Magneto-optical activity in high-index dielectric nanoantennas

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The control of light propagation in the visible and near-infrared domain using resonant systems such as optical nanoantennas has been a matter of intense research during the last decades. The possibility to create and manipulate nanostructured materials encouraged the exploration of new strategies to control the electromagnetic properties with an external agent. A possible approach is combining magnetic and plasmonic materials, where it is feasible to control the optical properties with magnetic fields in connection to the excitation of plasmon resonances [1].

These nanoantennas have been traditionally made of metallic entities, which have the important drawback of a sizeable absorption. In the case of magnetic resonances based on Babinet inverted magnetoplasmonic structures, it has already been demonstrated that the magneto-optical effect has the ability to manipulate magnetic dipole-like resonances [2].

In the last years, there has been a quest for the so-called magnetic resonances in the visible domain [3]. Linked to it, there has been an increasing interest in the use of high index dielectric nanospheres as optical antennas, in particular for their ability to sustain magnetic resonances and the absence of absorption [4-6].

In this work we introduce the magneto-optical effect in the context of those high index dielectric nanospheres, i.e. a silicon nanosphere with a non-negligible of diagonal element in the dielectric tensor. We will show how the magneto-optical effect is controlled by the internal resonances of the nanosphere, and that the magnetic resonances dominate the spectral dependence of the magneto-optical response, having the electric dipolar resonance a very weak effect. We will establish a clear correlation of the spectral magneto-optical response with the spatial field profile at the interior of the nanosphere that is, in turn, linked to each type of resonance [7].

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