Frequency addressing of nano–objects by electrical tuning of optical antennas

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Abstract:

Recent years have witnessed an impressive amount of research on optical devices conceived to efficiently couple free-space propagating light with localised light emitters or receivers, for a wide variety of potential applications, including nonlinear optics, efficient solar cells, near-field optical microscopy, and spectroscopy [1]. Beyond confining light of a given frequency at fixed locations, there is a need for dynamical control of such hot-spots [2, 3]. The possibility of dynamically tuning the resonance frequency of optical antennas might thus open new frontiers in probing of matter by optical means. To reach this goal, in our work we analyse a linear wire aerial immersed in a uniaxial anisotropic medium.
The behaviour of surface plasmon resonances in uniaxial anisotropic media has been already discussed both theoretically and experimentally in the literature; in this framework both individual and coupled spherical nano–particles have been considered. From the application viewpoint, in terms of antennas and equivalent circuits, what is needed is to determine the self impedance and effective length of a cylindrical wire and the load impedance describing the role played by a small gap in it. With these results at hand, we will then be able to discuss the tuning mechanism controlled by the director orientation for a linear wire optical antenna immersed in a nematic liquid crystal.

References:

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