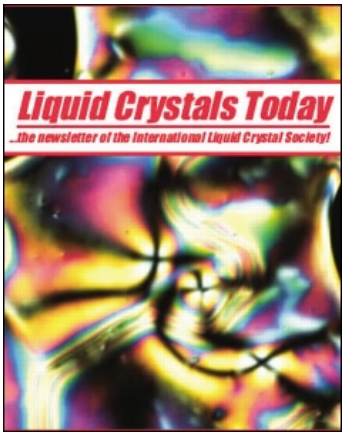

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Book Review

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Book Review

Nematic and cholesteric liquid crystals: concepts and physical properties illustrated by experiments, by Patrick Oswald and Pawel Pieranski, Taylor and Francis, CRC Press, 2005, 640 pp., ISBN: 9780415321402 or 0415321409

This book sat on my desk for over a year, as I kept waiting for my schedule to lighten a little. For this, I sincerely apologise to the authors. But when I finally took the time to read the book, I realised that this delay represented a missed opportunity for me far more than an annoyance for the authors. So I write this review in the hope of making researchers in the field of liquid crystals more aware of this wonderful addition to the literature. The book by Oswald and Pieranski is the first in a two-part series; perhaps this review will also serve as an advertisement for the second part!

The book devotes attention to the nematic and cholesteric liquid crystal phases, leaving smectic and columnar phases for the second volume. The coverage is much more about the physics of these phases than the chemistry. Many of the expected topics are present: phase classification, order parameters, Landau-deGennes theory, field effects, elasticity and optics. But there are extensive sections on less traditional topics: nematodynamics, instabilities, defects and textures, anchoring and anchoring transitions, the nematic–isotropic interface, the blue phases and growth phenomena. These latter areas represent the interests and backgrounds of the authors, allowing them to write sections that not only introduce the reader to topics that do not appear in general liquid crystal books, but also develop the science with their own unique perspective. Any worker in the field who desires to increase his or her understanding of these areas should definitely start with this book.

While the book strives to introduce each topic in a way that requires little previous knowledge, a strong background in general physics is necessary to fully appreciate the arguments and explanations. What is outstanding, however, is the way topics are introduced and discussed. Overarching principles are first explained and then illustrated by the development that follows. For example, the existence of the liquid crystal phase is explained by introducing the concept of molecular frustration, the fact that a single molecule contains different parts with different properties. Frustration between satisfying local tendencies and building a global structure is used to understand the phases formed by chiral molecules. Another aspect of the impressive way this book develops topics is the use of experimental descriptions and data to reinforce concepts. There is a recipe for creating myelin figures, a description of experiments that allow the Landau-deGennes coefficients to be determined, a discussion of the optics of a nematic prism, a description of a simple experiment to measure the twist elastic constant, ideas on how to make a simple display, how one can 'listen' to the orientational fluctuations of the director, quick ways to determine the type of anchoring on a substrate, and experiments one can do with a Cano wedge. Since simple experiments are rarely possible, the authors routinely keep to the idea of illustrating the concepts using experiments by including detailed descriptions of more complicated experiments and then showing the actual data. By taking the time to explain how many of the theoretical ideas are verified, the authors paint a much more realistic picture of how the science of liquid crystals progresses than is possible from descriptions of the theory alone. In fact, the images and illustrations in general are extremely well done, and add significantly to the quality of the explanations, not to mention the general appearance of the book.

Let me conclude with a few more examples of why I found the book so appealing. The charts and diagrams used when discussing phase classification are unique and very helpful. A discussion of conoscopy is used to illustrate birefringence, the Frederiks transition, viscosity measurement, hydrodynamic instabilities, and the nematic-isotropic interface. The twist-splay elastic term is introduced at the beginning of the elasticity section and used later when discussing the blue phases. The standard treatment of cholesteric liquid crystals is followed immediately by a description of cholesteric defects, textures and fingering. The chapter on growth phenomena

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develops nicely from basic ideas on binary mixtures to the behaviour of the growth fronts.

Oswald and Pieranski have written a book that should be in every scientific library and on many researchers' shelves. Both the experienced worker and the novice research student should find it extremely useful, both for its explanations of the basic principles and its elaboration of numerous subtleties.

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