Light transport by sets and chains of Mie resonances: whispering gallery modes and localized plasmons. Effects on extraordinary transmission

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We study the excitation of Mie morphology dependent resonances (MDR), (i.e. whispering gallery modes in dielectric nanocylinders and of localized surface plasmons in metallic ones), by light transmitted through a subwavelength slit in a metallic slab. Calculations are done both by the finite elements method and using FDTD simulations. We discuss the effect of that excitation on extraordinary transmission by the slit, and compare it with cases in which there are only evanescent or weakly propagating waves at the exit of the aperture. In this way, we show the dominant role of the MDR over the aperture enhanced transmission as regards the resulting transmitted intensity and its concentration inside the cylinders. When sets of these particles are placed in front of the slit, like linear or bifurcated chains, with or without bends, one can control the concentration of MDR in the stationary state by designing the parameters, so that these surface waves are coupled by both waveguiding of the nanocylinder eigenmodes and by scattered propagating waves. Also, the choice of the wavelength and polarization of the illumination, allows to select the excitation of either bonding or antibonding states of the field transmitted through the aperture into the particles. Metallic cylinders can exhibit nanoantenna characteristics.
Besides, these MDR are further enhanced when a beam emerges from the slit, due to a periodic corrugation in the slab.

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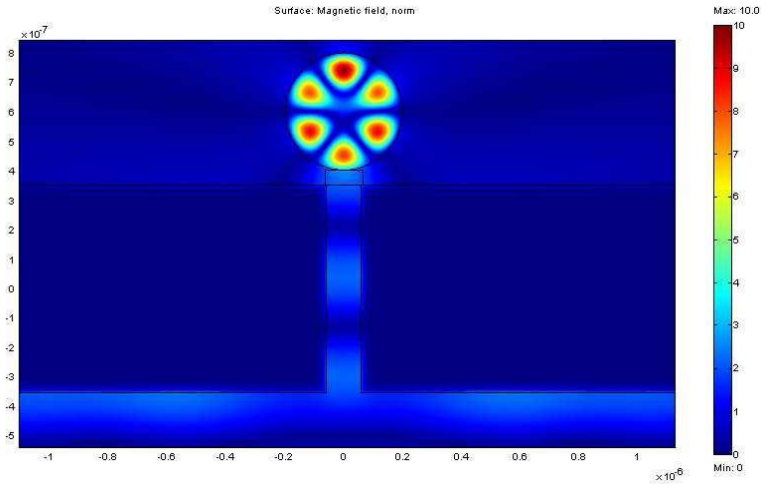
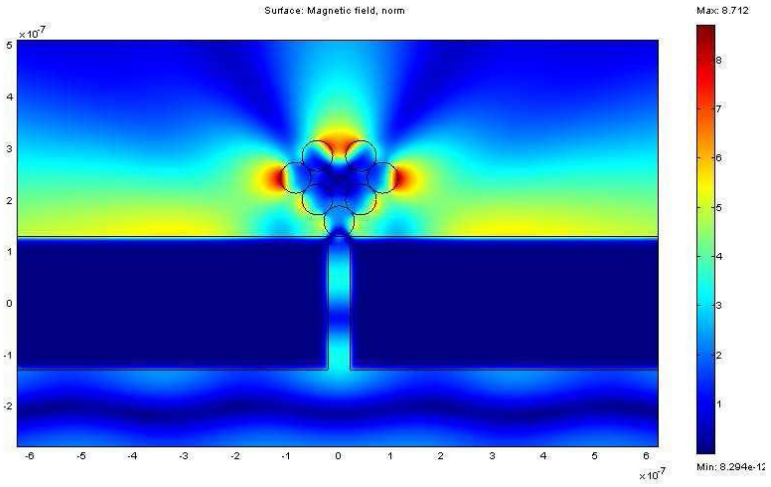


Magnetic field modulus (A/m) of a slit in supertransmission. Wavelength: 750*nm*, p-polarization) in presence of a dielectric cylinder (refractive index n = 3. 670+i0.005, radius r = 200*nm*) placed at 50nm of the exit plane of the aperture. The *WGH*31 mode has been excited.



Magnetic field modulus (A/m) in a bifurcation with not vertical elbow (angle between chains at bifurcation: 90º, elbow angle: 90º. Distance between cylinders: 0*nm*) of seven metallic cylinders (refractive index n = 0.234+i1.275, radius r = 60*nm*) in front of a metallic slit (refractive index n = 0.135+i10.275, slab width: 2562.96*nm*, slab thickness: 258.13*nm*, slit width: 43.02*nm*) under p-polarization, wavelength: 346*nm*). The *LSP*11 mode is excited.