Effect of Extinction on the High Energy Optical Response of Photonic Crystals

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An analysis of the optical response of photonic crystals in the high order band energy range ($\lambda \leq$ lattice parameter) is herein presented. High and abruptly fluctuating specular reflectance is predicted for perfect lattices at those energies even in the absence of any photonic gap or pseudogap. As optical extinction is gradually introduced, it is possible to reproduce experimental results found in the literature and which have recently been the subject of an intense debate. Band structure calculations demonstrate that extinction is extraordinarily amplified in the high energy range and is responsible for the features so far observed in that range in real crystals.

Our results demonstrate that, at the high-energy region, perfect 3D PCs should present a very intense and highly fluctuating reflectance spectrum, which smoothens due to extinction sources of different sort. All measurements reported up to date at those frequencies for sphere fcc lattices show just a peak or dip structure reminiscent of the well-defined one expected for a perfect lattice. The agreement between our model and the optical experiments supports the idea that extinction plays a crucial role determining the shape and intensity of these features. The effect of diffraction on the observed high energy features is clarified.

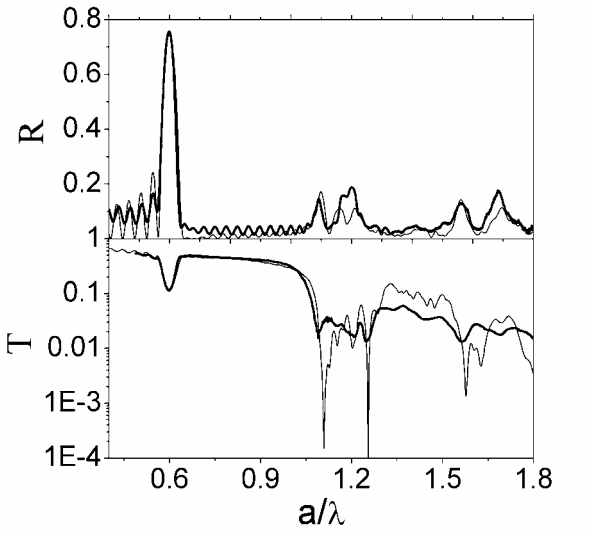

Figure1. Comparison between experimental (thick line) and theoretical (thin line) reflectance (upper graph) and transmittance (lower graph) spectra for face centred cubic sphere crystals.