Magnetolasmonic nanoantennas metamaterials: news and views

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The rapidly developing field of magneto-plasmonics merges the concepts from plasmonics and magnetism to realize novel and unexpected phenomena and functionalities for the manipulation of light at the nanoscale. Ferromagnetic nanoantennas support localized plasmons and exhibit magneto-optical activity under external magnetic fields. The fundamentals aspects of the physics underlying the optical behavior of magneto-plasmonic nanoantennas arising from the intertwined optical and magneto-optical properties have been in large part clarified [1-5]. In this talk I will show recent directions in the field of magneto-plasmonic nanoantennas, which involve the control of optical interaction by placing nanoantennas in close proximity or arranging them on periodic bi-dimensional arrays. Initial results show that indeed near field interactions between closely spaced nanoantennas (dimers, trimers, and chains) [6] or diffractive coupling leading to collective plasmonic surface lattice resonances in arrays (Rayleigh anomaly) [7], induce large and controllable modifications of the magneto-optic response of such metamaterials (see Fig. 1). Similar promising results are being observed in arrays of ferromagnetic nano-antidots [8]. A review of the most significant, although preliminary, discoveries in this area as well as simple initial modeling efforts developed to understand the essential physics involved, will be briefly presented.

Such multifunctional magneto-plasmonic metamaterials may open new views towards applications to variety of emerging technologies as, e.g., magnetoplasmonic rulers (dimers that are able to report the nanoscale distances) [6], ultrasensitive molecular sensing (see Fig. 2) [9] and ultrathin optical metadevices (flat nano-optics).

References

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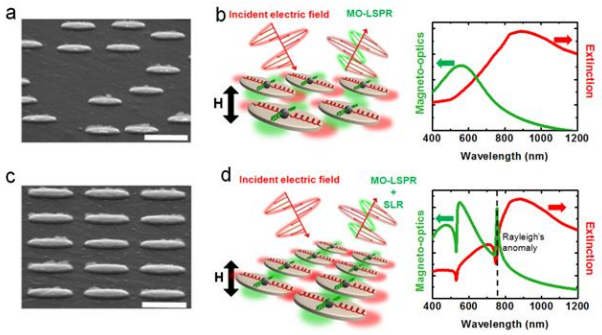

Figure 1. Effects of diffractive coupling on the optical and magneto-optical properties of ferromagnetic nanoantennas: a) disordered arrangement of Ni elliptical nanoantennas; b) ordered array of identical Ni elliptical nanoantennas.

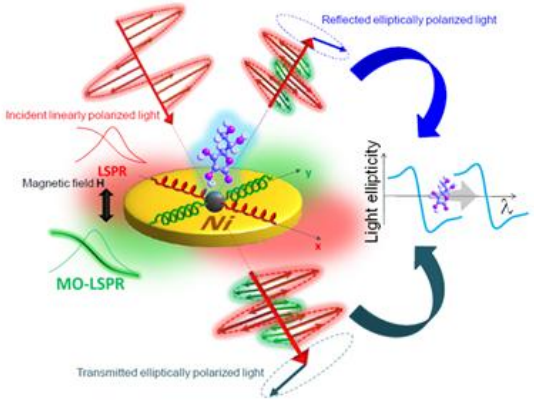

Figure 1. Light polarization manipulation enabled by phase compensation in the optical response of a magneto-plasmonic Ni nanoantenna and its exploitation for ultrasensitive sensing.