УДК 544.252.22

CONTROLLING THE BEHAVIOR OF LOCALIZED REVOLVING STRUCTURES IN LIGHT-RESPONSIVE CHIRAL NEMATICS LIQUID CRYSTALS

A. Piven (ITMO University), **D. Darmoroz** (ITMO University)
Supervisor – Ph.D., leading researcher T. Orlova
(ITMO University)

Introduction. Nowadays, it is widely known that liquid crystal materials can demonstrate various types of orientation defects in a partially ordered molecular field. Liquid crystal structures with such defects have non-trivial optical properties useful for technological applications in optics and photonics. On the other hand, such defects cannot be obtained by a continuous change of the liquid crystal material ordering, that also opens prospects for using such structures for recording and storing information at the molecular level [1, 2].

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 by both structured and Gaussian light beams [3, 4]. A recent approach based on light-induced control of cholesteric helix allows to generate multiple localized static structures as well as a unique dynamic revolving pattern by an ultraviolet Gaussian beam with a beam power of only tens of nW [5]. 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 nematics with controlling the spatiotemporal characteristics of a recording Gaussian light beam.

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. We found that a large-sized dynamic patterns demonstrate unstable revolving behavior. This problem can be solved by changing the beam waist of a recording Gaussian light beam.

References:

1. Ackerman, P.J. Two-dimensional skyrmions and other solitonic structures in confinement-frustrated chiral nematics / P.J. Ackerman, R.P. Trivedi, B. Senyuk, J. Lagemaat, I.I. Smalyukh // Physical Review E. 2014, №90.
2. Ackerman, P.J. Optical generation of crystalline, quasicrystalline, and arbitrary arrays of torons in confined cholesteric liquid crystals for patterning of optical vortices in laser beams / P.J. Ackerman, Z. Qi, I.I. Smalyukh // Physical Review E. 2012, №86.
3. Evans, J.S. Optical generation, templating, and polymerization of three-dimensional arrays of liquid-crystal defects decorated by plasmonic nanoparticles / J.S. Evans, P.J. Ackerman, D.J. Broer, J. Lagemaat, I.I. Smalyukh // Physical Review E. 2013, №87.
4. Hess, A.J. Control of Light by Topological Solitons in Soft Chiral Birefringent Media / A.J. Hess, G. Poy, J.B. Tai, S. Zumer, I.I. Smalyukh // Physical Review X. – 2020, №10.
5. Orlova, T. Revolving supramolecular chiral structures powered by light in nanomotor-doped liquid crystals / T. Orlova, F. Lancia, C. Lossert, S. Lamsaard, N. Katsonis, E. Brasselet // Nature Nanotechnology. 2018, №13. p. 304–308.