Electron microscopy and atomic force microscopy have developed into powerful tools in the field of polymer science. By using different techniques and methods, morphological details at length scales from the visible (0.1 mm) up to a few 0.1 nm can be detected. Consequently, the microscopic techniques used in polymer research support the tendency, over the last two decades, to shift the level of interest from the μm-scale to the nm-scale region. Systems with at least one structural dimension below ~100 nm are now considered to comprise a new class of materials, the so-called nanostructured polymers or nanocomposites. In addition, the influence of several parameters can be studied by changing the morphology of the material. In particular, the influence of the actual, local morphology on mechanical loading effects can be determined. The micromechanical properties or mechanisms that occur at nano- and microscopic levels form the bridge between structure, morphology and mechanical properties. Therefore, electron microscopy and atomic force microscopy directly contribute to a better understanding of structure–property correlations in polymers.

Part I offers an overview of electron microscopy and atomic force microscopy techniques and summarises distinctive applications of polymeric materials. The wide variety of preparation methods used to study polymers with the different microscopic techniques are presented and illustrated with typical micrographs in the chapters of Part II. Each technique is discussed in detail, highlighting its application for solving specific problems arising in the characterisation of materials. The applicability of the microscopic techniques and preparation methods described in Parts I and II to the main classes of polymers is documented in Part III. All relevant groups of solid polymers used domestically, industrially, in research and in medicine are mentioned. The characteristic features and also the variety of structures and morphologies of the different polymer classes are illustrated with typical micrographs. In particular, the application of different microscopic techniques is shown to reveal similar polymeric structures, enabling laboratories that possess only some of the techniques to use them beneficially. As well as descriptions of characteristic morphologies and micromechanical properties the most commonly occurring defects and failures are also illustrated.

The volume is directed at polymer scientists from research institutes and industry, and aims to demonstrate the widespread possibilities enabled by the application of microscopic techniques in polymer research and development. Each of these techniques allows one to solve a number of problems, as even for the specialist it is not always evident which technique is best suited to solving a given problem. The mono-
Preface

This volume draws upon the experiences and studies of the working groups of the editor in research institutes, industry, and academia in the period from 1970 onwards (i.e. over three decades). The authors or coauthors of the various chapters are:

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For additional contributions and remarks, I thank Prof. Dr. F.J. Baltá-Calleja, Instituto de Estructura de la Materia, CSIC, Madrid, Dr. W. Erfurth, Max Planck Institut für Mikrostrukturphysik Halle (in Chap. 4), Dr. J. Lacayo-Pineda, Continental AG, Hannover (in Chap. 20), DI St. Scholtyssek (in Chaps. 16 and 24) and DI M. Buschnakowski (in Chap. 11). My former or current coworkers DI (FH) I. Nau mann, DI (FH) H. Steinbach, Mrs I. Schülke, Dr. J. Starke, DP J. Laatsch, DI (FH) S. Goerlitz and Mrs C. Becker are gratefully acknowledged for providing many of the examples of microscopic investigations of different polymers and micrographs referred to in this book. I also thank DI W. Schurz for image processing many of the electron micrographs, Mrs B. Erfurt for typing many of the chapters, and DP W. Lebek for his valuable technical help during the completion of the manuscript.

Finally, I also wish to gratefully acknowledge the coworkers at Springer-Verlag for their understanding and help during the preparation of the manuscript.

Halle/Merseburg, March 2008

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Electron Microscopy of Polymers
Michler, G.H.
2008, XX, 473 p., Hardcover
ISBN: 978-3-540-36350-7