Wide band gap materials as a new tuning strategy for dye doped cholesteric liquid crystals laser

G. Petriashvili[b], M. A. Matranga[a], M. P. De Santo[a], G. Chilaya[b], R. Barberi[a]

a CEMIF.CAL, CNR-Licryl Lab., Physics Department, University of Calabria, Rende (Cs), Italy
b Institute of Cybernetics, Euli str. 5, 0186, Tbilisi, Georgia

Photonic properties of Cholesteric Liquid Crystals (CLCs) brought attention to a new field of liquid crystal science and technology: mirrorless lasing. Owing to the unique property: a supramolecular helicoidal periodic structure; and hence a 100% selective reflection of circularly polarized light, the cholesteric can be considered as a resonator in laser emission from doped luminescent molecules. The idea to build up a laser by using a CLC was patented several years ago by Goldberg and Schnur [1] and lasing from dye-doped CLC was obtained for the first time by Ilchishin et al. [2]. The consideration by Kopp et al. [3] of a CLC as a medium with a photonic band allowed to explain the observed laser emission at the edge of the selective reflection band in the dye-doped CLCs. The ability to change the position of the selective reflection range modifying external factors provided the possibility to make frequency tunable distributed feedback lasers. The change of the pitch in these systems was easily achieved by the change of the chiral dopant concentration, by temperature variation, by mechanical stress or by electric field.
Here we present two new strategies to finely tune the laser emission and to widen the range of the emitted wavelengths (420 nm - 790 nm) using a multilayer system. A three layer cell is prepared with two cholesteric layers sandwiching a layer containing an isotropic mixture of a photoluminescent dye. One of the chiral layers contains a wide band gap material while the second layer consists of a series of small band gap materials. Through the combination of these two layers, a series of mirrors that can selectively reflect different wavelengths is obtained. A different laser wavelength is emitted from different regions of the cell under the pumping beam irradiation.

References

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