

Preface

Over the past three decades, NMR spectroscopy has emerged as one of the most important methods for polymer characterization. In the early history, high resolution solution NMR spectra played a key role in characterizing polymer microstructure and in understanding polymerization mechanisms. More recently, solid-state NMR has been developed and used to probe the structure, conformation, organization, and dynamics of polymers in their native state. In fact, the solid-state characterization of polymers is such an important topic that it has driven the development of new solid-state NMR methods. A further revolution occurred with the introduction of multidimensional NMR, making it possible to observe polymers with much higher resolution, leading to a more detailed understanding of polymer microstructure and to the molecular level assignments of the dynamics that have long been measured by dielectric and dynamic mechanical spectroscopy. The current importance of NMR in polymer characterization can be judged from the many papers published in polymer science that rely on NMR to elucidate the properties of polymers.

The goal of this book is to provide an overview of the applications of NMR to polymer characterization. The book begins with a review of the fundamental principles in Chapter 1 and polymer structure in Chapter 2. The high resolution solution state NMR of polymers is presented in Chapter 3 and includes multinuclear NMR studies and the two-dimensional NMR methods used to study polymer microstructure, chain conformation, and the structure of associating polymers. The solid-state NMR of polymers is presented in Chapter 4 and includes NMR determination of chain conformation in semicrystalline and amorphous polymers, polymer blends, and multiphase

polymer systems, as well as the NMR methods used to study chain organization on longer length scales. The molecular dynamics of polymers is covered in Chapter 5, where the methods used to study polymer dynamics both in solution and in the solid state are presented. Included in this chapter are the wideline and multidimensional NMR methods that have been used to relate the transitions measured by other spectroscopies to the chain dynamics at the atomic level.

This book is intended for academic and industrial researchers and does not reference all the data collected on the NMR of polymers. It does, however, illustrate the types of problems in polymer science that can be solved by NMR spectroscopy. In certain instances it is most instructive to show the data from some of the early, classic experiments in polymer NMR, while in other cases experiments from the most current literature are provided.