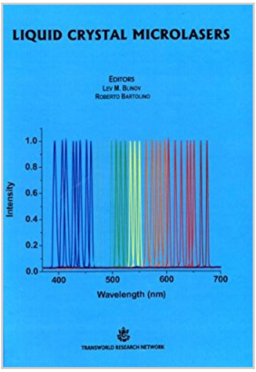

Liquid Crystal Microlasers

By Editor: Lev M. Blinov and Roberto Bartolino

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This book covers the most important results of studying liquid crystal microlasers for the last decade although the pioneering works on this type lasers have been made much earlier (for the history see Chapter 1). In fact, it is the first book on the subject. The main part of the book deals with low-threshold distributed feedback lasers on dye-doped cholesteric liquid crystals. These are helical materials that possess intrinsic periodicity and manifest optical properties of one-dimensional photonic crystals easily controllable by external factors such as temperature, mechanical stress, UV radiation, electric field, etc. The problems of tuning frequency, polarization and directionality of laser light and some technological aspects are discussed in Chapters 2, 4, 11 and 13. A review of pioneering works on lasing from dye-doped helical liquid crystal polymers is presented in Chapter 7. The laser effects in the cholesteric blue phase that is, in fact, the genuine three-dimensional photonic crystal, are described in Chapters 12 and 13. A special attention has been paid to investigations of the so-called defect modes (Chapters 2 and 4). The break of ideal periodicity of the helix of a cholesteric liquid crystal creates extraordinary narrow transmission bands in the otherwise forbidden photonic stop-band. Within these spectral lines the lasing threshold is especially low. The problems of the laser threshold and other theoretical issues are discussed in Chapters 1, 6, 8 and 12 whereas Chapter 9 makes an accent on the enhancement of the output efficiency of cholesteric microlasers. Nematic liquid crystals are very sensitive to electric field but they are not periodic. Therefore a photonic bandgap structure of a laser device should be made artificially. Distributed feedback microlasers based on the periodic liquid crystal structures tunable by electric voltage can be prepared by holographic techniques. The schemes may be different: Chapter 6 describes the in-plane periodic structures of a lasing waveguiding layer made by optical separation of polymer and liquid crystal materials from their mixtures. Other periodic structures described in Chapter 10 consist of alternating pure polymer layers with layers of polymer-dispersed liquid crystalline materials. Such stacks form Bragg mirrors and a laser dye may be introduced either inside the stack or within an additional micro-cuvette attached to the stack. Laser on the dye-doped nematic liquid crystal placed in a micro-cuvette with interdigitated electrodes playing the role of a periodic shadow mask for the pump beam is described in Chapter 5. In this case, the mask provides modulation of both the gain and the refraction index and, therefore, the laser frequency is controlled by low voltage from the interdigitated electrodes. In the same Chapter 5, for the first time, a possibility of the voltage controlled gain spectra is discussed and the constructions of light microamplifiers for cholesteric liquid crystals have been suggested. Nematic liquid crystals manifest also interesting lasing effects caused by light scattering in strong optical fields and related to the so-called random lasers (Chapter 3). We hope that the book will be useful for investigators and engineers working in the fields of information technology, optics, holography, liquid crystal displays and other fields related to photonics and electro-optics. The technology of microlasers on liquid crystals is compatible with planar technology of microchips and allows the development of matrix laser multi-colour structures (see Chapter 13), compatible with light amplifiers controlled by electric field. Other possibilities are opening in the field of optical sensors based on waveguiding microlasers. We thank the leaders of the groups who directly collaborated with us on this project for their patience, advise and help: Masanory Ozaki, Gius

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