Nanocomposites and nanomaterials

Nonlinear helical winding in highly viscous chiral thin films

A. Iljin[1], A. Gridyakina[2], H. Bordyuh[2]

[1] *Institute of Physics, NAS of Ukraine, Prospect Nauki 46, Kiev 03028 Ukraine. E-mail: lgtc@iop.kiev.ua*

[2] *National Aviation University, Prospect Komarova 1, Kiev 03058 Ukraine.*

Novel highly viscous chiral liquid crystalline (HVCLC) compositions have been attracting a lot of interest due to sensitivity of their photonic band gap to shear deformation. The system has revealed a gigantic shift of the selective reflection band under stretching and manifested mechanically tuned lasing in a wide range [1,2]. Novel rotation/displacement remote sensors with high accuracy and discrimination being well inferior to milliradians could be realized with these compositions [3].

The HVCLC systems were obtained by mixing cyclic oligomers able to form glassy state at a room temperature with low molar mass compounds based on cholesterol derivatives. Optical transformations occurring under a minute shift of substrates bounding HVCLC compound and their dependence on the concentration clearly point to the inclination and expansion of the helical structure that does not correspond to the behavior of usual low molecular mass cholesterics. In addition, the composition manifests an unusual nonlinear concentration dependence of its helical periodicity.

The model of coil formation due to physical bonding of nano- and micro-clusters of cyclic oligomer molecules is proposed for explaining the observed effects. Such elastic “floating springs” should influence the both optical and mechanical properties of HVCLC that could be useful for different electro-optical applications or opto-mechanical and deformation sensing.

1. *Shibaev P.V., Rivera P., Teter D. et al.* Color changing and lasing stretchable cholesteric films // Opt. Express.-2008.**-16.-**P. 2965–2970.

2. *Shibaev P. V., Uhrlass R., Woodward S. et al.* Cholesteric materials with photonic band gap sensitive to shear deformation and mechanical sensors // Liq.Cryst. -2010.**-37**.-P. 1601–1604.

3. *Shibaev P. V., Iljin A., Troisi J., Reddy K.* Distant optical detection of small rotations and displacements by means of chiral liquid crystals // AIP Advances.-2014.**-4**.-P. 017115-11.