

Preface

The ion irradiation of polymers (which had been treated in Volume 1 of this book) is frequently followed by transport processes, either of the implanted ions themselves or of the activated polymer chains, of radiochemical reaction products inside the irradiated zone, or of foreign atoms, ions or molecules that penetrate into the polymer after the irradiation has taken place (these entities will be called “penetrants” from now on). Transport processes in a polymer can be described in terms of diffusion, permeation, and/or solution phenomena, but there are also cases when, e.g., viscous flow through pores plays a role. There exist many elaborate theories on transport processes in unirradiated polymers, the most important ones of which will be briefly summarized in this volume in Chap. 1. Transport processes in irradiated polymers are much less well known, but nevertheless the presently available data base already allows one to obtain a rough understanding of the processes occurring. This will be summarized in the subsequent two chapters. As it has turned out that the formation of tracks by energetic heavy ions leads to many peculiarities of the transport processes in polymers, Chap. 3 will be devoted to these cases, while Chap. 2 rather treats the penetrant migration in low-energy ion-irradiated polymers. Finally, Chap. 4 deals with ion-track etching. The latter is of importance as quite a number of technical applications have emerged from the use of etched ion tracks in polymers.

Ion irradiation of polymers has found applications already since about 1950. This concerned especially low-energy ion beams (Chap. 5) that were used in electronics for semiconductor doping through polymeric photoresist masks. In the meantime, the ion-beam modification of polymeric surfaces for medical applications to improve the material’s biocompatibility has also found major use, and, furthermore, tribological and optical applications of low-energy ion beams have become more familiar.

In order to prepare high-energy irradiated polymers for applications, frequently additional manipulation steps have to be undertaken, e.g. etching, doping with penetrants, deposition of nanoclusters, nanowires, or nanotubules within the ion tracks, or deposition of additional structures on the polymeric surfaces. Whereas these manipulations will be treated in Chap. 6, the last chapter will be devoted to the emerging applications themselves.

For high-energy ion-beam irradiation of polymers, the major field is found in the production of microporous foils. These etch-track filters have found a

number of well-established applications, and more are currently under discussion or development.

For all applications of ion-irradiated polymers it is of fundamental importance to prevent the inherent degradation of their properties due to both the constituent and penetrant motion at ambient temperature, with possibly detrimental oxidative or corrosive reactions. Since this would otherwise restrict the applicability of polymers to inexpensive throwaway products with limited lifetimes and to low-temperature devices only, the continuous search for new polymer systems with good thermal stability even after their irradiation is of central importance.

This volume as well as the preceeding one on the fundamentals of ion-irradiated polymers are thought to challenge the reader to contribute himself to the yet open questions, to deepen our insight and to promote the technological applicability of this fascinating field.

Thanks to everybody who contributed to this book directly or indirectly by numerous discussions at conferences, meetings, etc. Apart from giving special credit to all the coauthors of this book, I want to acknowledge thankfully the continuous interest and help of Prof. Lewis T. Chadderton, Dr. Manfred Müller, and Dr. Jiri Vacík over the many years during which the idea of that book emerged, and which helped clarifying many findings that appeared to be a riddle in the moment of their discovery. We are also obliged to Dr. Ricarda Klett, Dr. Arne Schmoldt, Prof. Kamal K. Dvivedi, Dr. Svarnali Ghosh, Mr. Prashant Alegaonkar and Mr. Alexander Petrov who obtained quite a number of the results compiled in this book, partly in the frame of their PhD or Postdoc works. Many other important personal communications are mentioned in the references. We thank to Prof. Pedro Grande for his kind help in the chapter on stopping powers and ranges, to Prof. Jochen P. Biersack and to Dr. Amita Chandra for their critical reading, and to Dr. Mahalakshmi Iyer for her technical help in the last chapter of this book. Thanks also to the coauthors for their help in the chapters in which they are not explicitly named. Thanks also to all Publishing Companies who allowed the reproduction of figures in this book.

We are also obliged to the organizations that enabled this work by giving us financial support, especially to the DAAD and CAPES in the frame of the German-Brazil agreement "POBRAL". I also must not forget to mention the continuous support by my home institute, the Hahn-Meitner-Institute Berlin. Last not least I want to thank my good friends all over the world – especially to the families Chadderton, Stange-Ferreira, and Berdinsky, and also to my own family who always supported me with constant encouragement, friendship and love, and thus cared for the warm and good atmosphere necessary to write this book.

Transport Processes in Ion-Irradiated Polymers

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2004, XIII, 337 p., Hardcover

ISBN: 978-3-540-20943-0