Book Reviews

Macromolecules: an introduction to polymer science

Eds. F. A. Bovey and F. H. Winslow
Academic Press, New York, 1979, $39.50

This book consists of contributions from six authors from Bell Telephone Laboratories, which has a fine record in polymer research. It is aimed at the undergraduate and first year graduate level, its orientation being fundamental rather than technological. Bearing in mind the antecedents of the book, it is a little disappointing, particularly in the selection of material.

The introduction contains a very interesting historical survey, showing neatly the interplay of industrial and academic research. The second chapter on chemical synthesis is by far the longest and most factually detailed, with five pages of references. The chapter *Microstructure and chain conformations of macromolecules* consists mainly of an introduction to spectroscopy and its application to chemical configuration, followed by an outline of the rotational isomeric state method. Then follows a short section which states that spectroscopy is the main tool for testing these conformations in solutions, gives some of the classic crystal structures (polyethylene, nylon) and mentions the observation by neutron scattering of the theta dimension in amorphous polystyrene. X-ray scattering of solutions is not mentioned at all. A student would not believe from this chapter that the primary method for structure determination is some form of scattering or diffraction.

The chapter on *Macromolecules in solution* contains introductory statistical mechanics, a section on fractionation methods, and another on characterization of molecular weights (a small part of this is on gel permeation chromatography).

The chapter on *Morphology of crystalline polymers* places most emphasis on the productive years around 1960. Two recent articles on neutron scattering of melt grown crystals are referenced in passing in connection with solution grown crystals; but, on the whole, the author stops short of an attempt to cover recent work on the conformation of the whole chain in crystalline polymers. *Physical behaviour of macromolecules* includes an introduction to viscoelastic theory, dielectric relaxations, and failure modes. Finally, this part describes diffusion of low molecular weight species through polymers, a subject of practical interest which is often not included in polymer texts. This is also true of the next chapter, on *Degradation and cross-linking reactions.* Much information of this type is only available within industrial concerns. It seems odd, however, that irradiation cross-linking in crystalline polymers is quoted, without qualification, as being random (p 418).

The last chapter is a refreshing innovation in terms of recent polymer texts – a substantial section on *Biological macromolecules* which reflects increasing interest of the polymer community in this direction. There are some omissions however. It is not made clear that the section on DNA refers to bacteria – the recent and important work on binding of DNA with histone proteins in higher organisms is not mentioned. The section on polysaccharides is rather dated e.g. the cellulose structure quoted, and the lack of reference to the expanding application of fibre diffraction to a wide range of polysacchardies.

At the price, the volume would probably be bought in most cases by libraries rather than individuals, and for access by a group of researchers it earns its place on the shelves on the basis of some useful information it contains. However, it would be in most cases much too detailed for undergraduates. It would not be suitable as a text for someone starting research, since it does not give enough prominence to the newer and currently active areas in fundamental polymer research.

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This volume is produced to the high, technical standard usually associated with the publishers Springer–Verlag: printing, presentation, titling and labelling of tables, graphs, illustrations and mathematical formulae is very clear. However, the high price and the disparate nature of the four articles collected together under the general heading of Physical Chemistry will most probably restrict this volume to the shelves of specialist scientific libraries; only reviewers will have it in their private bookcase.

The first article, which takes up almost half the volume, is *Polymer analysis by thermofractography* (E. Stahl and V. Brüderle, University of Saarbrücken, Germany). The word 'thermofractography' is misleading; possibly, the meaning suffered in translation from the original German. 'Fractography' is in common scientific use and may be defined as 'the examination of the fracture surface of a metal (ceramic and/or polymer) at high magnification using a microscope'. However, thermofractography has nothing whatsoever to do with the microscopic examination of the topology of fracture surfaces of polymers broken at different temperatures: instead, it is used to describe generically the programmed pyrolysis of polymers followed by thin layer chromatography of the condensed degradation products. Various arguments are presented as to why this technique is superior to others such as pyrolysis/gas liquid chromatography and pyrolysis/mass spectroscopy. Apparatus and experimental procedures are described in considerable detail, and the results of applications of the technique to a wide range of natural and synthetic polymers are presented. The technique has potential for fast, easy analysis of polymers and their additives. It could be particularly useful for quick identification of copolymers and specific identification of a member of a homologous series of polyamides. May I make a plea that, if the technique does catch on, it is no longer called 'thermofractography?' I suggest 'analysis of polymers by programmed pyrolysis/t.l.c.'.

In the second article, Stanley Bywater (NRC, Canada) presents a short, interesting and authoritative account of the preparation and properties of star-branched polymers. In particular, the thermodynamic and viscoelastic properties of the polymers in solution and the melt are discussed critically, and experimental results compared with current theoretical predictions.

Drs. Tuzar, Kratochvil and Bohdanecký (Institute of Macromolecular Chemistry, Prague) present a rather disappointing, non-critical review of the dilute solution properties of aliphatic polyamides associated almost entirely with the measurement of molecular weight, and molecular weight distribution and characterization of branching. It is rather surprising to read that little progress has been made since I was last actively involved in the field some 25 years ago; the majority of the literature references cited are pre-1970. The very interesting polyelectrolyte behaviour of nylons in proton donating solvents such as anhydrous formic acid, first discovered in 1951, is mentioned briefly and there is a short account of the solution behaviour in mixed solvents. At best, this is an initial source of references for someone new to the field.

Wolfram Welte and Werner Kreutz (University of Freiburg, Germany) give clear, mathematical and authoritative account of the development of a *General theory for the evaluation of X-ray diagrams of lamellar systems*, containing a considerable amount of original work. This is a paper for the expert in the field of low angle X-ray scattering and its application to detection and measurement of lamellar microstructure. The adoption of Hosemann's paracrystalline state concepts to lamellar membrane structures and the assumptions associated with this approach are particularly interesting.

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