book reviews

Engineering Science of Polymer Materials

Z. H. Starchurski
Royal Australian Chemical Institute, Belmont, Victoria, Australia, 1987, xiv+217 pages, $US 50.00
ISBN 0-909589-577

This is the first book in the Australian Polymer Science Series published by the Polymer Division of the Royal Australian Chemical Institute and reflects the increasing interest and high level of expertise in polymer science in Australia.

The contents of the book are organized into four main sections beginning with an introduction which classifies polymeric materials according to a range of criteria, explains how they may be characterized and identified and describes some interesting current applications. A worthwhile subsection on solidification diagrams is also included and this will be of particular interest to those readers who are more familiar with metallic materials. It is pleasing to see this approach applied in a unified way to thermoplastics, rigid thermosets and rubbers.

The second section is confined to liquid–solid transitions. The structures of molecules in polymeric melts and the relationships between viscosity and molecular structure are explored. The section is then developed to explore solidification by gelling and crystallization and includes useful descriptions of the kinetic theories of crystallization. The microstructures of polymers are then explained with a brief section on the microstructures of copolymers.

The third section covers the mechanical properties of polymers in a generally conventional and clear manner with the usual descriptions of viscoelasticity and dynamic behaviour and some illustrative worked examples.

The final section is concerned with the search for increasingly stiff and strong polymers and explains the main methods of increasing the moduli and strengths of polymers including worthwhile subsections on the methods of achieving ultimate mechanical properties. Fibre reinforced polymers are covered rather briefly in view of their importance in engineering.

Comprehensive references to original papers are given with recommended reading lists at the end of each section.

The book is aimed at chemists and engineers and as a result is a compromise in its approach. It does not deal with many of the fundamentsl aspects of polymer chemistry or in any significant detail with the practical problems of manufacturing or designing with polymers in an engineering context. The overall result is a book which will appeal to scientists and technologists occupying the middle ground and, in particular, materials science, materials engineering and metallurgy students. The book is well written and presented. It is unfortunate that most engineering courses allow little time for the study of structure–property relationships in polymeric materials and so unfortunately this book may not reach one group of its intended readers.

D. W. Clegg
(University of Nottingham)

Renormalization Group Theory of Macromolecules

K. F. Freed
John Wiley and Sons Ltd, Chichester, 1987, viii+361 pages, £52.75
ISBN 0-471-82845-9

Real polymer chains have an excluded volume, ruling out conformations for which chains cross themselves. One of the great theoretical challenges has been to account for macroscopic properties of these chains in solution (such as their radius of gyration, for example), treating the excluded volume in as full-blooded a way as possible. Impressive advances have been made in this regard in the last decade by the application of renormalization group techniques. For the non-specialist reader, the papers in the literature can be rather impenetrable, so a book like this one which sets out to take one by the hand through the mysteries of scaling, ε-expansions and cross-over dependence is to be welcomed, especially when written by an acknowledged expert in the field.

After an introductory section the aims of the renormalization group are discussed, the mathematical technique of functional integration is introduced and a model Hamiltonian for a flexible chain with excluded volume presented and discussed. Then comes a review of earlier theories of the excluded volume problem, including an excellent critical account of self consistent field and scaling theory. The rest of the book is then devoted to the renormalization group, in which single-chain properties are treated in detail, both in the full excluded-volume scaling regime and also in the cross-over region in between the above and the Gaussian chain limits, both infinite dilution and also in semi-dilute solution. A chapter is also included to give a comparison between the theoretical predictions and experiment.

The style and the layout of the book is very lucid and coherent. I very much liked the way each chapter had an introductory section and a summary, and though mathematical details were never shirked, every attempt was clearly made to give the reader a physical understanding, wherever possible, at all stages of the exposition. I found the book most helpful and instructive and would recommend it to those who wished to become seriously acquainted with the aims of the mathematical workings of the renormalization group.

A. J. Masters
(University of Manchester)

Thermotropic Liquid Crystals

G. W. Gray (Ed.)
John Wiley and Sons Ltd, Chichester, UK, 1987, xii+178 pages, £38
ISBN 0-471-91504-1

Thermally induced liquid crystalline order is a subject that in recent years has excited a wide field of scientific and technological interest. Liquid crystal displays are the obvious area of application with which most people are familiar, however the true potential of coupling sophisticated chemical components to form locally ordered physical states is now only beginning to be realized. This compact book goes some way towards educating the reader on the current understanding of liquid crystal systems and provides an excellent balance between the chemical and physical viewpoints on liquid crystal systems.

The book consists of six chapters written by acknowledged experts in the fields of liquid crystal chemistry and

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