課題番号　　:F-21-HK-0046
利用形態　　:機器利用
利用課題名（日本語）　　:光電場の局在とプラズモンの寿命がプラズモン誘起光圧に与える影響
Program Title (English)　　:Effects of localization and plasmon lifetime on plasmon-induced optical force
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キーワード／Keyword　　:「リソグラフィ・露光・描画装置」、「成膜・膜堆積」、「分析」、「フォトニクス」

1. 概要（Summary）

To construct a highly sensitive chemical sensor using plasmons, it is indispensable to concentrate nanomaterials on the hot site of metallic nanostructures. Plasmon-induced optical trapping is a powerful means to concentrate the analytes in the vicinity of metallic nanostructures. In this study, I propose fluorescence correlation spectroscopy (FCS) for the evaluation of plasmon-induced optical force and elucidate the spatial and temporal effects of plasmons.

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 100 KV
・多元スパッタ装置
・電界放射型走査電子顕微鏡

【実験方法】

Au nanogap dimer arrays have been fabricated on a glass substrate by electron beam lithography and lift-off techniques. Extinction microspectroscopy was employed for evaluating the spectral properties of the fabricated Au nanogap dimer arrays. In this study, Au nanogap dimers with different gap widths and pitch sizes were fabricated to elucidate the near-field enhancement effects by the localization of near-field and the elongation of plasmon lifetime. Fluorescent polystyrene beads with a diameter of 40 nm were used for evaluating the plasmon-induced optical force. The fluorescent beads were dispersed in an aqueous solution. FCS curves were measured using confocal microscopy to obtain the potential of plasmon-induced optical force. 870 nm CW laser beam was used for inducing the plasmon-induced optical force and 488 nm CW laser beam was used for the fluorescence measurements. FDTD simulation was also performed.

3. 結果と考察（Results and Discussion）

Fig.1. (a) shows the gap width dependence of potential. It was revealed that the potential increases as the gap width decreases. Near-field enhancement factor was also elucidated by FDTD simulation and showed almost good agreement with the experimentally obtained potential.

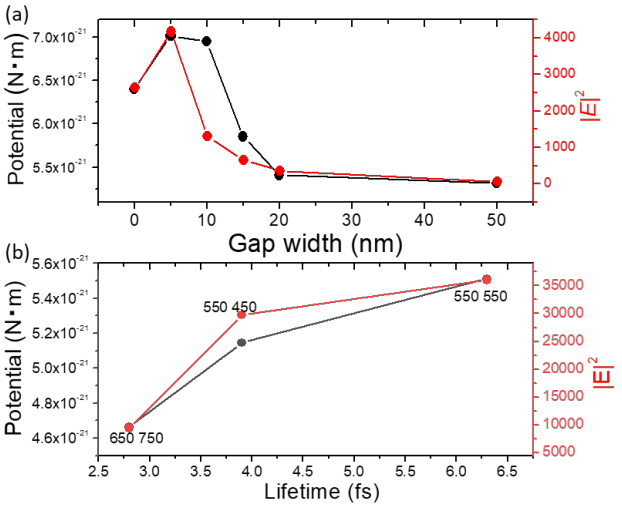

Fig. 1. (a) Gap width dependence of potential. (b) The relationship between plasmon lifetime and potential.

Fig. 1(b) shows the relationship between plasmon lifetime and potential. Plasmon lifetime (dephasing time) can be controlled by the structural pitch size based on the principle of far-field coupling. In this study, the plasmon lifetime and near-field enhancement factor were determined by FDTD simulations. From Fig. 1 (b), it was found that the potential obtained by FCS largely depends on the plasmon lifetime. The lack of linearity is because the resonance wavelength changes with pitch size. From the FDTD analysis, it became clear that the potential increases because the proximity field enhancement factor increases with the plasmon lifetime.

4. その他・特記事項（Others）

共同研究者:上野貢生（北大院理）

5. 論文・学会発表（Publication/Presentation）

なし

6. 関連特許（Patent）

なし