Book Reviews

Introduction to Polymers

R. J. Young

Chapman and Hall, 1981. 331 + viii pp. Paperback edition £7.95, Hardback edition £18.00

As the author points out in his preface, previous books written as introductory treatises on the subject of polymers have 'tended to be concerned primarily with chemistry, structure or mechanical properties'. Indeed, one can name several sucn 'Introduction to' books, but not one directed specially to polymer physics and engineering. The present publication may do much to fill this gap since in it Dr Young endeavours to display, often in admirable depth, those materials science and engineering principles which together form an essential background to the study of polymer properties, behaviour and performance.

Following a very brief introductory chapter which reviews structure and macromolecular concepts (and tabulates some typical polymers, although this scarcely does credit to the wide variety now available), the book comprises four main chapters, the first of which deals generally with polymer synthesis by addition and condensation methods, placing emphasis on physico-chemical considerations, reaction kinetics, molecular size and distribution, cross-linking, copolymerization and stereo-regular polymer formation. Here again, however, the many types of polymer could have been more widely exemplified while details on some processes may be misleading (e.g., nylon-6,6 salt is converted to polymer by heating only initially under pressure, nylon-6,10 can be made without resource to interfacial reaction, and the non-existent vinyl alcohol is certainly not the monomer used for PVA).

The next chapter of characterization considers in useful detail the conformation and thermodynamics of polymers in solution, molecular mass and distribution determination (using osmometry, viscosity, light-scattering, g.p.c. and ultra-centrifuge techniques) and spectroscopic (i.r., n.m.r., e.s.r.) analysis. Then follows a chapter in which the macrostructure features of polymers—crystallinity, crystal structure and crystal growth, and deformation—are dealt with. The final (and understandably the longest chapter, one third of the book) discusses mechanical properties with detailed analysis of stress-strain relationships, theory on shear and tensile strengths, visco-elastic behaviour and deformation and fracture mechanisms. Throughout, emphasis is placed on basic physical and materials concepts with considerable attention to the mathematical treatment of the principles involved, the whole text being well supported by many clearly-presented diagrams. Omission of a few important topics may give rise to some criticism, however. For example, under mechanical properties little or no attention is given to the use and effects of particulate and fibrous additives and polymer reinforcement, neither is there consideration of polymer degradative influences and the necessary stabilization.

The book should be of most interest to those immediately concerned with the physics, physical chemistry, materials science and engineering of polymers but will also prove useful to others who wish to learn more of the reasons for the behaviour of the macro-molecular materials they study or use. Although few original references are given, each chapter carries a list of publications for further reading as well as sets of questions on the subject matter of the chapter, a feature of some appeal to the serios student. The book is well produced and at the prices quoted both the paper- and hard-backed editions represent good value for a volume which can be regarded as providing a reasonable introduction to the basics of polymer properties and behaviour.

R. J. W. Reynolds

Developments in Polymer Stabilisation—4

Editor G. Scott

Applied Science Publishers Ltd, £18

This volume is concerned with the stabilization of rubbers against thermal oxidation, fatigue and ozone attack. Professor G. Scott reviews the functions of stabilizers and points out that while the stabilizing mechanisms for rubbers bear strong similarities to those accepted for plastics the vulcanization process adds to the complexity of the former. Professor J. R. Shelton gives an account of how organic sulphides and disulphides protect synthetic elastomers from thermal oxidation which will appeal to those seeking detailed information. Based primarily on work by himself and coworkers he demonstrates that the effectiveness of these compounds is due to their ability to form intermediates such as sulphenic and thiosulphoxylic acids which are efficient destroyers of hydroperoxides.

The effects of mechanical stress on chemical reactions in polymers is a subject which has long been of interest to Russian workers. As Kuzminsky considers this complex subject in terms of elastomers and argues that stress can have an important influence on the chemical and physical processes of ageing. To account for the fatigue induced changes observed in rubbers, explanations are advanced which, while they may not be universally acceptable, help to make this a stimulating review.

K. M. Davis and D. G. Lloyd describe standard methods which are used to assess the stability of elastomer compositions. Although the authors point out in their introduction the general advantages and disadvantages of accelerated testing it would have been more helpful if examples had been given to demonstrate the strength and weaknesses of particular tests.

R. W. Laver reviews the development of non-staining phenolic antioxidants for rubbers in terms of their synthesis, performance and mechanism. The final comment by the author is surely expressing the hope cherished by many who are involved in all facets of polymer stabilization.

Loss of antioxidant, for example by extraction or volatilization, reduces the effectiveness of a polymer/stabilizer combination. In the second of his articles in the volume Professor Scott describes how more stable systems have been developed by the addition of antioxidants through copolymerization, grafting and by the use of polymeric antioxidants. Problems resulting from the incorporation of antioxidants by these various routes into the complex mixtures which constitute elastomers, and how in many cases they have been overcome, are well illustrated in this comprehensive review.

The final two papers, by representatives of the rubber industry, are concerned with the practical aspects of stabilizing commercial elastomers. J. R. Dunn presents an account of the stability of nitriles and butyl rubber which has a good blend of fact and explanatory comment. This is a valuable review of the performance of these rubbers against thermal oxidative and ozone attack. J. J. Verbanc reviews the stabilization of five speciality elastomers manufactured by his company by presenting a comprehensive description of the degradation modes of the various elastomers and by giving a reasoned account for the choice of stabilizers. The last two contributions are authoritative reviews which must help all who are concerned with the realities of stabilizing of elastomers.

This volume has something for everyone interested in the stabilization of elastomers. It tackles this complex subject on a broad front and goes some way to redressing the imbalance between the study of rubbers and plastics.

A. Davis

Conductive Polymers

R. B. Seymour (Ed.)

Plenum Press, New York, 1981, 237 pages, 35 US dollars

This volume contains the proceedings of the Symposium of Conductive Polymers sponsored by the American Chemical Society, Division of Organic Coating and Plastic Chemistry, held August 26–27, 1980, at the Second Chemical Congress of the North American Continent in Las Vegas, Nevada.

The appearance of this book is very opportune at the present time when the potential usefulness of the conductive polymers has been increased by several orders of magnitude by 'doping'. As the editor underlines, the more extensive technological application of this group of polymers is in the electrophotographic industry.

The 19 papers presented at this Symposium may be grouped with respect to their topics as follows:

—General problems related to different groups of semi-conductive polymers (6 papers).
—Synthesis and electrosynthesis of conductive polymers (3 papers)
—Conductive polymeric composite (1 paper)
—Metalloplastics—High conductivity materials (1 paper)
—Characterization and properties (3 papers)
—Charge transfer at a photoconductor | copolymer interface (1 paper)
—A comparative study between macromolecular metals and semi-conductors (1 paper)
—Polymer electronic structure (1 paper)
—Iodine doped polyacetylene (1 paper)
—Cofacial assembly of metallomacrocycles (1 paper)

All the papers are presented at a high scientific level, providing very important data for researchers in polymer science. The book may also serve as a useful reference in the field of materials science, electronic materials, solid state physics and superconductivity.

D. Feldman