

**Liquid crystals.** Edited by Satyendra Kumar. Pp x + 483. Cambridge: Cambridge University Press, 2001. Price £70.00. ISBN 0 521 46132 4.

This book gives detailed descriptions of a number of the experimental research techniques most commonly used in the study of liquid crystals. It is designed to be of particular interest to graduate students in physics and chemistry who are about to embark on liquid-crystal research, as well as to established workers in the field who may wish to gain an insight into experimental techniques outside their own field of expertise. The book fulfils this role. Three (out of ten) chapters are directly related to X-ray studies. Several of the other chapters are not of direct interest to most crystallographers. However, to any crystallographer who wishes to become involved in the study of liquid crystals, the book will be valuable.

Liquid-crystal research involves scientists from a range of disciplines. Many reference books already exist that provide detailed theory on the subject. This particular book does not attempt to repeat large amounts of theory, or provide a comprehensive bibliography, but rather concentrates on experimental techniques and limits references to those most directly related to the work treated. The individual authors are experimental researchers of international repute, currently working in the USA.

Chapter 1, by Michael R. Frisch and Satyendra Kumar, provides a short introduction to liquid crystals. It describes the many types of liquid-crystal phases (mesophases) and discusses their structure and order, along with the nomenclature used to describe them. It is followed by a chapter written by Mary E. Neubert that describes how these numerous mesophases and transitions between them can be characterized. Initial identification is likely to be by

## book reviews

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thermal analysis and the use of a polarizing microscope, fitted with a hot stage, but the important use of X-ray crystallography to define structure and confirm preliminary identifications is briefly mentioned, although details are left until later chapters. Thirty-eight beautiful colour prints of phase textures support this chapter.

Chapter 3, by Kumar, is the main chapter on X-ray diffraction studies. Conventional analysis and interpretation of data cannot be applied to liquid-crystal mesophases. Accurate temperature control, sample preparation and alignment using magnetic or AC electric fields, are frequently needed. Kumar introduces the types of scans commonly used and goes on to describe important experimental techniques. Diffraction patterns, including 3 colour prints and scans from a number of mesophase types, are described and examples are given with clear explanations of the structural implications.

Further X-ray scan techniques are described in Chapter 8 by Joel D. Brock and in Chapter 9 by Sumil K. Sinha. Brock describes how freely suspended films can be used to study the in-plane structure of smectic liquid crystals. Experimental design and technique are well described, although labels on diagrams would have made this easier to follow. Relevant theory is provided and results are given for a number of samples. Sinha concentrates on X-ray surface scattering studies. These studies can reveal details of surface ordering and surface behaviour. Again, various techniques are described, particularly the use of synchrotron radiation and neutron sources. Theory and examples are provided as necessary and the chapter is generally well written with adequate diagrams and explanations.

The remaining chapters have less relevance for the crystallographer. They deal with Physical properties (Panos Photinos),

NMR studies of orientational order (Paul Ukleja and Daniele Finotello), Light scattering and quasielastic spectroscopy (John T. Ho), Calorimetric studies (Carl W. Garland) and Chemical structure–property relationships (Mary E. Neubert). All these authors follow the major theme of the book, generally providing good coverage of experimental techniques, some relevant theory and examples of results obtained on liquid crystals, which serve to clarify their explanations, together with adequate lists of references.

Taken as a whole, the book fulfils its objective of providing details of the important experimental techniques used to study and characterize liquid-crystal systems, particularly where the techniques require modifications to traditional experiments. With different contributors there are differences in style in the various chapters, but the general emphasis is the same throughout. However, further general editing could have been performed to eliminate some unnecessary differences, *e.g.* units could be based on the SI system in all cases, rather than having the mixture that occurs in different chapters. For the person interested in main stream crystallography, as opposed to the study of liquid crystals, the book will only be of limited interest. For anyone interested in crystallographic techniques applied to liquid crystals, whether a newcomer or already established in the field of experimental liquid-crystal research, this book makes a welcome addition to the available literature.

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