Optical response of magnetoplasmonic nanodisks and new schemes for MO-SPR sensors

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Magneto-plasmonic systems composed by noble/ferromagnetic metals structures can be used for the control of light polarization [1-3]. The extraordinary optical properties arising from combining strong local enhancements of electromagnetic fields in surface plasmon excitations with the magneto-optical activity inherent to ferromagnetic materials, can be controlled by external magnetic fields that have demonstrated the possibility to control and amplify the MO properties via plasmonic excitations [4-5].
In this work, the anisotropic optical, ellipsometric, and magneto-optical surface sensitivity to dielectric environment of multilayered hybrid Au/Co magnetoplasmonic nanodisks are studied in the framework of the mean field approximation, where the real and imaginary components of the dielectric tensor of the system are modeled using Lorentz-like oscillators.
By other hand, full electromagnetic simulations were performed using the standard Finite Element Method (FEM) (implemented in the commercial software COMSOL Multiphysics), which allow us to characterize the modes and explore the role of the dielectric environment of the nanodisks in the optical properties of the nanostructures via the variation of a coating SiO2 layer thickness. Our model and numerical results show a very good agreement with spectral ellipsometry measurements, where two orthogonal plasmonic modes -one in-plane and one out-of-plane- are well characterized. Our results show a well-behaved evolution of the in-plane mode which undergo a red-shift, while the out-of-plan mode presents an unexpected blue-shift. We can suggest the possibility for new schemes of magneto-optical surface-plasmon-resonance (MOSPR)-based sensors with an additional degree of freedom provided by the orthogonality of the described modes.

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