Fast fabrication of photonic glasses achieved by pressure

Denise Montesdeoca, Andre Espinha, F. Bayat, Carlos Pecharroman, Cefe Lopez, and Alvaro Blanco

Instituto de Ciencia de Materiales de Madrid ICMM-CSIC
c/Sor Juana Inés de la Cruz, 3, Cantoblanco, 28049 Madrid, Spain
d.m.c@icmm.csic.es

Abstract

Photonic random structures presenting multiple light scattering have been of great interest in the last few years [1] and their fabrication has led to the development of new and sophisticated fabrication methods. In these systems, important fundamental phenomena such as Anderson localization of light might take place [2]. Further, polymeric photonic glasses have recently demonstrated resonant light transport [3] in which random lasing can be controlled [4].
Here we show a new method to prepare photonic glasses from different colloidal suspensions (SiO_2, Polystyrene, or PMMA) in a very fast way. Starting from raw materials in powder form (as synthesized or purchased) we propose a method for fabricating high quality photonic glasses in minutes, by applying pressure [5]. Our studies on how monodisperse building blocks pack open a new window to understand light behavior in complex optical media. Further, this work might provide deeper knowledge on random granular media at the nanoscale [6].

References

[1] D. S. Wiersma, Nat. Phot. 7 (2013) 188.
[2] D. S. Wiersma, P. Bartolini, A. Lagendijk, and R. Righini, Nat. Phot. 390 (1997) 671–673.
[3] P. D. García, R. Sapienza, Á. Blanco, and C. López, Adv. Mater. 19 (2007) 2597.
[4] S. Gottardo, R. Sapienza, P.D. García, Á. Blanco, D. S. Wiersma, and C. López, Nat. Phot. 2 (2008) 429.
[5] D. Montesdeoca et al. submitted (2015).
[6] Y.Kallus, S. Torquato, Ph. Rev. E, 90 (2014) 022114.

Figures

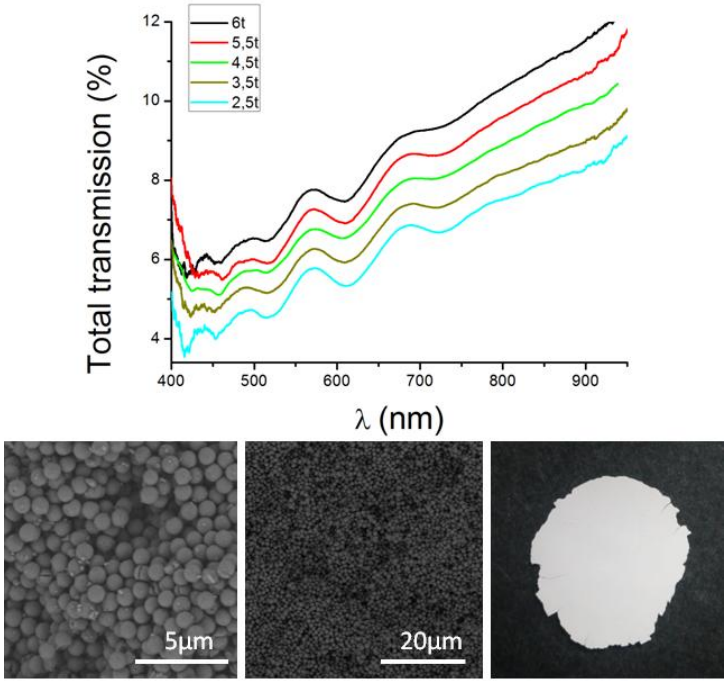

Figure 1. Resonant total transmission for silica photonic glasses composed of spheres with 920 nm in diameter, for different applied pressures (up). Scanning electron microscopy images and optical image of a silica photonic glass for an applied pressure of 6t (460 MPa) (bottom).