Book Reviews

Interpenetrating Polymer Networks and Related Materials

L. H. Sperling

Plenum Press, N.Y., 1981; xi+265 pp. ISBN 0-306-40539-3, price $35

Interpenetrating polymer networks (IPN's) are still relatively unfamiliar materials and, as most strictly defined, consist of a network of polymer A swollen by and interlaced with a network of a second polymer B. As such, IPN's are just one of many types of multicomponent polymer formed from combinations of two polymers which include such other materials as polyblends and block and graft copolymers. However, when the definition is broadened to include not only simultaneously interpenetrating networks (SIN's) but also semi-SIN's (maybe there's hope for some of us yet!), in which one component is not crosslinked, and given the variety of components which have already been incorporated into such structures, IPN's represent a large and complex group of materials at one end of the spectrum of multicomponent polymers.

Research directed specifically to the study of IPN's is still very much the perogative of a few groups, although other groups, some unwittingly, have produced and examined IPN's. The author of this volume is one of the prime exponents of this field and has stamped his personality on much research into IPN's as well as on this book.

Background topics, e.g. thermodynamics of polymer–polymer miscibility, relations between glass-transition temperatures and compositions of phases or microphases and relationships between dynamic mechanical properties of multicomponent polymers and the properties of the constituent homopolymers in terms of mechanical models, are not discussed in detail but are referred to briefly in simple terms and references are given to detailed discussions elsewhere.

Fundamental physical principles apply equally to IPN's and to other, simpler multicomponent materials. Sperling recognises that to reach a full understanding of IPN's it will be necessary to use information derived from simpler systems and he has included reference to some of them in this volume. However, IPN's have features which are distinctive (e.g. more severely restricted segregation of unlike components as a result of network constraints) and which can have a major influence on their morphologies. Consequently we may expect distinctive properties due to the intimate relationship between the different components and possible interactions between them.

Although most IPN's consist of at least two chemically different polymers, one chapter is devoted to the use of homopolymer IPN's (in which two chemically identical networks interpenetrate) as model networks. Interactions between the networks are explored through swelling behaviour, the results of which are used to obtain information on chain entanglements, etc.

Details of several syntheses are presented, illustrating the variety of IPN structures which can be prepared. Emphasis is placed on the fact that the detailed chemical architecture of IPN's depends on the sequence of operations employed in the synthesis to a greater extent than do the structures of simpler polymers. A nomenclature system, devised by the author, which describes the constitution of IPN's and which reflects the sequence of steps used in the synthesis is presented. Reaction conditions during synthesis, as well as subsequent sample treatment, may have a marked influence on the morphologies of the polymers.

The study of IPN's is still a young topic in polymer science and it is not yet possible to provide a quantitative description of IPN morphologies and properties from a knowledge of synthetic procedures. Consequently this monograph is not a definitive text, rather it describes information available on IPN's and attempts to correlate morphologies and properties with the synthetic procedures.

Two chapters, comprising 40% of the book, are devoted to the morphologies, transition behaviour and mechanical properties of IPN's. Shifts in glass-transition temperatures, compared with those of the constituent homopolymers, are discussed in terms of compositions of phases; incomplete separation of components can arise from inherent miscibility or from physically restricted separation. Absolute values of moduli between the two glass-transition temperatures of an IPN are discussed in terms of morphologies, specifically in terms of continuities of the phases. There are also general discussions of toughness, extensibility, etc. Although the main emphasis is on tensile properties there are also discussions of adhesion, electrical properties and ion-exchange behaviour.

A final chapter discusses proposed applications for IPN's ranging from noise damping systems and impact modifiers to contact lenses and dental fillings, in terms of the patent literature extant.

This volume is a useful addition to the literature of multicomponent polymers. It provides, in easily readable form, an up-to-date account of the state of knowledge of IPN's. In addition to many references to relevant literature within the text, it contains an extensive annotated bibliography to IPN's and some related materials. Several references are also given to important but often over-looked papers in the multicomponent polymer field. This book is worthy of examination by anyone interested in multicomponent polymers or otherwise interested in new types of polymeric materials.

G. C. Eastmond

Polymer Melt Rheology

F. N. Cogswell

(George Godwin, London, 1981)

Pl xiv+178. Price £18.00

Polymer Melt Rheology is a text on the interaction between polymer structure and polymer processing. It comprises chapters on basic rheology, polymer melt rheometry, the effects of physical conditions, flow geometry and molecular structure on rheology, so-called adventitious flow phenomena (i.e. the effects of flow instabilities on processing), rheology in specific processing operations (extrusion, injection moulding, etc.) and finally a short discussion of possible future developments. There are also several short appendices amplifying or backing up points made within the main part of the text.

In some ways, the book is successful. It is easy to read. The style is engaging and the whole text is broken down into a sequence of sections, few of which are more than two pages long. In other ways, regrettably, the book is less successful. Some of the discussion is unnecessarily tendentious. Thus, for example, Cogswell claims that he has never encountered the phenomenon of stress overshoot '*except that it be associated with some secondary flow*' in the rheometer. Does he really write off all the evidence for the existence of the phenomenon? Some of the discussion is peculiarly sloppy, and stems from a lack of mathematical and/or physical rigour. This does not mean, of course, that advanced theory is what is required, merely that the theory (of whatever level) is used properly. This is rather a pity. What might otherwise have been a most recommendable book, based as it is on the considerable experience of Cogswell and also his many colleagues at ICI, is seriously flawed. For a short text, it is also rather expensive.

S. M. Richardson

Developments in Polymer Stabilisation – Volume 3

Editor G. Scott

Applied Science Publishers Ltd £16

The first two papers of this volume deal with the regenerative properties of some antioxidants. Denisov, with the help of model compound studies carried out in his laboratory and the considerable Russian literature advances reasons to explain why aromatic and hindered amines can inhibit more than one or two oxidative chains in their role as stabilisers.

De Jonge and Hope concern themselves solely with the regenerative capabilities of antioxidants based on 2,6-diphenylphenol in the presence of thiodipropionate esters; the effectiveness of such stabiliser combinations in