Scattering due to Structural Defects in 3D Woodpile Photonic Crystals

Stefan Aeby
Geoffroy J. Aubry
Frank Scheffold

University of Fribourg, Ch. Du Musée 3, 1700 Fribourg, Switzerland

stefan.aeby@unifr.ch

Abstract

Structured dielectric materials in three dimensions can exhibit photonic properties that allow the control of the propagation of light [1]. For crystalline structures, a complete or incomplete photonic band gap emerges and the propagation of light is hindered or even completely suppressed over a certain range of wavelengths [1,2]. Full photonic band gaps can be found in structured dielectric materials with a sufficiently high refractive index contrast.
However, imperfections in the crystal cause light scattering and extinction of coherent propagating waves [3]. Positive as well as negative defect volume contribute to this kind of optical perturbations of the material.
Here we present a study of fabrication and characterization of three-dimensional disordered metamaterials. We study woodpile crystals showing photonic features in the near infrared. We discuss the fabrication of the structures by means of direct laser writing (DLW). Furthermore, we study experimentally and numerically the influence of intentionally added random defects on light scattering properties in periodic woodpile structures.

References

[1] J.D. Joannopoulos, Photonic Crystals: Molding the Flow of Light, 2008.

[2] C. Marichy, N. Muller L.S. Froufe-Pérez and F. Scheffold,Scientific Reports, Scientific Reports 6, (2016) 21818

[3] Koenderink et al., Phys. Rev. B 72 (2005) 153102

Figures

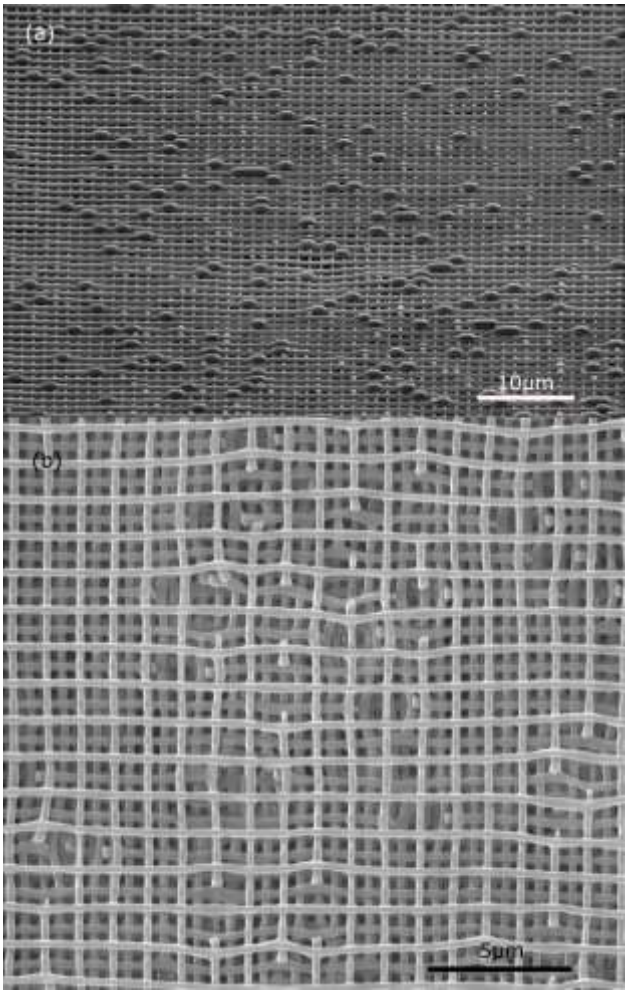

Figure 1: Polymer woodpile structure including positive (a) and negative (b) volume defects.