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利用課題名（日本語）	:
Program Title (English)	:Correlation between Near-Field Enhancement and Dephasing Time in Plasmonic Dimer Nanostructures
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1. 概要（Summary）

Near-field enhancement and dephasing time are two crucial properties of plasmonic systems, and they play important roles in many applications such as SERS, sensing, nonlinear optics process, and photocatalysis. However, little is known about the correlation between the two properties. Here, we systematically investigate both the near-field enhancement and dephasing time of plasmon modes in nanostructures, using gold nanoparticle dimers as an example using photoemission electron microscopy (PEEM).

2. 実験（Experimental）

【利用した主な装置】

PEEM (Elmitec); High-resolution electron beam lithography (EBL, ELS-F125-U, Elionix); Helicon sputtering system (MPS-4000C1/HC1, ULVAC); FE-SEM (JSM-6700FT, JEOL).

【実験方法】

The sample was fabricated using standard electron beam lithography followed by sputtering and lift-off process. Both isolated and dimer disks are arranged on a two-dimensional array with the period of 1000 nm. The diameter and thickness of gold disks are 160 nm and 30 nm, respectively. A series of dimer arrays with different gap sizes were prepared.

3. 結果と考察（Results and Discussion）

The SEM images and PEEM images under femtosecond laser excitation of both the isolated disks and dimers can be found in Fig. 1. The near-field enhancement is evaluated with excitation wavelength dependent PEEM measurements, and the dephasing time is obtained directly in time domain by time-resolved PEEM associated with numerical fitting using a harmonic oscillation analytical model. It is found that the dimers exhibit stronger near-field enhancement but shorter dephasing time, compared to single nanoparticles. Furthermore, the gap dependent near-field enhancement and dephasing time is also examined. The dephasing time is found to be slightly reduced with the reduction of the gap distance, while the near-field enhancement is increased. It is concluded that in plasmonic dimers, the dephasing time is reduced with the increase of the near-field enhancement. Our experimental results can be reproduced very well by numerical simulations using the finite-difference time-domain method. We believe that this work will pave the way to study the correlation between near-field enhancement and dephasing time in other plasmonic systems.

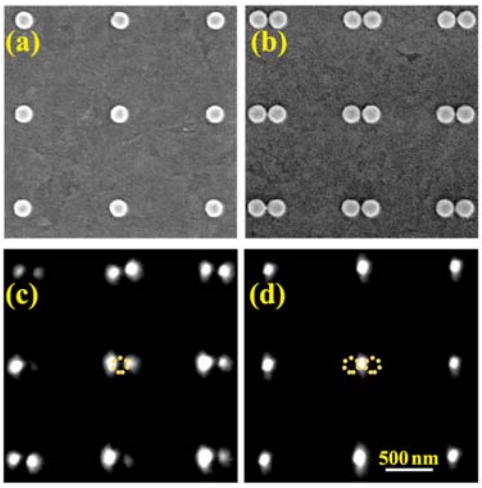

Fig. 1 SEM images of isolated disks (a) and disk dimers with the gap size of 25 nm (b). PEEM images (FOV = 5 μm) of isolated disks (c) and disk dimers (d) at respective plasmon resonance wavelengths of 760 nm and 850 nm, with longitudinal excitation.

4. その他・特記事項（Others）

Collaborators: Quan Sun, Shuai Zu, Kosei Ueno, and Hiroaki Misawa (RIES-Hokkaido University)

5. 論文・学会発表（Publication/Presentation）

Y. Li, Q. Sun et al., The 11th LEEM/PEEM workshop, Chongqing, China, October 31, 2018. (Best Poster Award)

6. 関連特許（Patent）

N/A