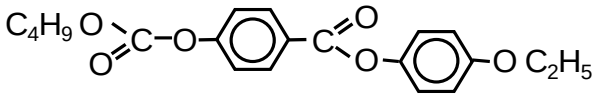
Twist disclination loops in a bent-core nematic liquid crystal–Electronic Supplementary Information

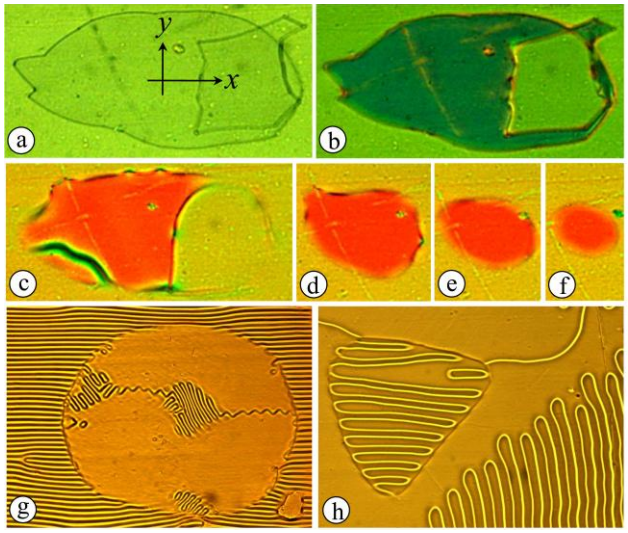
Kanakapura S. Krishnamurthy*[a], Pramod Tadapatri[a] and Wolfgang Weissflog[b]

[a]*Centre for Soft Matter Research, P. O. Box 1329, Jalahalli, Bangalore 560013, India. Email:murthyksk@gmail.com*
[b]*Martin-Luther-Universität Halle, Institut für Physikalische Chemie, von-Danckelmann-Platz 4, 06120 Halle (Saale), Germany*

Formation, detection and properties of π-twisted loops in a nematic liquid crystal composed of rod-like molecules

The experimental results described below concern the formation and stability of twist disclination loops in the calamitic nematogen butyl 4-(4-ethoxyphenoxycarbonyl) phenyl carbonate (BEPC). BEPC has a small positive dielectric anisotropy ε_a, varying between 0.21 at the crystal-nematic point (55 °C) and 0.06 near the nematic-isotropic point (86 °C). Its conductivity anisotropy is positive. Electroconvection and Freedericksz reorientation are known to be the dominant competing modes of instability in BEPC.[1]





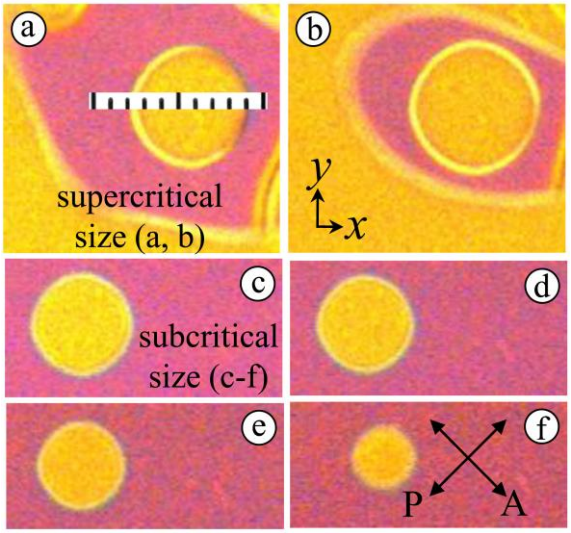


Fig. 1 Fig. 2

Fig. 1 Textures observed in an initially planar [n=(1, 0, 0)], 8 μm thick sample of nematic BEPC. The images in (a-f) show the process of formation of a normal twist loop L(T) separating inner π-twisted and surrounding untwisted regions in a supercooled nematic layer

at 45 ^{o}C, held between diagonally crossed polarizers: (a) Freedericksz distorted state, 38 V, 1kHz; the dark loops are a pair of closed wedge disclinations of strength 1/2, formed by the pincement of an annular Brochard-Leger wall; (b-f) time images of the same region as (a) after field removal; within the red island, the structure is π-twisted and outside, planar with the director along *x*; between crossed polarizers along *x* and *y*, the planar region becomes extinct, while the twisted region shows an interference colour due to the breakdown of the Mauguin condition.

(g) A planarly aligned elliptical region enveloped by a π-twisted region; an inverse twist loop L(P) exists between the two regions; the sample at 55 ^{o}C is subjected to an electric field along *z* and viewed with a single polarizer along *x*; 5.5 V, 5 Hz; the layer is in an electroconvecting state, exhibiting the conduction rolls; within the elliptical region, the rolls are oblique and localized; the wave vector in the surrounding region is along *y*, indicating the midplane alignment as along *x*.

(h) A π-twisted triangular region enveloped by a planar region; a twist loop L(T) exists between the two regions; the sample at 55 ^{o}C is subjected to an electric field along *z* and viewed with a single polarizer along *x*; 47 V, 100 kHz; the layer in the electroconvecting state is in the process of transforming to the Freedericksz state; the wavevector within the triangular region is along *y*, indicating the midplane alignment as along *x*; and the rolls are along *y* in the surrounding planar region, as expected.

Fig. 2 Supercritical and subcritical loops in BEPC at 80 ^{o}C viewed under diagonally crossed polarizers. It is noteworthy that the birefringence colour within the loops differs from that outside. The critical diameter is found to be about 30 μm. Scale division 5 μm.

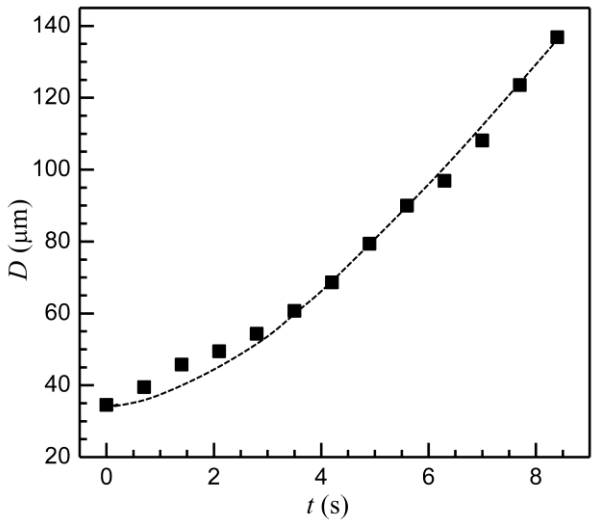


Fig. 3

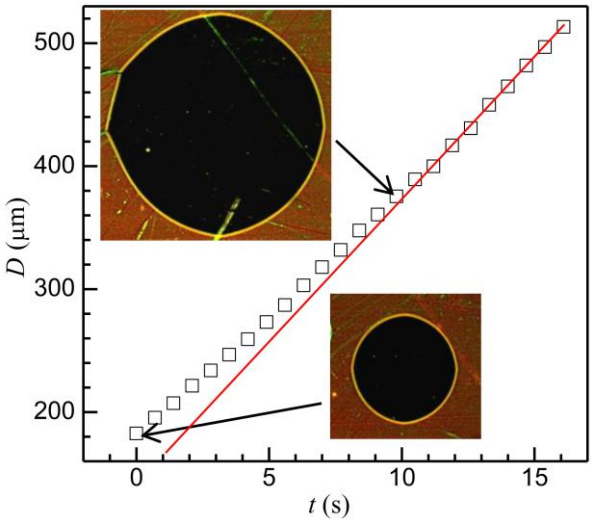


Fig. 4

Fig. 3 Time dependence of diameter for an enlarging circular twist loop L(P) in a layer of BEPC of 8 μm thickness. The critical radius R_c is about 15 μm. The dotted line is the fit to the model discussed in Appendix A of the paper. The relaxation time for the fitted curve is 0.06 s corresponding to γ_1/k=4.6 ms μm^{-2}, which is an order lower than the corresponding value for the bent-core nematic discussed in the paper.

Fig. 4 Time dependence of diameter for an expanding circular twist loop L(P) of large radius in a layer of BEPC of 8 μm thickness, showing a near linear variation in the long thread regime. The slope of the curve in the end region (23.3 μm s^{-1}) corresponds to γ_1/k=4.4 ms μm^{-2}.

References

1 Pramoda Kumar and K. S. Krishnamurthy, *Phys. Rev. E: Stat., Nonlinear, Soft Matter Phys*., 2006, **74**, 031705.