

課題番号 : F-13-HK-0024
 利用形態 : 機器利用
 利用課題名 (日本語) :
 Program Title (English) : Selective excitation of surface plasmon resonance modes in gold nanoparticles and probing their dynamics by photoemission electron microscopy
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1. 概要 (Summary)

We study on the localized surface plasmon modes in gold nanoparticles by photoemission electron microscopy (PEEM). We demonstrated the dipole and quadrupole surface plasmon modes can be selectively excited under the oblique incidence light. Their dynamics have also been investigated.

2. 実験 (Experimental)

Gold nanostructures were fabricated by electron beam lithography (EBL) followed by metal sputtering and lift-off techniques. As excitation source, we used a mercury lamp (4.9 eV), a mode-locked Ti:Sapphire oscillator (Femto lasers) that delivers 7 fs laser pulse at the central wavelength of 800 nm and a wavelength tunable (700 nm to 930 nm) laser with bandwidth around 10 nm. The PEEM used in this study is PEEM-III (Elmitec) with the spatial resolution of 8 nm.

3. 結果と考察 (Results and Discussion)

We investigate the near-field properties of higher order LSPRs using photoemission electron microscopy (PEEM). For thin gold nanoblocks (side length: 180 nm, thickness: 24 nm), we explore that the dipole and quadrupole modes can be selectively excited under oblique incidence. With p-polarized light excitation the quadrupole mode cannot be excited and the dipole dominates the plasmonic field enhancement; in contrast, with s-polarized light excitation the quadrupole mode dominates as shown in Fig. 1(a). However, only the dipole mode can be observed under the normal incidence (Fig. 1(b)) due to the symmetry. Furthermore, we can clearly find the FWHM of quadrupole mode is much narrower than that of the dipole mode, indicating it has longer dephasing time. We validate this

point by comparing the dynamics of the two plasmon modes using time-resolved PEEM.

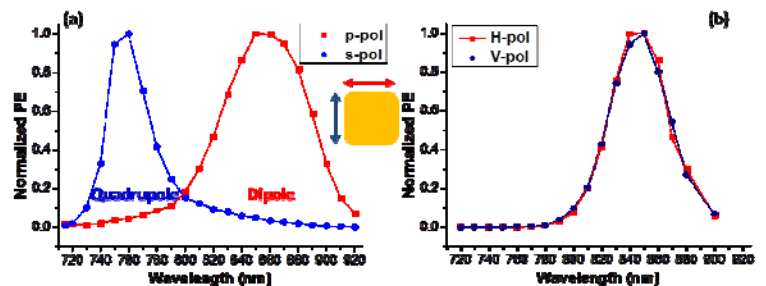


Fig.1 (a) Action spectra of photoemission electron intensity under oblique incidence conditions with p- and s-polarized light. (b) Action spectra of photoemission electron intensity under normal incidence conditions with L- and T-mode excitations.

4. その他・特記事項 (Others)

なし。

5. 論文・学会発表 (Publication/Presentation)

- (1) H. Yu, Q. Sun et al., 日本化学会第 94 春季大会、名古屋大学、名古屋、3 月 (2014).
- (2) H. Yu, Q. Sun et al., *Light: Science & Applications*, **2**, e118 (2013).

6. 関連特許 (Patent)

なし。