ACTIVE CONTROL OF SURFACE PLASMON POLARITONS IN SILVER FILMS WITH A MAGNETIC GRATING COUPLER

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Magneto-plasmonics is an emerging research field aiming at active control of plasmonic devices by integration of ferromagnetic materials. Magneto-plasmonic structures are either based on pure ferromagnets [1,2] or, to lower losses, ferromagnetic/noble-metal hybrids [3-5]. In these previous studies, we focused on Ni nanoparticles and demonstrated that the magneto-optical activity is significantly enhanced by the excitation of localized surface plasmons. We also showed that surface lattice resonances (SLRs) in ordered arrays of Ni nanoparticles lead to even stronger magneto-optical signals and that variation of the nanoparticle shape or lattice geometry tailors the spectral response.

Delocalized surface plasmon polaritons (SPPs), i.e., electromagnetic waves that travel along an interface between a metal and a dielectric, underpin the operation of an emerging class of photonic and optoelectronic devices. Active control over SPPs is desirable, but the propagation of SPPs is only weakly modulated in most proof-of-principle experiments. Here, we report on a new approach to actively tailor SPPs in noble-metal films using magnetic fields. We use Ag films on a glass substrate. The films are covered by a SiO_2 layer and a patterned array of Ni nanoparticles. Optical and magneto-optical spectra of our samples contain two main resonances, a sharp peak originating from SPPs at the Ag/SiO_2 interface and a broader Fano-like SLR from the Ni array. Using magnetic circular dichroism (MCD), we demonstrate that both modes are magnetically active. In other words, SPPs at the Ag/SiO_2 interface are actively controlled by reversal of the magnetization in the Ni nanoparticles by an external magnetic field.

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[5] M. Kataja, et al., Opt. Exp. 24, 3652 (2016)