

Preface

Stable nitroxide radicals have proved to be effective tools in solving many problems in chemistry, physics, biology, and biomedicine at the molecular level. The nitroxide labels are used as "molecular rulers" to measure the distances between chosen groups and to measure the size, form, and micro-relief of objects of interest. The labels provide information that helps the scientist to understand the structure and molecular dynamics of individual molecules, polymers, liquid crystals, enzymes, proteins, membranes, and nucleic acids and how they function. Recently, new important developments of nitroxides as redox-probes, spin-traps, imaging and pharmacokinetic reagents, and magnetic materials have been reported. Nitroxide derivatives are successfully used for the investigation of chemical kinetics, photo-physical, and photochemical processes. Therapeutic and clinical applications of nitroxides appear to be a new advance in medicine.

This volume covers all aspects of this field. It also critically discusses recent results obtained with the use of nitroxides and gives an analysis of developments in the field in the future.

This book is a view of the area by a group of scientists with long-term experience in the investigation of chemistry, physicochemistry, biochemistry, and biophysics of nitroxides. It is not intended to provide an exhaustive survey of each topic but rather a discussion of their theoretical and experimental background, and recent developments. The literature of nitroxides is vast and many scientists have made important contributions in the area so that it is impossible in the space allowed in this book to give a representative set of references. The authors apologize to those they have not been able to include. More than 1100 references are given, which should provide a key to essential relevant literature.

In Chapters 1 to 3 (J. Yamauchi) of the present monograph, the general theoretical, and experimental background is expounded for magnetic properties and ESR techniques. Chapter 4 (A. Smirnov) describes recent advances in modern ESR technique and related areas, which to a considerable extent were stimulated by the growing requirements of nitroxide application in biology and biomedicine. Fundamentals, recent results in preparation, and basic chemical properties of nitroxides are the main subject of Chapter 5 (S. Nakatsuji).

Chapters 6 and 7 (G.I. Likhtenshtein) offer a brief outline of principles and current results in nitroxide application as spin-labels and spin-probes in the

investigation of the molecular dynamics and microstructure of biological and non-biological objects, and as redox-probes and spin-traps. An important role of nitroxides as spin pH-meters, spin oximeters, and reactive radical-nitron adducts is elucidated. These chapters form the basis for subsequent profound studies of molecular properties of various objects such as polymers, inorganic materials, complexes of nitroxides with paramagnetic metals, photochemical systems, and so forth (Chapter 8 by G.I. Likhtenshtein). Advantages in a new area, the construction and investigation of magnetic materials on the basis of nitroxides are the subjects of Chapter 9 (R. Tamura). Chapter 10 (G.I. Likhtenshtein) discusses recent results from the utilization of the spin-labeling method for the investigation of molecular structure, dynamics, and functional activity of proteins, enzymes, biomembranes, nucleic acids, and polysaccharides. The concluding Chapter 11 (G.I. Likhtenshtein) considers biomedical, therapeutic, and clinical applications of nitroxides in areas which appear to be of great importance for human wellbeing.

Chemical, biochemical, biomedical, and material researchers may find in this book knowledge about fundamentals, instrumentation, data interpretation, capacity, and recent advances in nitroxide applications. It will help them to understand how nitroxides can help to solve their own problems. Physicists and experts in ESR instrumentation may learn about current problems and achievements in various areas of chemistry and molecular biology, and in the rapidly developing field of the application of nitroxides in biomedicine and medicine in particular. The book is also suited as a subsidiary text for instructors, graduate, and undergraduate students of university biochemical and chemical departments.

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