

課題番号 : F-17-HK-0060
 利用形態 : 共同研究
 利用課題名(日本語) :
 Program Title (English) : Systematical investigation on near field properties of plasmonic hetero-trimer
 利用者名(日本語) : 宋瀚法, 龔旗煌
 Username (English) : Hanfa Song, Qihuang Gong
 所属名(日本語) : 北京大学物理学院现代光学所
 Affiliation (English) : Institute of modern optics, school of physics, Peking University, China
 キーワード/Keyword : リソグラフィ

1. 概要(Summary)

We investigate the far-field and particularly the near-field properties of plasmonic hetero-trimer numerically, theoretically, and experimentally. In our simulations we find that the dipolar mode of the middle nanorod in the trimer system is greatly suppressed both in far field and near field. This phenomenon is confirmed by our FT-IR spectrometer and photoemission electron microscopy (PEEM) experiments. The far field suppression is caused by destructive interference due to anti-phase dipolar response of respective nanorod while the near field suppression is explained by an analytical model taking both near field coupling and far field coupling into consideration.

2. 実験(Experimental)

【Utilized facilities】

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

【Method】

The sample (schematically shown in Fig. 1 (a)) was fabricated through standard electron beam lithography (EBL), sputtering and lift-off process. The structure is arranged on a two-dimensional square array in a $75 \times 75 \mu\text{m}^2$ area with pitch size $1 \mu\text{m}$ to avoid near field interaction of adjacent units. The thickness of gold is 30 nm with an additional 2 nm Titanium as the adhesion layer.

3. 結果と考察(Results and Discussion)

The far-field extinction spectrum is measured through a Fourier transform infrared spectrometer (FT-IR) with an infrared microscope with the polarization perpendicular to principle axis (parallel to the length direction of nanorod). From Fig. 1 (b) we can clearly see there are two extinction peaks which locate at about 750nm and

860nm respectively. While for the near field spectrum, we perform PEEM measurements using a wavelength tunable laser ranging from 720nm to 920nm. From near field spectrum shown in Fig.1(b) we can observe two peaks locating at 760nm and 860nm corresponding well to those of the far field extinction peaks.

The simulative spectra are shown in Fig. 1 (c) indicating good consistency with the experimental results. Both experimental and numerical results indicate that the middle mode is greatly suppressed. From Fig.1 (d) we can see the phase response of two sided nanorod is opposite manifesting a destructive interference in the far field and that makes the far field spectrum smooth at P2.

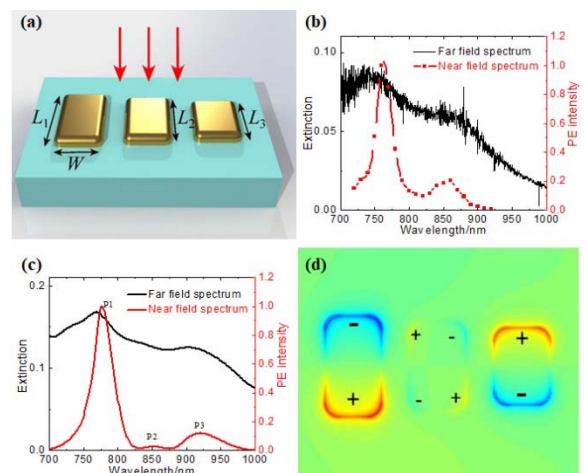


Fig. 1 (a) Schematics of gold hetero-trimer. (b) Measured far field extinction spectrum by FT-IR and near field spectrum by PEEM. (c) Simulative far- and near-field spectra. (d) Calculated charge distribution at wavelength P2.

4. その他・特記事項(Others)

Collaborators: Quan Sun, Yu Han, Kosei Ueno, and Hiroaki Misawa

5. 論文・学会発表(Publication/Presentation)

N/A

6. 関連特許(Patent)

N/A