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"Liquid crystalline systems as sources of electrically tunable laser white light"

DESCRIPTION FOR THE GENERAL PUBLIC

A conventional laser emits photons of the same color and phase so that the corresponding output beam is directional and has high power density. A white-light laser, which has optical characteristics similar to that of a conventional laser, however, demonstrates multicolor emission based on the mixture of the three basic colors: red, green, and blue. When compared to white-light light-emitting diodes, white-light lasers have the advantages of low beam divergence and high power density emission. Hence, white-light lasers find scientific applications such as the lasing sources of three dimensional (3D) optical tweezers, fluorescence microscopy, and true-color 3D holograms. More importantly, white-light lasers have potential utilization in consumer products such as spotlights and headlights of automobiles as well as laser lighting.

Liquid crystals belong to the class of soft matter showing properties of crystals and flow as liquids. Characteristic for them is the long range orientational order, enabling easy tuning of their properties by optical, magnetic and electric fields. Some liquid crystals e.g. cholesterics or stabilized by polymerization "blue phases" show the existence of a photonic bandgap for visible light. Photonic bandgap materials have attracted considerable attention in recent years because of their ability to control the propagation of light. It can slowdown and even trap the light with frequencies in close vicinity of photonic bandgap. Therefore such materials are interesting for applications in designing new laser light sources, active filters, waveguides, nonlinear optical elements or all-optical switches. Especially interesting are tunable resonators, in which resonance frequency can be tuned by changes in size, shape, temperature or external electric field. The main task of this research project is synthesis or organic and hybrid organic/inorganic systems and characterization of new, hybrid materials based on modified and/or dye doped liquid crystals showing laser light generation upon optical pumping enabling emission of white light. The task of the project is also description of light amplification mechanisms based on distributed feedback on periodic or random micro and nano-objects (resonators) containing dye-doped liquid crystals.