at the location of the irradiated nanostructures. The fluorescence intensity gradually increased for a few seconds and remained stable after stopping the laser irradiation. SEM observations confirmed the deposition of an irregular material layer at the surface of the irradiated structures. However, the material deposition was not localized near the nanogap, which may be due to heat-induced phenomena. Further investigation will be performed to understand the deposition mechanism and optimize the experimental conditions for optical trapping.

4. その他・特記事項（Others）

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5. 論文・学会発表（Publication/Presentation）

なし。

6. 関連特許（Patent）

なし。