PREFACE

"Biopolymers" are polymeric materials of biological origin, including globular, membrane, and fibrous proteins, polypeptides, nucleic acids, polysaccharides, lipids, etc. and their assembly, although preference to respective subjects may be different among readers who are more interested in their biological significance or industrial and/or medical applications. Nevertheless, characterizing or revealing their secondary structure and dynamics may be an equally very important and useful issue for both kinds of readers. Special interest in revealing the 3D structure of globular proteins, nucleic acids, and peptides was aroused in relation to the currently active Structural Biology. X-ray crystallography and multidimensional solution NMR spectroscopy have proved to be the standard and indispensable means for this purpose. There remain, however, several limitations to this end, if one intends to expand its scope further. This is because these approaches are not always straightforward to characterize fibrous or membrane proteins owing to extreme difficulty in crystallization in the former, and insufficient spectral resolution due to sparing solubility or increased effective molecular mass in the presence of surrounding lipid bilayers in the latter.

It is a natural consequence to expect solid state NMR as an alternative means for this purpose, because major developments in the past 30 years witnessed remarkable progress of this technique. The expected NMR line widths available from achieved high-resolution solid state NMR can be manipulated experimentally and are not any more influenced by motional fluctuation of proteins under consideration as a whole, in contrast to solution NMR. Accordingly, detailed structural information such as mutual orientation of molecules, interatomic distances, torsion angles, etc. is available from NMR parameters contained in solid state NMR, although most of them are lost due to time-averaging in solution NMR.

This book is intended to give a comprehensive account as to how polymorphic, secondary, and dynamic structures of a variety of the abovementioned biopolymers are revealed by (high-resolution) solid state NMR.

In particular, a special emphasis is made toward the following two aspects: historical or chronological consequences of a variety of applications and dynamic aspect of the biopolymers. It is unfortunate that the latter aspect seems to be sacrificed in recent years in exchange for better structural information available from spectra taken either at lower temperature or hydration level far from biological significance. Indeed, revealing dynamics aspect of biopolymers is really an excellent and unrivaled means as revealed by solid state NMR study, as compared with other spectroscopic or diffraction methods. In this connection, it is emphasized that special attention to recording spectra by the most simple DD-MAS (one-pulse excitation with high-power decoupling) NMR is the unrivaled and only means to be able to record signals from such a flexible but structured portion of a variety of biopolymer systems, even if a number of complicated pulse techniques have been developed to obtain more detailed information. Readers may realize that very valuable structural information is still available from such a simple NMR technique. Indeed, we must bear in our mind *Simplex Sigillum Veri* (the truth is reflected in simplicity), as known since old times.

This book consists of the two parts: principles and applications. In the first part, a brief account of basic principles, NMR parameters, experimental strategies, and dynamics available from solid state NMR spectroscopy is made. In the second part, on the other hand, illustrative examples of these techniques to various subjects such as hydrogen-bonded systems, fibrous proteins, polysaccharides, polypeptides as new materials, globular and membrane proteins, membrane-associated peptides with biological functions, and amyloid and related biomolecules, are given. The organization of this book is thus like textile fabrics woven from the warps of biopolymers and the weft of solid state NMR.

The references in this book are of course by no means to intend to provide a complete compilation of related subjects. For this purpose, please consult references cited in a variety of review articles or books. Many of the data from our contributions are collaborative works with our colleagues and students at National Cancer Center Research Institute, Himeji Institute of Technology (currently University of Hyogo), Tokyo Institute of Technology, Yokohama National University, Gunma University, Tokyo University of Agriculture and Technology, especially with Professor A. Shoji, Professor T. Asakura, and Professor S. Tuzi, to whom the authors are deeply indebted. We are also grateful to Dr. S. Kuroki, Dr. K. Nishimura, Dr. S. Yamaguchi, Dr. M. Tanio, and Mr. I. Kawamura for their help in preparation of this manuscript.

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