of lubricating and floating thin sections for transmission microscopy may not be possible, in which case reflected light microscopy from surface finished sample blocks, with enhanced contrast/reflectivity by metal coating, yields rewarding results.

The inclusion by Hemsley of a brief excursion into Information Theory and optical transfer functions is to be commended as a tantalising approach to the basic principles of light microscopy (Chapter 2).

The theory and measurement principles of polarized light microscopy are adequately described in the contribution by B. P. Saville, University of Loughborough (Chapter 3). It is to be expected that the usual crop of errors will appear, most of which are interpretable from the context. However, this chapter contains more than its fair share. Those readers attempting to apply the algebraic expressions given in Section 3.3 and Figure 3.4, p. 82, could become confused by the interchange of axial systems y, z for x, y and the alternate presence and absence of subscripts. Similarly, equation 3.14, p. 96, should read,

$$fz = fy = \frac{1 - 3\,\overline{\cos^2 \phi_{1x}}}{2},$$

not

$$\frac{1 - 3\,\overline{\cos^2 \phi_{1x}}}{z}.$$

The contribution in Chapter 4 from the same author contains a wealth of practical observation, and particular attention is drawn to concepts of texture in relation to polymer crystallization.

Hoffman's contribution (Modulation Optics, NY) in Chapter 5 contains a good description of the physical systems required to obtain modulation contrast, and offers the greatest sense of unity by cross reference to the other contributions. But, sadly, here is the worst example of constraint by monochrome graphics—how can an author adequately describe Newton's colour sequence in the context of Differential Interference Contrast when the reader is rendered colour blind? It also shows the microscopist's desire to stress the resolution limit of an observation when referring to an optical path difference of 'about 0.200 μm'—is one to assume $0.200 \pm 0.0005\,\mu$m? I suspect not.

Hemsley's discussion of interference microscopy reveals descriptive powers at their best (Chapter 6), with an excitement and enthusiasm surrounding practical observation and including many examples of the investigative power of the technique when applied to material identification.

Calvert and Billingham (University of Sussex) continue the excellent theme of applied techniques to polymer science in their updated review (Chapter 7) of ultraviolet and fluorescence microscopy. In the closing pages the reader obtains a glimpse of the sophistication and elegance of the light microscope for the study of such phenomena as molecular mobility and diffusion throughout polymer structures, with specific examples describing the diffusion: spherulitic growth ratios of impurities associated with their relative solubilities in the crystalline and amorphous phases.

It is to be hoped that, despite the book's overall shortcomings, the inclusion of these concluding chapters, together with a well compiled bibliography and reference list, will enable the publication to inspire the investigative polymer scientist with at least a sense of awareness of the many significant advantages the methodology has to offer.

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N.m.r. Spectroscopy and Polymer Microstructure: The Conformational Connection

A. E. Tonelli (Ed)
VCH Publishers (UK) Ltd, Cambridge, UK, 1989, 252 pages
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Without doubt, n.m.r. spectroscopy is the principal method for determining the molecular structure of polymers. Evidence for this is obtained merely by noting the number of papers in polymer journals which report the use of n.m.r. spectroscopy as the primary means of polymer characterization. In the 1970s, books by Bovey ('High Resolution NMR of Macromolecules', Academic Press, New York, 1972) and Randall ('Polymer Sequence Determination', Academic Press, New York, 1977) championed the application of n.m.r. methods to the study of polymers. Given the rapid progress made in n.m.r. spectroscopy since then, such as the advent of two-dimensional n.m.r. and high-resolution solid-state n.m.r., and ever-increasing magnetic field strengths, this new text is long overdue.

The stated aim of this book is to enable polymer scientists to determine more readily the microstructures and conformations of polymers using n.m.r. spectroscopy. The book begins with a relatively brief chapter providing clear and useful definitions of polymer microstructure. The following three chapters, which are also reasonably short, introduce the reader to the general concepts of n.m.r. spectroscopy and its application to polymers. The author has sensibly kept the n.m.r. theory to a minimum, providing only the bare essentials of the technique. Thus, for example, two-dimensional n.m.r. is dealt with in a couple of pages. In later chapters, the author then quite rightly prefers to concentrate on the kinds of information available from 2D n.m.r. measurements, rather than on the intricate theory of how the experiments work. In this way, the non-specialist is informed without being put off by lengthy discussion.

In Chapter 5, discussion of the link between polymer microstructure, conformation, and observed n.m.r. spectra begins in earnest. The chapter shows how carbon-13 chemical shifts of a polymer may be predicted using the rotational isomeric state model of a polymer and the *gamma-gauche* effect. Indeed, this connection between microstructure, conformation, and n.m.r. spectra provides a unifying theme for the rest of the book.

Chapters 6–9 provide a wide range of examples of the use of n.m.r. spectroscopy to study polymer microstructure, dealing with determination of vinyl polymer stereosequence, microstructural defects, copolymer microstructure, and chemically-modified polymers. Throughout these chapters, great emphasis is placed on the use of the *gamma-gauche* effect method, the success of which justifies its pre-eminence. These chapters also include useful sections on the use of 2D n.m.r. techniques to study microstructure and conformation, and a discussion of copolymerization mechanisms. The majority of the examples presented in these chapters (indeed, throughout the book) are taken from the work of the author and his colleagues. However, no criticism can be levelled at this, given that the examples chosen cover all the major areas of polymer microstructure. Moreover, the author's familiarity with the examples means that they are presented in a logical and comprehensible manner.

Chapter 10 provides a brief introduction to the elucidation of biopolymer microstructure using n.m.r. techniques. Of course, a whole text could be devoted to this area. However, the author brings out the key elements of biopolymer characterization, emphasising the importance of 2D-COSY and NOESY measurements in this area. The book concludes with a chapter on solid-state n.m.r. spectroscopy of polymers. Although a number of recent texts are already available on this subject, its inclusion is justified since its context is again the link between microstructure, conformation and n.m.r. properties.

Overall, the book is well-written and the quality of presentation is generally excellent. However, one small criticism stems from the way the figures are interspersed with the text, particularly in Chapter 10. I found it slightly annoying to have to flick four or five pages ahead to find a figure referred to in the text.

In conclusion, I feel that the book will achieve its aim and is worthy of a place on the boci shelves of polymer scientists and n.m.r. spectroscopists alike.

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