

Structural and diffractive properties of two-dimensional photonic lattices in polymer-dispersed liquid crystals

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Liquid crystals (LCs) provide a number of outstanding features for the fabrication of tunable photonic bandgap structures. Composites with remarkable properties are achieved by incorporating LCs into photopolymer networks. Various photonic architectures can be realized in such composites by holographic lithography technique. This can be exploited for fast and relatively simple fabrication of 1-, 2- and 3-dimensional photonic crystals.

The relationship between LC orientational ordering and optical diffraction properties was investigated for a 2-dimensional photonic square lattice fabricated in a polymer-dispersed LC composite. To that purpose samples of 12 μm thickness were prepared from a UV curable emulsion composed of commercially available ingredients. To obtain a 2-dimensional square interference pattern, an expanded linearly polarized output beam from an Argon ion laser at $\lambda = 351 \text{ nm}$ was sent through a four-fold glass pyramid with an inclination angle of 2° [1]. This results in a square lattice with a lattice constant of 13.2 μm .

The first part of our analysis was focused on a comparison between the structural transition induced by an external electric field and the phase transition induced by heating or cooling of the sample [2]. Modifications were detected by polarization microscopy and by analysis of far-field light diffraction patterns. Intensities of diffraction orders from the 0th up to the 10th diffraction order were monitored and their variations were correlated with the modifications of the director field as observed under the microscope.

Another part of the study was devoted to the effects of addition of nanoparticles of LiNbO_3 on the diffractive and switching characteristics of such holographic polymer-dispersed LC lattices.

(1) M. Lei M, B. Yao, R. A. Rupp, *Opt. Express* 2006, **14**, 5803.

(2) M. Devetak, J. Milavec, R. A. Rupp, B. Yao, I. Drevenšek-Olenik, *J. Opt. A: Pure Appl. Opt.* 2009, **11**, 024020.