課題番号 :F-19-HK-0034
利用形態 :共同研究
利用課題名(日本語) :
Program Title (English) :Fabrication of plasmonic nanostructures for ultrafast EUV-PEEM experiments
利用者名(日本語) :鄭偉, 吳成印
Username (English) :Wei Zheng, Chengying Wu
所属名(日本語) :北京大学物理学院
Affiliation (English) :School of Physics, Peking University, China
キーワード/Keyword :Electron beam lithography, Plasmonic nanostructures, Extreme ultraviolet (EUV), Photoemission Electron Microscopy (PEEM), リソグラフィ・露光・描画装置

1. 概要(Summary)

The recent vast progress in the development of ultrafast laser sources in extreme ultraviolet (EUV) range has enabled new types of ultrafast experiments using the EUV pulses as a probe to measure the dynamics of electrons in solids upon optical excitation. In this study, we fabricated plasmonic gold (Au) nanostructures, which would be used as samples for time-resolved ultrafast EUV-Photoemission Electron Microscopy (PEEM) measurements.

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 (EBL, ELS-F125-U, Elionix); ヘリコンスパッタリング装置 (MPS-4000C1/HC1, ULVAC); 高分解能電界放射型走査型電子顕微鏡 (FE-SEM, JSM-6700FT, JEOL).

【実験方法】

Various types of gold (Au) structures were fabricated by EBL and lift-off techniques on ITO-coated glass substrates. Different patterns could be achieved using EBL. The 30-nm-thick Au layer was deposited by a helicon sputtering system. A 2-nm-thick Titanium (Ti) layer was also deposited between the Au layer and the substrate as an adhesion layer. The fabricated structures were examined by an FE-SEM.

3. 結果と考察(Results and Discussion)

More than ten different patterns were designed and fabricated. For most of the structures, there are localized surface plasmon resonances (LSPRs) near the fundamental femtosecond laser wavelength (800 nm). Figure 1 show four typical different Au nanostructures. It is found that the structural quality and the homogeneity are very high for all the fabricated structures. Especially, the dimers in Figs. 1 (c) and (d), the sharp corners could give extreme strong field enhancement, which would benefit our PEEM measurements.

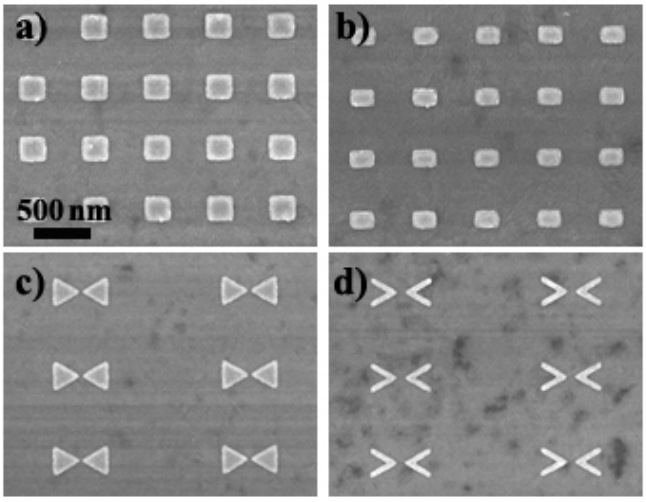

Figure 1 SEM images of four typical Au nano-structures in two dimensional arrays on ITO-coated glass substrate. (a) nanoblocks, (b) nanorods, (c) bowtie-type dimers, (d) arrow-type dimers. The thickness of the Au is all 30 nm.

In the next step, we will test time-resolved ultrafast EUV-PEEM experiments at Peking University. The photon energy of EUV covers 30-50ev, and through the energy selection of the hemispherical energy analyzer, EUV-PEEM can provide the valence electron(5d) and surface electron dynamic imaging information of gold.

4. その他・特記事項(Others)

Main collaborators: Quan Sun, En Cao, Hiroaki Misawa (RIES-Hokkaido University)

5. 論文・学会発表(Publication/Presentation)

N/A

6. 関連特許(Patent)

N/A