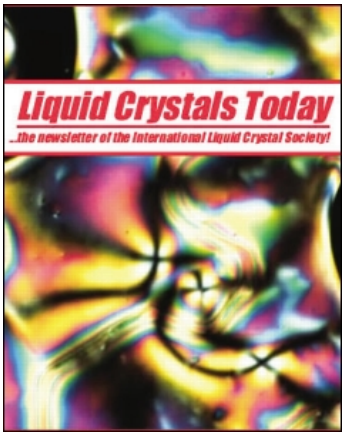

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BOOK REVIEW

Liquid Crystals in Complex Geometries

edited by G. Crawford and S. Zumer

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Review by
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The surge of interest in polymer dispersed liquid crystals over the last ten years has also led to a great deal of creative work in the generalized area of composite structures of liquid crystals and a solid matrix. This is the theme of *Liquid Crystals in Complex Geometries Formed by Polymer and Porous Networks*, edited by Gregory Crawford and Slobodan Zumer. Crawford (currently at Brown University, USA) and Zumer (University of Ljubljana, Slovenia) have been associated with the area of liquid crystal composites for many years: Crawford as a graduate student at Kent State University, and Zumer as both a frequent collaborator with the Kent State group and the source of much original work. The editors are both specialists in the condensed matter physics of liquid crystals, which is the perspective shared by a majority of the authors of the book.

The book consists of 22 chapters spread over 500 pages. Each chapter is written by one or more authors who have published work relevant to each sub-topic. The subject covers both LC/polymer composites, as well as microconfined liquid crystals within inclusions on the order of nanometres or smaller. The tone and coverage of each chapter varies considerably, ranging in style from authoritative mini-reviews to the equivalent of long single-topic journal papers. The variety of topics reflects the diversity of interests and varying levels of maturity in the area of liquid crystal composites.

The coverage of the book can be mostly split into two general sub-categories. One major sub-topic is the structure and electro-optical properties of composites of liquid crystals and polymers, particularly polymers formed from mesogenic diacrylates. The chapter by Yang *et al.* presents a significant amount of otherwise unpublished electro-optical data on cholesteric LC composites and the physics of their switching between different textures. The chapters by Crawford and Zumer and by Yang *et al.* also expand on published work on the structure of diacrylate/LC composite systems. These authors argue that in the polymer the structure is hierarchical: on a molecular level bundles of polymer chains form fibrils, which organize on a nanoscale to form a polymer-rich phase which can form microscale inclusions with liquid crystals. The techniques used to model these networks are described in detail and should serve as the basis of future work in this area. Still, it is necessary to keep in mind that very few material systems have actually been analysed in any detail, so that it is a bit early to draw broad generalizations on the structures of these composites, a point that is not often stressed.

Other work related to LC/polymer composites include two chapters by Hikmet and by Broer. These authors provide a nice overview of the substantial body of work that has come from the Philips laboratories, where the authors did much pioneering work in LC–diacrylate chemistry and composites. Vilfan and Vrbancic-Kopac provide an excellent introduction into the magnetic resonance of liquid crystals, with many examples drawn from structural work on LC/polymer networks. Kitzerow supplies a well-written chapter on polymer-dispersed chiral liquid crystals, in which the liquid crystal is confined to dispersed spherical cavities. This chapter outlines both the liquid crystal alignment and electro-optical properties of droplets of cholesteric and ferroelectric liquid crystals in PDLC-like systems, and provides an update on his 1994 review in *Liquid Crystals* on the same topic. Other contributions include West and Yuan (each discussing the properties of displays containing cholesteric materials), chapters by Bos *et al.* and by Iwamoto *et al.* (properties of polymer-stabilized STN and amorphous TN devices, respectively), and Jakli *et al.* (LC/polymer 'paste' composites). The chapter by Kreuzer and Eidenschink provides an interesting look at the structure and switching of composites of LCs and fumed colloidal silica.

A second focus of the book is the phase behaviour and structure of nematic and smectic phases in random porous media, such as silicate glasses and aerogels, but also with some attention to polymeric composites and thin planar cells. This generalized topic encompasses nine chapters and over 200 pages, and are organized primarily by experimental or theoretical technique. The focus of these chapters is highly fundamental, and the chapters do a nice job of covering their particular subject matter. These include Finotello *et al.* (calorimetry), Aliev (light scattering and dielectric measurements), Tripathi and Rosenblatt (birefringence in magnetic fields), Bellini and Clark (light scattering), Rappaport *et al.* (X-ray scattering), and chapters by Cleaver *et al.* and Maritan *et al.* (theoretical approaches for modelling microconfined nematics). The chapter by Blinc *et al.* describes ordering and structure in both confined ferroelectric LC and polymer/ferroelectric composite systems.

There are two other chapters of the book left to note. The first chapter by Crawford and Zumer provides their capsule view of 'traditional' polymer dispersed liquid crystals. This chapter does provide an abbreviated entry into the literature, but it is not possible to cover a field as substantial as PDLC materials and devices in just nineteen pages. Barbero and Durand provide a terrific introduction to the theory of liquid crystal anchoring, a topic of prime importance in systems like these with very large surface areas. It is perhaps disappointing, though, that the authors

did not choose to apply their perspective on anchoring to the specific cases of liquid crystal composites or micro-confined material systems. As such, the chapter, as good as it is, stands by itself with respect to the rest of the book.

The book's strongest aspect is that the chapters are (for the most part) well-written and referenced. The chapters concern areas that are still of current scientific and technical interest. In several chapters a significant amount of information is provided that is either unpublished, or found only in limited form in conference proceedings or theses. These particular chapters (mainly concerning LC/polymer electro-optics) provide a useful overview of material that is otherwise difficult to obtain.

The primary weakness of the book is that of organization, a fact perhaps inevitable in a book with 52 (total) authors. Some chapters overlap considerably and could have been combined under a single set of authors without loss of detail. In a few topical areas (the LC 'paste' work and polymer-stabilized TN/STN chapters, for example) the amount of work in the area is relatively small, and the topics perhaps better served by incorporating the work into a larger chapter with a broader perspective.

In a sense, there are really two books here under one cover: one on the structure and electro-optics of LC/network composites, the other on the order and phase transitions in microconfined nematics. The diversity of material is substantial, both in the choice of topics and in the formality of presentation. While I learned much reading the book, it was difficult to find connections between the rich phenomenology of structure and electro-optics described in the first half of the book and the detailed order and phase-transition information covered in the second half. Nevertheless, the overall coverage of each of these subjects is very good, and the readers looking for authoritative reviews of the current status of these sub-topics will not be disappointed.

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