Towards a full understanding of the growth dynamics, optical response and crystalline structure of self-assembled photonic colloidal crystal films

Gabriel Lozano, Luis A. Dorado, Ricardo A. Depine, Hernán Míguez

Recent advances in the comprehension of the growth dynamics of colloidal crystal films opens the door to rational design of experiments aiming at fabricating lattices in which the density of intrinsic defects is minimized.[1,2] Since such imperfections have a dramatic effect on scattered light of wavelength smaller than the lattice constant, the evaluation of the experimental optical response at those energy ranges, based on the comparison to rigorous calculations, is identified as the most sensitive guide to accurately evaluate the progress towards the actual realization of defect-free colloidal crystals.[3] The importance of the existence of a certain distortion becomes particularly relevant at the above mentioned energy range. We have thoroughly analyzed the effect of fine structural features on the optical response to conclude that, rather than the generally assumed FCC lattice of spheres, opal films are better approximated by a rhombohedral assembly of distorted colloids. Interparticle distance of actual colloidal crystals coincides with the expected diameter for spheres belonging to the same close-packed (111) plane but differs significantly in directions oblique to the [111] one.[4]

[1] G. Lozano, H. Míguez, *Langmuir* **23**, 9933 (2007).
[2] G. Lozano, H. Míguez, *Appl. Phys.Lett.* **92**, 091904 (2008)
[3] G. Lozano, L. A. Dorado, D. Shinca, R. A. Depine, H. Míguez, *J. Mater. Chem.* **19**, 185 (2009)
[4] G. Lozano, L. A. Dorado, D. Shinca, R. A. Depine, H. Míguez, *Langmuir* **25**, 12860 (2009).