テラヘルツ波増強のための金ナノフィンアレイ構造

Gold nano-fin array for THz wave enhancement

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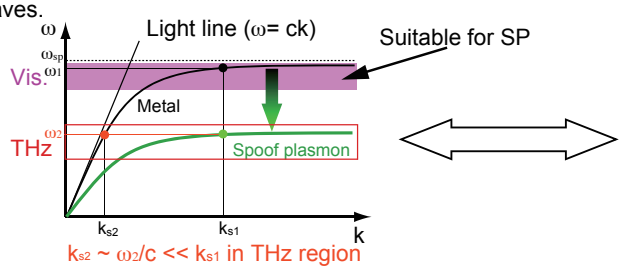
Introduction

Surface plasmon (SP) is used for bio-/chemical-sensors, non-linear effects, high-resolution imaging, and so on using its high-k and field enhancement properties.

However, these properties are achieved only in the higher frequency region.

No large-k, No field enhancement in low frequency region such as THz waves.

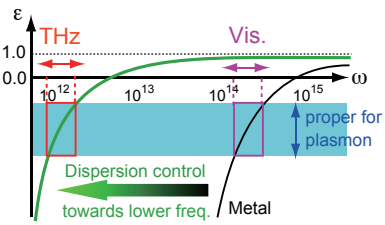


$k_{s2} \sim \omega_2/c << k_{s1}$ in THz region

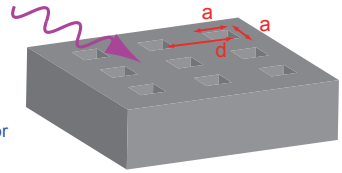
Surface plasmon in THz (Spoof Plasmon)

ω-k dispersion is originated from the electrical permittivity of the metal as the function of the frequency.

The electrical permittivity is determined by surface structure (metamaterials).



Metal with surface structure

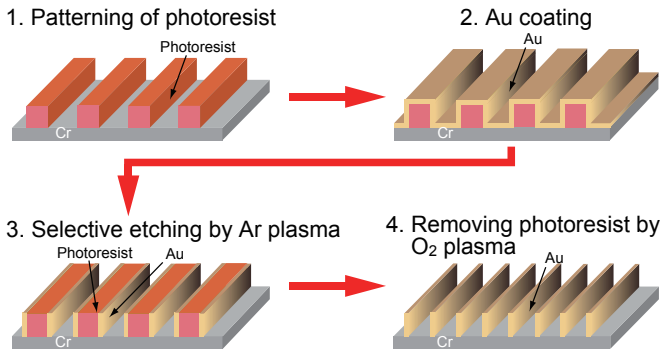


Grating (1D) or hole-array(2D) can support surface modes.

J. B. Pendry, *Science* **305**, 847 (2004).

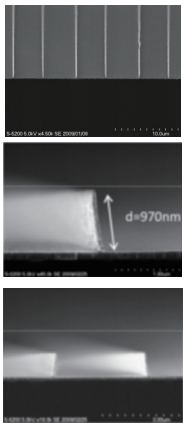
Fabrication & Measurement

Fabrication Process (Sidewall lithography technique)

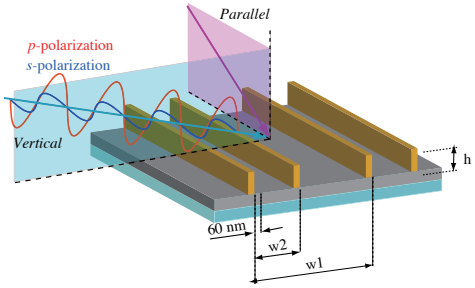


Au fins can be fabricated over wide area with high-aspect ratio.

The pitch and height of the fins are controlable.



Measurement of reflection spectrum



Range: 4000cm^{-1} ~ 400cm^{-1}

Polarization: p- and s-

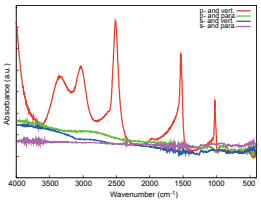
Incident angle: 5 ~ 85 deg.

In vacuo

Alignment: paralell and vertical to fins

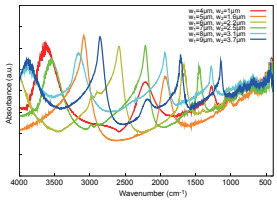
Results

1. Dependence on Pol.& Incident direction



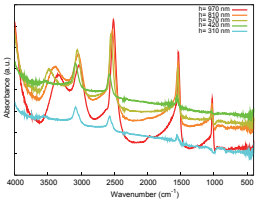
w_1=10 μm,
w_2=3.7 μm,
h=970 nm

2. Dependence on pitch

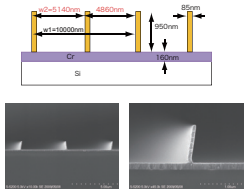


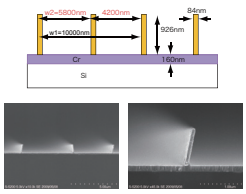
h=1000nm,
p- and vert.

3. Dependence on the height of fins

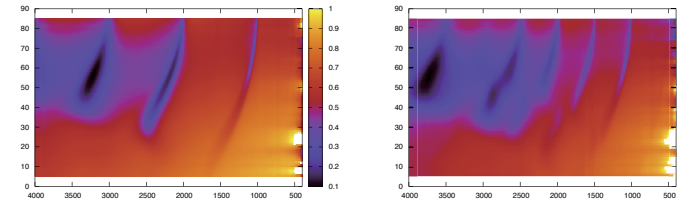


w_1=10 μm,
w_2=3.7 μm,
p- and vert.

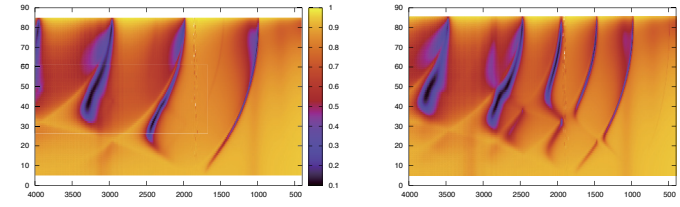




Experimental results



Calculation results by RCWA



Summary

Metal surface with periodic fin structure was fabricated by sidewall lithography technique, and then the reflection spectra were measured in mid-infrared region. Absorption peaks were observed only with p-polarization at vertical incidence to the fin structures. It was confirmed that the absorption peaks depend on the pitch and the height of the fin structures.