

INTERACTION BETWEEN LSP AND SPP IN MAGNETOPLASMONIC STRUCTURES

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Purpose

It is well known that the fundamental optical properties of hybrid structures conformed by arrays of metallic nanoparticles, sustaining localized surface plasmons (LSP), and metallic films, which support propagating surface plasmons (SPP), are strongly influenced by their mutual electromagnetic coupling [1,2]. On the other hand, the inclusion of ferromagnetic materials in nanoparticles or metallic films allow us to control the respective excitation LSP and SPP by an external magnetic field [3,4]. In this work we analyze a system presenting both situations: LSP on gold nanoparticles over a continuous metallic trilayer exhibiting magneto-optical (MO) activity.

Methods

Figure A shows the configuration under study: a Au/Co/Au trilayer film over a glass substrate and below a thin SiO₂ spacer that has an array of gold nanoparticles on top of it. The magneto-optical response of samples with different thicknesses of SiO₂ and different array periodicities have been measured in the polar Kerr and the transverse Kerr configurations. In the polar Kerr configuration we analyze the polarization conversion (p-light into s-light) in the reflected light when a magnetic field is applied perpendicular to the sample plane and parallel to the incident light plane; and in transverse Kerr measurement, we study the modification of the reflected p-light intensity when the magnetic field is applied parallel to the sample plane and perpendicular to the incident light plane.

Results

The polar Kerr spectra show that the MO response differs from that of the trilayer alone due to the presence of LSP, even being physically separated. Moreover, we have determined that the electromagnetic field inside the trilayer is redistributed when the LSP is excited, resulting in an enhancement of the MO signal only for those energies where the electromagnetic field is increased [5].

In the transverse Kerr configuration both the LSP and SPP plasmons are excited, and from the dependence on the angle of incidence of the TMOKE spectra, we can reconstruct the SPP dispersion relation. Furthermore we have seen that the magnetic field modulates the SPP wavevector allowing us to use an external magnetic field as a tuning parameter of SPP properties.

Conclusions

We have studied the influence of LSP on the MO activity of the system, the effect of the magnetic field on both kind of plasmons, and the interaction between them.

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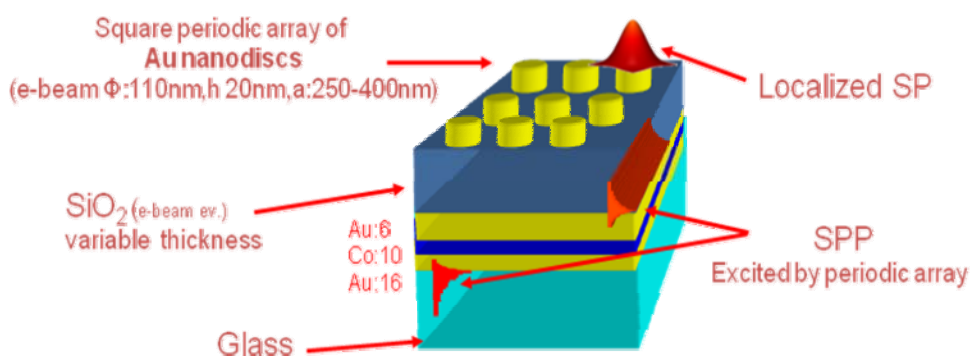
Figures:

Figure A. Configuration sustaining LSP, SPP and magneto-optical activity analyzed in this work