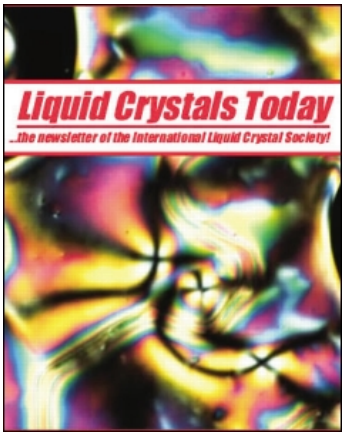

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BOOK REVIEW

Introduction to Liquid Crystals: Chemistry and Physics

Peter J. Collings and Michael Hird

Review by
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The field of liquid crystals is truly interdisciplinary, combining basic principles from physics, chemistry, and engineering, and in some cases crossing the boundaries with biology and sophisticated mathematics. Needless-to-say, writing an introductory book on liquid crystals that covers vast topics in various fields of science and engineering is a real challenge. Peter Collings and Michael Hird have met this challenge in their recently published book entitled *Introduction to Liquid Crystals: Chemistry and Physics* (Taylor & Francis, London, 1997). The book is an impressive undertaking. Collings and Hird have done an excellent job in preparing a text that, assuming only an introductory level of basic physics and chemistry, lays the foundations of an understanding of liquid crystal science and technology, for students who have little or no prior knowledge of the field. The book is treated from the perspectives of a physicist and chemist, making it a very interdisciplinary and comprehensive treatment of the subject matter. The liquid crystal community has long awaited such an introductory text. There are many excellent books on liquid crystals at the advanced level, but virtually nothing is available for the beginning student with a science and/or engineering background. The book is perhaps ideally suited for undergraduate students and graduate students who are just entering the field and desperately need a 'primer' for liquid crystals. I was pleased to be the one chosen to review this book since I was in the process of preparing an introductory course on liquid crystals. I therefore had the unique opportunity to thoroughly test it in the field.

The book begins with a historical account of the discovery of liquid crystals and proceeds with a detailed description of how different phases are formed and how the molecular architectures affect the liquid crystalline phase properties. Coming from a physics and applications background, I took one look at the molecular structures in Chapters 3 through 8 and thought to myself — 'Oh no, this looks too much like chemistry'. But on a more serious note, I can sincerely say that after reading through those chapters, I have greatly enhanced my understanding of the chemistry of liquid crystals. For example, in Chapter 8 entitled *Synthesis of Liquid Crystals — Strategies and Methods*, the book elegantly describes the synthetic routes to calamitic liquid crystals, chiral liquid crystals, discotic mesogens, and polymeric mesogens. The chapter clearly illustrates, with the help of many instructive examples, how materials are synthesized by describing how the basic structural units are introduced into desired positions to manufacture pure compounds that exhibit the liquid crystalline phase. Very little chemistry is required to follow the well thought out explanations and examples. After reading the first half of the book, I can candidly say that I have gained a much deeper appreciation for the basic chemistry of liquid crystals and their phase–structure relationships.

The second half of the book, Chapters 9–12, is dedicated to the physics of liquid crystals. When preparing an introductory text, there is certainly a delicate balance between the science at hand and mathematical complexity. The authors have done an excellent job at maintaining this balance, and they have included just the right amount of mathematical detail for the introductory student. Let us take for example the Freedericksz Transition presented in Chapter 10. In my experience, many students that I have introduced to the elastic theory formalism have troubles getting over the hurdle from the free energy equation to the solution of the differential equation. Most advanced texts do not treat the intermediate details. Collings and Hird have laid out the calculation in sufficient detail so the beginner can easily set up the free energy equation, minimize the integral using the Euler equation, and they present a method to solve the differential equation for the traditional splay, twist, and bend geometries. The book is rich in basic physical phenomena, with clear and accurate explanations of the helical unwinding transition, convective instabilities, electromagnetic wave theory, birefringence, optical activity, selective reflections, and a detailed look at the Maier–Saupe theory.

The book culminates with Chapter 13 on liquid crystal technology. The chapter provides the beginner with a 'flavour' of the many exciting applications of liquid crystal materials in modern technologies. Brief explanations on nematic based liquid crystal displays, smectic displays, polymer dispersed liquid crystals, and some of the engineering details of electronic displays such as the transmission curve, multiplexing, and active matrix technology.

'Two thumbs up' — Collings and Hird are skilled writers whose imposition of form, clarity, and coherence should be applauded — certainly a significant accomplishment. As an academician, I find the book a wonderful addition to my library, and a great textbook on liquid crystals for the beginner. It served as a very valuable textbook for my introductory class on liquid crystals, and was very popular amongst the undergraduate students making their way through this material for the first time. It will also serve as a primer for graduate students entering this field for years to come. Collings and Hird have performed a valuable service for the liquid crystal community, and I, for one, am grateful they did so.