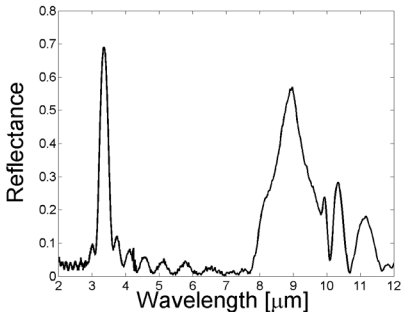
A three-dimensional photonic crystal with a polaritonic gap

Herman Högström and Carl G. Ribbing*
Department of Engineering Sciences, The Ångström Laboratory, Uppsala University
Box 534, SE-751 21 Uppsala, e-mail: herman.hogstrom@angstrom.uu.se
*and Dept. of Functional Materials, Swedish Defense Research Agency, Linköping
SWEDEN

In photonic structures gaps have different origins. Oscillators e.g. electrons or ions, give rise to imaginary k-vectors for photons in various wavelength intervals. Another way to obtain an imaginary k-vector is to structure a material periodically, i.e. a photonic crystal. Photonic crystals consisting of dielectric or metallic materials have been successfully fabricated in one to three dimensions, but not much has been done using polaritonic materials. We demonstrate, to our knowledge for the first time, an experimental demonstration of a three dimensional photonic crystal with a polaritonic gap, PG. The crystal was made by sedimentation of silica microspheres with d=1.58µm that formed a fcc structure. Bulk silica has a reflectance band close to λ=9 µm. The reflectance peak originating from the fcc structure results in a peak at 3.4 µm. Both peaks are clearly seen in the reflectance spectrum. Since the PG is a bulk material property it is not obvious that small structures, e.g. microspheres, will exhibit bulk optical properties. This contribution demonstrates the possibility to simultaneously have a polaritonic and a structural gap in a three-dimensional photonic crystal.



Reflectance spectrum for a three dimensional photonic crystal made of silica spheres with d=1.58 µm.