Diastereomeric Domains of Chiral Guest Mesogens confined in Helical Nanofilament Networks of B4 Liquid Crystal

D. Chen¹, M. Tuchband¹, B. Horanyi¹, E. Korblova², D. M. Walba², J. E. Maclellan¹*, M. A. Glaser¹ and N. A. Clark¹

1 Department of Physics and Liquid Crystal Materials Research Center, University of Colorado, Boulder, USA
2 Department of Chemistry and Biochemistry and Liquid Crystal Materials Research Center University of Colorado, Boulder, USA.

Mixtures of the bent-core liquid crystal material NOBOW with a variety of guest mesogens have been studied using polarized optical microscopy and freeze-fracture transmission electron microscopy. The mixtures are homogeneous and isotropic at high temperature but upon cooling, B4 domains nucleate and phase-separate directly from the melt, forming locally homochiral, dendritic networks of helical nanofilaments (HNFs). The sample is typically a conglomerate of independently nucleated left- and right-handed B4 domains, each many tens of microns across, with the isotropic guest material now confined to the nanoscale interstitial volumes between the filaments. We have studied the behavior of these nanophase-separated mixtures as the guest component is cooled from the isotropic to the nematic and smectic phases. When the guest material is chiral, we observe a dramatic difference in the optical appearance of the diastereomeric domains, with opposite signs of birefringence in the two diastereomeric domains when the guest material is nematic (Fig. 1a) and the birefringence changing sign in one set of domains at the nematic to smectic transition (Figs. 1b,c). This optical behavior is an extremely sensitive indication of the chirality of the nematic guest in the twisted environment of the helical nanofilament network pores (Figs. 1d,e), suggesting novel applications of B4 materials as chirality detectors.

References:

* presenting author; E-mail: jem@colorado.edu