book reviews

Polymer Update: Science and Engineering

W. D. Cook and G. B. Guise (Eds)
Royal Australian Chemical Institute, Victoria, 1989, 285 pages
ISBN 0 909589 67 4

The Polymer Division of the Royal Australian Chemical Institute, like the Plastics and Rubber Institute in the UK, is a national forum for discussion, education and training. This book is the second in a series, edited by G. B. Guise, with which it has entered the arena of publication for a wider international scientific community. Its objective is clear from its origin in an intensive two-day course for scientists and engineers whose careers had led them into the area but who lacked a formal training in polymer engineering, physics or chemistry: the book is an 'update' in the sense of a review of currently accepted basic understanding ('dogma'?) to frame an appreciation of new research developments. Cook and Guise have mastered the formidable editing task of integrating 'course notes' from seven contributors into a substantial, linear and consistent text, with little duplication, few omissions and research hobby horses firmly reined.

Guise opens with a readable historical review, which highlights the quantum jumps in which polymer science and engineering has progressed. Like biological evolution seen on the 'punctuated equilibrium' model, the pace of progress has often been forced by acute stimuli, both external (war, oil price changes) and internal (the 'discovery' of macromolecular structure and Ziegler-Natta catalysts). It is interesting—especially as we currently face another emergency of uncertain feedstock supply and price—to reflect that the current emphasis on special small-tonnage, functional and high performance polymers was partly determined by the oil price rises of the early 70s.

The next two chapters focus on polymer synthesis. This route to a basic understanding of microstructure and properties has been adopted by some textbooks (e.g. Rodriguez) and can be very effective even for those whose first subject is not chemistry. E. Rizzardo's exhaustive review of the mechanisms of chain growth polymerization is followed by R. A. Shanks on step-growth polymerization reactions, in which many of the more exciting new high-performance polymers are introduced; this chapter also considers some microstructural topics, such as rubber toughening in epoxies and gelation in networks, as they arise.

A didactic path from molecular structure through amorphous melt to amorphous glass and the crystalline phase continues with Z. H. Stachurski's chapter on Melt Properties and Solidification. The approach remains firmly based in the underlying molecular phenomena; polymer melt properties are introduced by moving from concepts of mobility, diffusion and viscosity in gases and simple liquids, to chain conformation, configuration and reptation. The section on solidification provides both a platform for presenting Stachurski's own work on TTT diagrams and a bridge to the following chapter by K. R. Chynoweth on Glass Transition and Crystallization.

R. P. Burford's chapter on Elastomers recognises the subject as one which has evolved in weaker communication with the main population of polymer science. Thus all aspects of these materials, from physics through formulation and processing to mechanical testing, are dealt with, before turning to a material-by-material account of specific materials, from natural rubber through to block copolymer and IPN structured thermoplastic elastomers.

The final chapter, by D. R. G. Williams, on Mechanical Behaviour of Amorphous and Semicrystalline Polymers, opens by reconsidering transitions as modulus/temperature variations. Physical and processing properties are touched on as well as the microstructure of copolymers and blends. Some of this depth has been achieved at the expense of broader mechanical phenomenology. Williams declares an equivalence of 'brittle' fracture to primary bond breakage, ductile fracture to secondary bond slippage—although it is known that microductile deformation dominates 'brittle' surface fracture work. Surely, after a 20 year contribution to polymer engineering research, Fracture Mechanics has earned more than a single paragraph, and could have served to deepen discussion of this and other areas?

In general, this book is a valuable resource for travellers through the vast landscape of research literature in polymer science and engineering. The overall standard of writing, illustration and typography are high, and this book can be recommended as a particularly good investment for readers from a background in chemistry.

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Applied Polymer Light Microscopy

D. A. Hemsley (Ed)
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Light microscopy has been sadly neglected as an investigative tool, following the development of more perceivedly glamorous techniques such as electron imaging microscopy. The ultimate in resolution, however, frequently blinds the observer to the necessary statistical relevance of viewing structures large enough to contribute to the macroscopic properties of a material. This is unequivocally the case in the ever-burgeoning field of polymer science. It is, therefore, timely to re-evaluate the potential uses and applications offered by the optical microscope, especially in those branches of scientific study outside the field of biology—a conventional stronghold for light microscopists—in which its value has been largely forgotten or unrealised.

For the want of other texts, this collection of contributions from various authors, each individually respected in their discipline, suffices as an introduction to the subject. However, it disappoints in its lack of coherence—not unique to the practice of collating monographs—and more importantly its failure to impress the value and quality of the images attainable. Primarily, the problem lies in the dated style of presentation, especially noticeable in the early chapters describing specimen preparation and basic microscope construction. The graphics are poor and suffer from being hand-drawn. The photography is often ill-composed and monochrome reproduction proves wholly unsuitable for illustrating images formed by methods of colour contrast (although it is a means of achieving economy).

It has to be recognised that a book of limited size (271 pages) aimed at an introductory audience must suffer from omissions. Perhaps the most obvious is the lack of discussion of the role of fillers, not only from the aspects of microscopic imaging but the fundamental constraints imposed on sample preparation (Chapter 1, A. D. Curson, ICI). For example, it would have been valuable to have included comments on the precautions necessary in preparing sections from polymers filled with a hard crystalline mineral, such as calcium carbonate, or a soft 'smearable' talcum. Furthermore, some fillers are soluble and the practice