Spatially continuous tunable cholesteric liquid crystal laser array and its optical properties

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Finely spatial-structured 1D cholesteric liquid crystal (CLC) laser array devices have been realized. With tuning wavelength resolution less than 0.3 nm in full visible spectral range, more than one hundred laser lines could be obtained in a general CLC or in a polymerized CLC (PCLC) cells without extra devices. The continuous tuning behavior of the CLC cell is due to the fact that the concentration of the pitch gradient matches the helical pitch determined by the wedge cell thickness. For practical device application of PCLC, we studied the stability of the device in detail over time, strong external light sources, and thermal perturbation. Although the laser peak intensities were decreased by up to 34% in total for all of the perturbation cases, the remaining 34% laser peak intensity is considerable extent to make use. This good stability of the PCLC laser device is due to the polymerization of the CLC by UV curing.

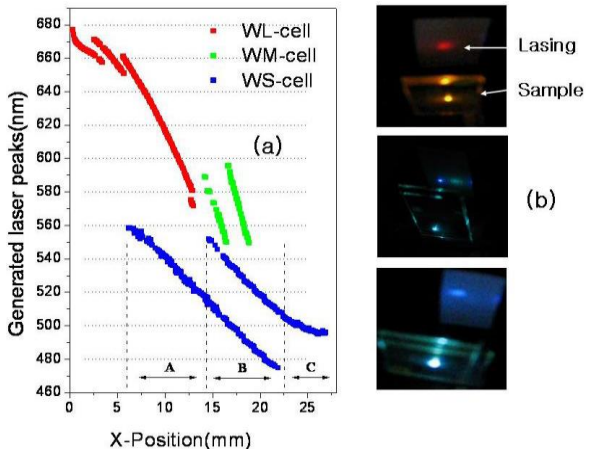

Fig. 1. Laser lines of the wedge cells as a function of spatial position for each WL-, WM-, and WS-cell, respectively; (b) Photographs of red, green and blue lasing.

We also experimentally studied the comprehensive optical properties of the laser lines and fluorescent spectrum generated by a continuous tunable CLC laser array. We found that the laser lines generated from a CLC with a right(left)-handed circular helix were right(left)-handed circular polarized, respectively and inside the photonic band gap, the CLC structure with right-(left-) handed helicity suppressed the fluorescence generated with right (left) circular polarized light and instead the suppressed right (left) circular polarized light energy moved to the outside of the photonic band gap, so we can say that the fluorescence intensity outside of the photonic band gap is enhanced with right (left) handed circular polarized light, respectively. This study will be helpful for practical CLC laser device development.

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