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LIGHT-INDUCED GENERATION OF LOCALIZED TWISTED STRUCTURES IN THE THIN FILMS OF LIGHT-RESPONSIVE CHIRAL NEMATIC LIQUID CRYSTALS

A. Piven (ITMO University), **D. Darmoroz** (ITMO University), **V. Belyaev** (ITMO University)
Supervisor – Ph.D., Leading researcher of the REC "Infochemistry" T. Orlova
(ITMO University)

The paper presents a method for creating a wide wealth of static and dynamic localized complex structures in thin films of a light-responsive chiral nematic liquid crystal by optically induced photochemical transformations of chiral dopant molecules.

Introduction. Liquid crystal materials are well-known to demonstrate various types of defect structures, whose optical properties can be used for different applications in optics and photonics. These defect structures cannot be transformed into one another by continuous changes of the material ordering, that also makes such structures highly important for information storage.

The main part.
In thin films of frustrated chiral liquid crystals, various localized defect structures can be created by optically induced reorientation of liquid crystal molecules by either structured or unstructured light beams. A new approach based on light-induced control of the cholesteric helix, allows to create a unique dynamic revolving pattern and several static localized structures by an ultraviolet Gaussian beam with a beam power of only tens nW. The interaction between the twisting of the supramolecular structure and the diffusion of chiral molecular motors creates a continuous, regular and unidirectional rotation of the liquid crystal structure under non-equilibrium conditions. Our research is aimed at a detailed study of the relationship between the structure and behavior of light-induced localized supramolecular patterns in the thin films of frustrated chiral nematic liquid crystals with controlling the spatiotemporal characteristics of a recording light beam. We investigate the light-driven reconfiguration of the generated structures to demonstrate the possibilities of structural rearrangement of localized chiral structures. Intensive scientific and technical development in the fields of adaptive, tunable, reconfigurable optical elements for photonic devices, 3D optical memory cells and light structured by optically anisotropic complex materials stimulate our research.

Conclusions. The aim of this study is to generate a wide wealth of static and dynamic localized complex structures in thin films of a light-responsive chiral nematic liquid crystal by optically induced photochemical transformations of chiral dopant molecules. Then, the light illumination of the frustrated chiral liquid crystal by a Gaussian beam enables the local winding of cholesteric helix and formation of localized twisted patterns. The resulting localized space-variant birefringent structures can be used to create, for example, a multifunctional material with an arbitrary array of microscopic lenses or deflectors.

Anastasiia Piven (author) Signature 

Tetiana Orlova (supervisor) Signature