
Preface

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-

graph is also directed at research and applied technicians, since it provides a basic understanding of the principles of the different microscopic techniques and exhausts all of the possibilities of using these techniques to solve specific research problems. All of the preparation methods applied for the study of a variety of polymeric materials using different techniques are described in depth, which will also aid laboratory assistants or students that are new to microscopy, as well as those that wish to improve their skills. Finally, the book will be also helpful for students of polymer physics, chemistry and engineering, as well as those researchers interested in the micro- and nanoscopic world of polymers.

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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