

課題番号 : F-21-HK-0029
利用形態 : 機器利用
利用課題名(日本語) : 結合系プラズモニックナノ構造の寿命と近接場増強効果
Program Title (English) : Plasmon lifetime of coupled plasmonic nanostructures and its relationship to near-field enhancement effects
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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)

Localized surface plasmon resonances (LSPRs) can confine the light wave to the local surfaces of metallic nanoparticles as a near-field. Not only near-field coupling but also far-field coupling between adjacent metallic nanoparticles are essential for inducing strong near-field enhancement due to spatial and temporal effects of LSPRs. We aim to elucidate the temporal effects on near-field enhancement effects. In this study, the far-field coupling is used for controlling the plasmon lifetime and the relationship between plasmon lifetime and near-field enhancement effect was explored.

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 dimer arrays have been fabricated by electron beam lithography (EBL) and lift-off techniques. Time-resolved two-photon induced photoluminescence (TPI-PL) were measured by using an interferometric pump and probe system utilizing a mode-locked Ti: sapphire laser as an excitation source to evaluate the phase relaxation dynamics of LSPR.

3. 結果と考察(Results and Discussion)

Fig. 1 shows the TPI-PL autocorrelation trace of nanogap Au dimer arrays with pitch sizes of 500 and 600 nm, respectively. These revealed that the plasmon dephasing dynamics (phase relaxation time) changes depending on the pitch size and the dephasing time of the nanogap Au dimer array with a pitch size of 500 nm is about twice prolonged rather than the structure with a pitch size of 600 nm. In addition, the experimental results are well consistent with those in FDTD

simulations. Furthermore, simulated near-field information indicated the plasmon dephasing time is correlated with the near-field enhancement, which is desirable to be explored experimentally in the future.

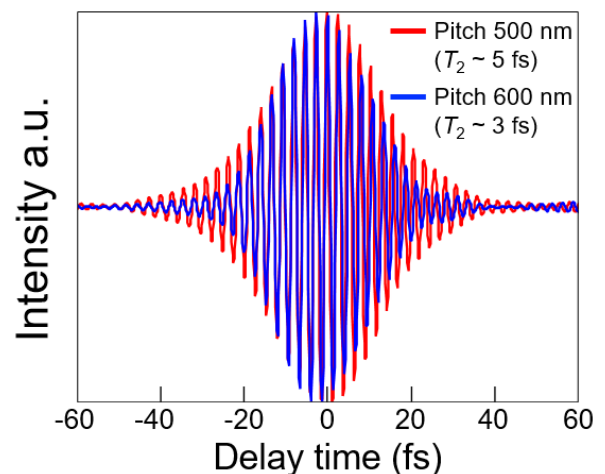


Fig. 1 Time-resolved autocorrelation traces of nanogap Au dimer arrays with pitch sizes of 500 nm (red curve) and 600 nm (blue curve), respectively. The inset shows the estimated dephasing time (T_2) at each pitch size, respectively.

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