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Optical modes of photonic structure containing nematic with abnormal electro-convective rolls

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The Fabry-Pérot cavity-type multilayer photonic structures based on the distributed Bragg mirrors evoke great interest as a promising optical material for nanophotonics and optoelectronics functional elements. A thin twisted nematic layer with the strongly violated Mauguin's waveguide regime gives rise to the unique spectral features of multilayer photonic structures [1].

In this paper, the optical modes of the multilayer photonic structure with a defect layer of the electro-convective nematic with the abnormal roll instability have been investigated. In contrast to the well-known Williams domains, this instability is characterized by the homogeneous twist deformation of the director field [2]. In this case, the incident *o*-wave diffracts on the roll-structure in nematic layer. The diffraction pattern is a superposition of zero-order reflex linearly polarized perpendicular to the director and zero- and higher-order reflexes polarized parallel to the director (cross-polarized diffraction). Under the voltage growth, the cross-polarized diffraction results in smooth decay of resonant ordinary (*ro*) modes of a cavity. The observed short-wave range shift of the *ro*-modes (Fig. 1) is attributed to the contribution of the geometric phase to the total phase delay experienced by the wave during a round-trip propagation [3]. The proposed approach based on a photonic structure analysis can be used for the study of the features of spatially periodic structures in dissipative liquid-crystalline systems with a complex director field configuration because of the high sensitivity of the optical modes to the electro-convective processes.

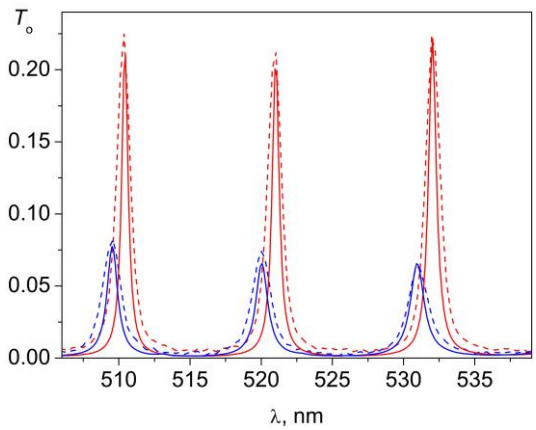

Figure 1 – Spectral positions of the modes in the photonic bandgap center without (red lines) and under (blue lines) voltage, measured (dashed lines) and simulated using the 4×4 transfer matrix method (solid lines).

References:

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[3] V. Gunyakov, M. Krakhalev, I. Timofeev, et al., *Opt. Mater.*, **100**, 109630 (2020).

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