Magneto-optical Kerr effect in resonant subwavelength nanowire gratings.

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Multiple scattering theory can be used to obtain a full analytical description of complex resonant phenomena arising in sub wavelength nanowire gratings or in single mode waveguides with small defects. The strong coupling between the dipolar field scattered by small particles and the evanescent modes (in a waveguide) or evanescent diffracted beams (in a grating) can lead to a number of interesting resonant effects.

Here we analyze the optical response of sub-wavelength nanowire gratings made of arbitrary anisotropic materials [1]. For transparent dielectric nanorods it is possible to obtain very large local field enhancements at specific resonant conditions [2]. These structures would lead to enhancement of molecular fluorescence signals without quenching. In the presence of absorption, it is possible to derive the conditions to tune the absorption/thermal emission and extinction resonances [2].
For magneto-optical dielectrics we show that there is a complex interplay between the geometric resonances of the grating and the magneto-optical Kerr effects (MOKE) response [1]. As we will show, for a given polarization of the incident light, a resonant magneto-optical response can be obtained by tuning the incidence angle and grating parameters to operate near the resonance condition for the opposite polarization.

A completely equivalent analysis was applied to study electromagnetic forces on neutral particles in hollow waveguides [3]. At the geometric resonance, the effective scattering cross section of a very small particle can be made as large as the wavelength even far from any localized plasmon-polariton resonance. A small particle can then be strongly accelerated along the guide. The presence of the two particles splits the resonance leading to a nontrivial oscillating interaction. The existence of stable, optically bound dimers under two counter-propagating (non-correlated) light modes was also discussed. In analogy with these findings, we will discuss some interesting radiation pressure effects on subwavelength nanorod gratings.

References

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