

book reviews

Chemical Reactions in Plastics Processing

K. Kircher

Carl Hanser Verlag,
distributed by John Wiley
and Sons Ltd, Chichester,
1987, x+214 pages,
£38.20
ISBN 0-446-14279-7

Perhaps a quarter of industrially produced polymers are not simply processed by spinning, moulding, extruding or by vacuum forming, but are subjected to a chemical process to obtain the finished article. This is an English translation from the German of Kircher's book that deals with these issues, together with topics such as decomposition reactions that occur during high temperature extrusion and other physical modifications. The book is a suitable introduction to the relevant chemistry for the process engineer who has little training in polymer chemistry, but whose process may be limited by or may exploit chemical effects. It also provides the polymer chemist an applied or user's perspective of his subject.

The major part of the literature cited was written by German authors, which may be an advantage for English-speaking workers who seek an introduction to this field, but because the book was written some time ago there are few cited articles and reviews with publication dates after 1979. This may be why there is no reference to RIM in the index. While 'macromonomer' is also lacking from the index and is not recognized as a useful concept in the introductory chapters, the book does contain many accounts of the chemistry of that class of substance, for example, the free radical curing of unsaturated polyester resins, the catalysed curing of phenolic and amino resins, the reaction casting of poly(methyl methacrylate) and the production of polyurethane and epoxy resin thermosets. The substances produced by the reactions are materials, rather than special effect or high value polymers such as for electron beam lithography, ion exchange resins and polymeric sensors or conductors. Approximately 35 pages are used to establish the basic framework of polymer preparative chemistry.

The depth of coverage of the main fields may be gauged from the section on crosslinking reactions for polyethylene,

other polyolefins, polysilicones and linear polydiene chains, *inter alia*. There are 23 pages devoted to this section, and 86 references are cited. The radical reactions for crosslinking polyethylene may be stimulated by electron beams, by u.v. light on the polymer itself or on incorporated photoinitiators, by similar thermal treatments, or using polymer to which alkoxy silane groups have been grafted by one of a number of reactions. The latter polyethylene can be moulded conventionally and subsequently cross-linked by exposure to water to yield items with improved performance. Polymers with dielectrically active units can be crosslinked with microwave radiation (10^9 Hz), but to crosslink polyolefins by this means polar additives must first be incorporated. Graphs show the gel fractions obtained over periods of a few minutes when polyethylene is activated with carbon black or a number of different organic peroxides. The art in relation to a cable protection is to achieve a uniform crosslinking effect without disturbing the insulating properties with decomposed contaminants.

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Polymer Electrolyte Reviews—1

J. R. MacCallum and C. A. Vincent (Eds.)
Elsevier Applied Science,
Barking, 1987, x+352
pages, £48.00
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In the words of the editors: 'We therefore considered that it would now be appropriate to make available a comprehensive account of the current state of knowledge, presented as a broad approach, so making it possible for research workers from different disciplines to understand how the subject has evolved, and what problems remain to be solved.' So long as it is understood that this target presumably refers not just to the present book but to this and the forthcoming volume(s), then it has to be said that this book is a jolly good start. And they are right about the different disciplines; not only polymer scientists and electrochemists, but also alert manufacturers of electrochemical cells

and batteries, will be informed and interested by the chapters in this book, all of which have been written by experienced workers in the field. It is fitting that the first chapter should be written by Professor M. B. Armand, because much of the current interest in polymer electrolytes was initiated by the proposal by him and his coworkers 10 years ago that solvent-free electrolytes could be based on poly(ethylene oxide) (PEO), and that these could be used in solid-state batteries. Indeed the question of battery design is considered in some detail in Chapter 10, where Professor B. Scrosati indicates that the future development of high-power-density batteries will require the development of polymer electrolytes which assure single-ion transport, in addition to being good conductors. The editors themselves have contributed a chapter which deals with the interactions of ions with each other and with the polymer electrolyte. Such interactions influence the transport properties within the systems, and a whole chapter on transport theory and the various associated theoretical models has been contributed by Professor M. A. Ratner. Despite the delightful erudition inherent in some of the model treatments, he concludes that future progress will depend upon the developments of truly dynamic models. For readers with real intentions of becoming practically involved in this field of polymer electrolytes, Dr P. G. Bruce has provided an excellent chapter on the making of electrical measurements, and Drs A. V. Chadwick and M. R. Worboys a chapter on the application of n.m.r., tracer techniques, and X-ray absorption fine structure to the characterization of the polymers. The remaining chapters by Professor Watanabe and Dr Ogata, Professor Cheradame and Dr LeNest, Professor Cowie, and Dr Gray, deal with a variety of polymer electrolytes other than linear PEO. The incentive to consider alternatives arises principally from the fact that PEO tends to crystallize if moderately long chain lengths are used, and must be used above the melting point if sufficiently high levels of ionic conductivity are to be obtained. The book as a whole will be a delight to electrochemists with polymeric experience, or polymer chemists with electrochemical interests. To others, it provides enough of both fields to be a valuable educational source.

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