

課題番号 : F-14-HK-0068
 利用形態 : 共同研究
 利用課題名(日本語) :
 Program Title (English) : Fabrication and optical characterization of optical antennae in THz frequency
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1. 概要(Summary)

We are constructing plasmonic optical antennae whose resonant frequency is terahertz frequency region. In the present study, we explored spectral properties of metallic optical antennae in THz frequency region using THz time-domain spectroscopy and elucidated electromagnetic field intensity distribution of their structures using finite-difference time-domain (FDTD) simulation. We also studied the possibility for a chemical sensor in the THz spectral range.

2. 実験(Experimental)

• Apparatus

Ultra-precision electron beam lithography system, Helicon sputtering system, Scanning Electron Microscope

• Method

Ordered array of gold rods (200 nm wide) separated by 10 μm from the adjacent gold rods along both longitudinal and transverse direction were fabricated by electron beam lithography and lift-off techniques on a silicon substrates. The spectral properties of the fabricated optical antennae was measured by a terahertz time-domain spectroscopy using photoconductive antennae as well as femtosecond laser pulse (λ_p : 800 nm, f : 80 MHz, τ : 20 fs) as an excitation source of the pump and probe optical system.

3. 結果と考察(Results and Discussion)

Figure 1 shows extinction spectra of gold rods with different rod lengths. It was obviously exhibited that the plasmon resonant frequency shows spectrum shift toward lower frequency with increasing of the rod length. Therefore, we plotted the plasmon resonant wavelength to the rod length as shown in Figure 2. The plasmon resonant wavelength linearly shifted to longer wavelength with the rod length. This behavior is very similar to the spectral properties of gold nanorod in

near-infrared wavelength region. From a FDTD simulation analysis, the electromagnetic field enhancement was estimated to be as high as ~ 4500 ($|E|^2$) around the edge of the rod. It was concluded that the various optical phenomena might be induced even in the terahertz frequency region.

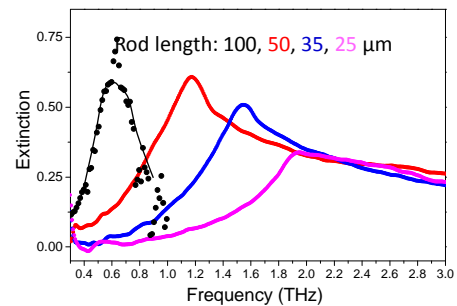


Figure 1. Extinction spectra of gold rods with different rod lengths.

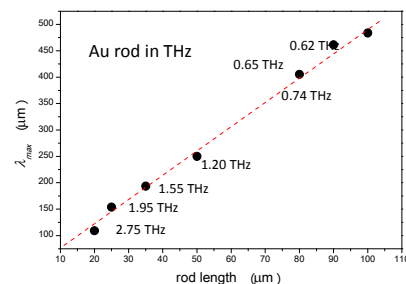


Figure 2. Gold rod length dependence of the plasmon resonant wavelength.

4. その他・特記事項(Others)

• Coauthor: (RIES, Hokkaido University) Kosei Ueno, Sho Nozawa, Hiroaki Misawa

5. 論文・学会発表 (Publication/Presentation)

Nothing

6. 関連特許(Patent)

Nothing