

book reviews

Polymer Degradation and Stabilisation

N. Grassie and G. Scott
Cambridge University Press,
Cambridge, 1988,
viii + 222 pages, £11.95
ISBN 0-521-35797-7

This is a paperback issue of a previously hardback edition of the book and consequently, is now available at a much reduced price and more readily accessible to undergraduate and postgraduate students who may require a basic grounding in this subject. In this respect, the book serves an invaluable purpose and it was written, according to the authors, with this aim in mind. Polymer degradation and stabilization is a complex field of research and to compile a student-based text on the subject is quite some feat. On this point I must congratulate the authors on a well-written and very readable text, and the publishers on a fine presentation.

The book is divided into seven chapters. The first covers and highlights the practical problems encountered in polymer degradation, from outdoor durability through recycling to scientific test procedures. The second chapter covers thermal degradation processes and is orientated more towards mechanisms and product identification, and assumes that the reader has some prior knowledge of degradation techniques, such as t.g.a. and d.s.c. Photodegradation then follows in Chapter 3 and here only the very basics are considered—all controversies being left to the more advanced research texts. Oxidation processes are then dealt with in Chapter 4, and structure-stability relationships, kinetics and mechanisms are covered. Antioxidants and light stabilizers are dealt with in Chapter 5 and here again only the established mechanisms are covered although the reader is brought up-to-date with current theories but only up to the time of printing the original hardback. Flammability follows in Chapter 6 and then degradation processes in special environments in Chapter 7.

I found the contents of each chapter easy to follow, even in areas that I am not familiar with, and the reader is given suggested further reading after each chapter. In general, I feel, taking into account the voluminous literature, that the authors have presented a well-balanced and simple picture of all the main subject areas in polymer degradation and stabilization. This should

provide a valuable educational text for academics, postgraduate students and industrialists who are interested in learning about the field, as well as for the undergraduate student taking specialised lectures in the subject. In conclusion, the book would be an invaluable addition to libraries in educational institutions.

N. S. Allen
(Manchester Polytechnic)

Dynamics of Polymeric Liquids (Second Edition)

Volume 1: Fluid Mechanics
XXI + 649 pages, £64.15
ISBN 0-471-80245X

Volume 2: Kinetic Theory
XXI + 437 pages, £59.65
ISBN 0-471-802441

*R. Byron-Bird, R. C. Armstrong
and O. Hassager (Eds.)*
John Wiley and Sons Ltd,
Chichester, 1987

A number of readers will be familiar with the first edition of 'Dynamics of Polymeric Liquids' and will welcome the appearance of the second edition. It is now almost a decade since the first edition was published, and in the ensuing period significant advances have been made in the understanding and modelling of polymer fluid dynamics. These texts are written as teaching texts and lead the reader through the complexities of fluid dynamics of polymeric liquids. The text is clearly presented and well written. As with many classic texts; the serious reader will find the footnotes a fascinating comment and a promoter of thoughts on the unanswered questions on polymer fluid dynamics. The two volumes represent a tour de force in terms of a course on polymer fluids and contain a very useful collection of problems classified according to their type and degree of difficulty. The text is divided into eight parts; Volume 1 dealing with Newtonian *versus* non-Newtonian behaviour, elementary constitutive equations, non-linear viscoelastic constitutive equations and continuance mechanics, and Volume 2 covers polymer models and equilibrium properties, kinetic theory, phase space-kinetic theory and network models. The preface indicates the many colleagues consulted in the

presentation of these texts and whose valued criticism has added richly to the value of these volumes as teaching texts. The only criticism which could be raised of these texts is that they do not cover adequately detailed molecular models of polymer dynamics and as a result the connection between conformational and overall polymer dynamics is, as with many other texts on the dynamics of polymers, left as a topic of some mystery.

These volumes will become frequently consulted references on polymer fluid dynamics and, whilst expensive as course texts, will be consulted avidly by academics trying to improve their course material. May I congratulate the authors on a difficult task successfully completed.

R. A. Pethrick
(University of Strathclyde)

Polymers for High Technology: Electronics and Photonics

M. J. Bowden and S. R. Turner (Eds.)
American Chemical Society,
Washington DC, 1987, X + 631
pages, US \$109.95
ISBN 0-8412-1406-9

This publication, No. 346 in the ACS Symposium Series, has been developed from a symposium sponsored by the Division of Polymeric Materials: Science and Engineering at the 192nd Meeting of the American Chemical Society held at Anaheim, California, in September 1986. The book contains 50 papers which emphasize the considerable contributions that polymer scientists are making to advances in electronics and photonics. It is organized into eight sections with each section having an introduction, written by the chair of that session at the symposium, which provides an interesting and informative commentary on the state of development of each field covered.

The first four sections cover aspects of concern to the science and technology of microlithography. These sections complement and develop the topics introduced in 'Introduction to Microlithography' (No. 219, ACS Symposium Series) and extended in 'Materials for Microlithography' (No. 226, ACS Symposium Series). These three books

should be seen as essential reading for researchers coming new to the field of microlithography.

The opening section on 'Fundamentals in Radiation Chemistry of Polymers' contains five papers which take the reader from the discovery of X-rays and radioactivity in 1895 to present day attempts at understanding the reactions occurring during the radiolysis or photolysis of polymers. The section on 'Resist Materials for Electron and X-Ray Lithography' addresses issues concerned with the design of new resist materials or processes, and contains many impressive SEM micrographs of patterns developed from novel resist materials. New resist materials and processing considerations in optical lithography are covered in the third section of the book, and the potential of multi-level resist processing is clearly demonstrated in the section on the 'Etch Resistance of Polymers in Plasma Environments'.

Given the considerable and growing importance of photonics, particularly for technologies related to communication and information handling, it is appropriate that five papers discuss the properties of polymers in this context. The use of polymers as dielectrics can be traced back to Bakelite, but more recently inorganic materials have been mainly used in microelectronic devices. However, polyimides are growing in their use and importance, and a further six papers give the reader an insight into the type of research being carried out in the search for high temperature polymers for electronics applications. Polymers used in the packing and interconnection of microelectronic devices are given due attention, reflecting the concern of industry to maintain a high level of performance in such operations. In the final section of the book the topic switches to 'Conducting Polymers', Four papers illustrate the breadth of research in this field which ranges from the synthesis of new conducting polymers to calculations of electronic band structures, which can be used to assess the potential of particular polymers as electrical semiconductors.

Although all papers have been produced by the authors for direct reproduction, rather than being typeset by the publisher, the quality of the print,

diagrams and figures is generally high. This book is a must for polymer scientists, both academic and industrial, who wish to keep abreast of research into applications of polymers in electronics and photonics.

G. C. Corfield
(Humber College of Higher
Education)

Developments in Oriented Polymers—2

I. M. Ward (Ed.)
Elsevier Applied Science, Barking,
1987, X+279 pages, £42.00
ISBN 185-166-0453

This second volume in the series of developments in oriented polymers provides a good account of both theoretical and practical aspects of oriented polymers. The book consists of seven well-written chapters.

Chapter 1 by Young opens with an introduction on the subject of polymer single crystal fibres followed by sections on solid state polymerization, structure, elastic deformation, plastic deformation and fracture behaviour of single crystal polydiacetylene fibres. Properties of polydiacetylene/epoxy composite systems are also discussed.

In the second chapter, on high-strength/high modulus structures based on flexible macromolecules, Lemstra *et al.* review the development of various techniques and processes to produce high-strength/high-modulus polyethylene structures. The article consists of six sections. The first section is a general introduction to the subject followed by sections on solution-spinning of linear polyethylene, basic aspects of ultra-drawing, some properties of high-performance polyethylene fibres and gel-spinning of other flexible polymers.

Spinning from lyotropic and thermotropic liquid crystalline systems is the subject of a chapter by Ciferri. In his

article, the author reviews recent results on mesophase formation, and includes a discussion on spinning data for four classes of polymer. These polymers have been the basis of studies on lyotropic and thermotropic systems and include chains with rigid conformations such as poly(*p*-benzamide), poly(*p*-phenylene terephthalamide); chains with semi-rigid conformation, e.g. polyterephthalamide of *p*-aminobenzhydride, cellulose and polyesters containing flexible methylene units.

In Chapter 4 Dobb and Johnson present studies of the structures of fibres obtained from lyotropic liquid crystals and mesophase pitch. The authors describe the development and structure/property relationships of poly(*p*-phenylene terephthalamide) fibres obtained via a lyotropic mesophase and carbon fibres derived from thermotropic mesophase pitch.

Structure and properties of thermotropic liquid crystalline copolyesters are discussed by Blackwell and Biswas in Chapter 5. There are good sections on synthesis, characterization and properties of main-chain liquid crystalline polyesters.

Chapter 6 by Monnerie deals exclusively with infra-red dichroism and fluorescence polarization. The experimental results are compared with theoretical predictions of molecular viscoelasticity in polymer melts.

In the final chapter, relating to oriented polyamides, Owen discusses relationships between structure and thermomechanical properties of oriented polyamide. Section 2 of this chapter deals with crystallographic and morphological structure of oriented nylons and this is followed by a section on their orientation behaviour. Thermomechanical properties are reviewed in section 4 and the last section deals with the structure and properties of aramid fibres.

As a whole the book is well produced and provides an up-to-date account of the state of the art and will be of interest to polymer and materials research workers, particularly those interested in the science and technology of oriented polymers.

T. H. Shah
(University of Manchester Institute
of Science and Technology)