

# Programmed Generation and Manipulation of Disclinations by Two Dimensional Constraints

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The half integral strength disclinations are unique topological singularities ubiquitously found in liquid crystals from which the term “nematic” originated. As such, the understanding of the microscopic and macroscopic structures has been well established for many years [1,2]. They occur randomly, especially at the phase transitions, and undergo an interesting evolution which sometimes intrigues even physicists outside the liquid crystal field. Surfaces are known, both empirically and theoretically, to play a significant role in creating and stabilizing disclinations [1]. However, few attempts have been made to take explicit advantage of the alignment surfaces so as to create disclination lines by-design until a recent remarkable report by Fleury, Pires and Galerne [3]. We have studied a similar  $120^\circ$ -apart 3-segment alignment pattern for the purpose of realizing a tristable alignment [4]. We, however, did not observe a surface-nucleated disclinations in Ref.[4], which indicates a need for a proper account of the energetic aspect of the disclination formation in addition to the topological characteristics.

Inspired by the cholesteric blue phases consisting of self-organized ordered lattice of disclination lines and the rich behavior of disclinations under electric fields [5], I conceived the idea to generate and manipulate disclinations as programmed by the microscopic alignment surface patterns. The ultimate goal is to achieve a novel state of liquid crystal that may be called the “meta-liquid crystal” in which disclinations, generated at high enough density, can act as an independent entity to form their own ordered structures with a particular dynamics on top of the background of the liquid crystalline ordering.

This talk is aimed to present the preliminary experimental results in this direction. The surface alignment pattern is fabricated by the photoalignment method using a newly developed maskless polarized UV optical pattern generator, which can transfer arbitrary computer-generated patterns with one micrometer resolution. Figure 1a shows the topologically conflicting alignment pattern fabricated on the azo-polymer based photoalignment layer (courtesy DIC, Corp). The dark line at the neck of the pattern in Fig.1b is  $1/2$ -strength disclination.

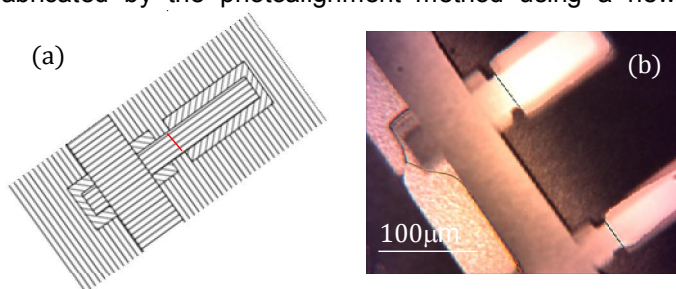


Fig.1 Surface alignment pattern to generate disclinations at a programmed position indicated by a red line (a), and the polarized micrograph of the nematic 5CB on the fabricated surface pattern (b).

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5. J. Fukuda, M. Yoneya and H. Yokoyama, Phys. Rev. E **80**, 031706 (2009).