High Refractive Index dieletric dimer as element unit for switching devices

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Low loss high refractive index (LLHRI) dielectric particles (like Si, Ge and other semiconductor compounds in the NIR) and smaller than the incident wavelength, have recently shown to be an alternative to the conventional metallic particles to overcome their inherent ohmic losses[1]. Furthermore, the coherence effects between the electric and magnetic excited resonances lead to interesting directionality properties[2,3] which, suitably handled, make them useful in many different applications for new designs of metamaterials, sensors or optical devices[4-6]. Here, we investigate both numerically and experimentally, the possibility of using a dimer of spherical particles made of LLHRI material, as elementary unit for building a binary switching device. This binary state will depend on the polarization of the incident radiation[7]. The study of this effect was done through the analysis of the linear polarization degree of the light scattered perpendicular to the exciting incident beam, $P_L(90°)$. This parameter contains information about the magnetic or electric character of the resonances. The scattered intensity at 90° reaches null or maximum values at the same frequency of the incident electromagnetic radiation perpendicular, I_S, or parallel, I_P, to the scattering plane, respectively. This effect is especially relevant when both particles are close enough and interact electromagnetically, as it is evidenced in Fig. 1.

References

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Figures

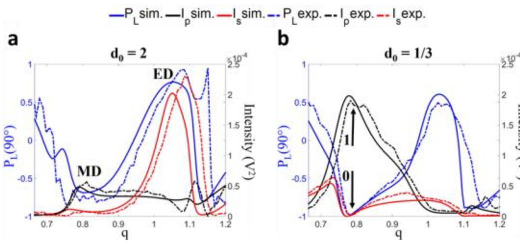

Figure 1: Linear polarization degree at the right scattering configuration and scattered intensities, I_P or I_S parallel and perpendicular respectively to the scattering plane, for a dimer of spherical silicon particles for two different distances between the particles as a function of the parameter size q ($q = 2\pi R/\lambda$ where R is the particle radius and λ is the wavelength of the incident radiation). In **a)** the relative distance between the particles is d_0 =2 (weak electromagnetic interaction) and in **b)** d_0 = 1/3 (strong electromagnetic interaction). d_0 is defined as the ratio between the dimer gap distance and the particle radius, R. Simulated (solid blue line) and measured (dashed blue line) $P_L(90^o)$. Simulated (solid red line) and measured (dashed red line) I_S. Simulated (solid black line) and measured (dashed black line) I_P.