Stability study of polymerized cholesteric liquid crystal laser array

Mi-Yun Jeong¹*, Ki Soo Chung¹, and Jeong Weon Wu²*

¹ Department of Physics and Research Institute of Natural Science, Gyeongsang National University, Jinju, Gyeongnam 660-701, South Korea
² Department of Physics and Quantum Metamaterials Research Center, Ewha Womans University, Seoul 120-750, South Korea

Fine-structured polymerized cholesteric liquid crystal (PCLC) wedge cells were fabricated, and verified the high fine spatial tunability of the lasing wavelength, with resolution less than 0.3 nm in a broad spectral range. For a practical device applications, their stability was studied in detail over time and in response to strong external light sources and thermal perturbation. The PCLC wedge cells had good temporal stability for 1 year, and showed good stability for strong perturbations. After harsh trials, the PCLC cells showed lasing wavelength shifts of less than 1 nm, and the laser peak intensities were decreased by up to 34%. After temperature cycling, the high energy band edge of the PBG red shifted by 3 nm, while there were no PBG shifts in response to light perturbation. The polymerized CLC cell is most strongly influenced by the temperature for all the perturbation cases. When the lasing wavelength of the spatial point of the cell is blue shifted (or red shifted) by 1 nm, the lasing wavelength of just beside the point of the cell is also blue shifted (or red shifted) by 1 nm, or all the spatial points of the PCLC cell are blue (or red) shifted simultaneously, or when we consider the entire lasing spectrum for the PCLC cell, the 1-nm wavelength shift does may not matter. Although the laser peak intensities were decreased by up to 34% in total for all the perturbation cases, the remaining 34% laser peak intensity is considerable extent to make use. Therefore, the PCLC cell had good stability for strong light and thermal perturbations. This research will be useful for practical CLC laser device development.

[1] Reference