Introduction to Solid-State NMR Spectroscopy

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Solid State NMR Spectroscopy

This book is for those familiar with solution-state NMR who are encountering solid-state NMR for the first time. It presents the current understanding and applications of solid-state NMR with a rigorous but readable approach, making it easy for someone who merely wishes to gain an overall impression of the subject without details. This dual requirement is met through careful construction of the material within each chapter. The book is divided into two parts: "Fundamentals" and "Further Applications." The section on Fundamentals contains relatively long chapters that deal with the basic theory and practice of solid-state NMR. The essential differences and extra scope of solid-state NMR over solution-state is dealt with in an introductory chapter. The basic techniques that all chapters rely on are collected into a second chapter to avoid unnecessary repetition later. Remaining chapters in the "Fundamentals" part deal with the major areas of solid-state NMR which all solid-state NMR spectroscopists should know about. Each begins with an overview of the topic that puts the chapter in context. The basic principles upon which the techniques in the chapter rely are explained in a separate section. Each of these chapters exemplifies the principles and techniques with the applications most commonly found in current practice. The "Further Applications" section contains a series of shorter chapters which describe the NMR techniques used in other, more specific areas. The basic principles upon which these techniques rely will be expounded only if not already in the Fundamentals part.
The power of nuclear magnetic resonance, NMR, for characterizing molecules dissolved in solution is widely acknowledged and NMR forms an essential component of undergraduate chemistry degrees. However, the application of NMR to the solid state is much less well appreciated. This text sets out the fundamental principles of solid-state NMR, explaining how NMR in solids differs from that in solution, showing how the various interactions of NMR can be manipulated to yield high-resolution spectra and to give information on local structure and dynamics in solids. This book aims to take some of the mystique out of solid-state NMR by providing a comprehensible discussion of the methodology, including the basic concepts and a practical guide to implementation of the experiments. A basic knowledge of solution-state NMR is assumed and is only briefly covered. The text is intended for those in academia and industry expecting to use solid-state NMR in their research and looking for an accessible introduction to the field. It will also be valuable for non-experts interested in learning how NMR can be usefully applied to solid systems. Detailed mathematical treatments are delayed to a chapter at the mid-point of the text and can be skipped. Introductions to experiments and numerical simulations are provided to help link NMR results to experimental practice. The different aspects of solid-state NMR, from basic pulse-and-acquire experiments to sophisticated techniques for the measurement of anisotropy information are presented. Examples illustrate the wide variety of applications of the technique and its complementarity to other solid-state characterization techniques such as X-ray diffraction. Various aspects of NMR crystallography are covered as are topics of motion in solids.

Solid State NMR: Principles, Methods, and Applications offers a systematic introduction to the theory, methodological concepts, and major experimental methods of SSNMR spectroscopy. Exploring the unique potential of SSNMR for the structural and dynamic characterization of soft and either amorphous or crystalline solid materials, this comprehensive textbook provides foundational knowledge and recent developments of SSNMR, covering physical and theoretical background, experimental methods, and applications to pharmaceuticals, polymers, inorganic and hybrid materials, liquid crystals, and model membranes. Written by two expert authors to ensure a clear and consistent presentation of the subject, this textbook:

- Includes a brief introduction to the historical aspects and broad theoretical background of solid-state NMR spectroscopy
- Provides helpful illustrations to explain the various SSNMR concepts and methods
- Features accessible descriptive text with self-consistent use of quantum mechanics
- Covers the experimental aspects of SSNMR spectroscopy and in particular a description of many useful pulse sequences
- Contains references to relevant literature

from international leaders of this growing field, covering the most recent developments in the methodology and applications of solid state NMR to studies of membrane interactions and molecular motions.

Solid State NMR: Klaus Müller 2021-09-07 Solid State NMR A thorough and comprehensive textbook covering the theoretical background, experimental approaches, and major applications of solid-state NMR spectroscopy. Nuclear Magnetic Resonance (NMR) spectroscopy is a powerful non-destructive technique capable of providing information about the molecular structure and dynamics of molecules. Alongside solution-state NMR, a well-established technique to study chemical structures and investigate physico-chemical properties of molecules in solutions, solid-state NMR (SSNMR) offers many exciting possibilities for the analysis of solid and soft materials across scientific fields. SSNMR shows unique capabilities for a detailed investigation of structural and dynamic properties of materials over wide space and time ranges. For this reason, and thanks to significant advances in the past several years, the application of SSNMR to materials is rapidly increasing in disciplines such as chemistry, physics, and materials and life sciences. Solid State NMR: Principles, Methods, and Applications offers a systematic introduction to the theory, methodological concepts, and major experimental methods of SSNMR spectroscopy. Exploring the unique potential of SSNMR for the structural and dynamic characterization of soft and either amorphous or crystalline solid materials, this comprehensive textbook provides foundational knowledge and recent developments of SSNMR, covering physical and theoretical background, experimental methods, and applications to pharmaceuticals, polymers, inorganic and hybrid materials, liquid crystals, and model membranes. Written by two expert authors to ensure a clear and consistent presentation of the subject, this textbook:

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frances separovic 2014 advances in biological nmr brings the reader up to date with chapters
State NMR: Principles, Methods, and Applications is the ideal textbook for university courses on SSNMR, advanced spectroscopies, and a valuable single-volume reference for spectroscopists, chemists, and researchers in the field of materials.

**Multidimensional Solid-State NMR and Polymers** - Klaus Schmidt-Rohr 2012-12-02 NMR spectroscopy is the most valuable and versatile analytical tool in chemistry. While excellent monographs exist on high-resolution NMR in liquids and solids, this is the first book to address multidimensional solid-state NMR. Multidimensional techniques enable researchers to obtain detailed information about the structure, dynamics, orientation, and phase separation of solids, which provides the basis of a better understanding of materials properties on the molecular level. Dramatic progress much of it pioneered by the authors has been achieved in this area, especially in synthetic polymers. Solid-state NMR now favorably competes with well-established techniques, such as light, x-ray, or neutron scattering, electron microscopy, and dielectric and mechanical relaxation. The application of multidimensional solid-state NMR inevitably involves use of concepts from different fields of science. This book also provides the first comprehensive treatment of both the new experimental techniques and the theoretical concepts needed in more complex data analysis. The text addresses spectroscopists and polymer scientists by treating the subject on different levels; descriptive, technical, and mathematical approaches are used when appropriate. It presents an overview of new developments with numerous experimental examples and illustrations, which will appeal to readers interested in both the information content as well as the potential of solid-state NMR. The book also contains many previously unpublished details that will be appreciated by those who want to perform the experiments. The techniques described are applicable not only to the study of synthetic polymers but to numerous problems in solid-state physics, chemistry, materials science, and biophysics. Key Features * Presents original theories and new perspectives on scattering techniques * Provides a systematic treatment of the whole subject * Gives readers access to previously unpublished material * Includes extensive illustrations

**Multinuclear Solid-State Nuclear Magnetic Resonance of Inorganic Materials** - Kenneth J.D. MacKenzie 2002-04-26 Techniques of solid state nuclear magnetic resonance (NMR) spectroscopy are constantly being extended to a more diverse range of materials, pressing into service an ever-expanding range of nuclides including some previously considered too intractable to provide usable results. At the same time, new developments in both hardware and software are being introduced and refined. This book covers the most important of these new developments. With sections addressed to non-specialist researchers (providing accessible answers to the most common questions about the theory and practice of NMR asked by novices) as well as a more specialised and up-to-date treatment of the most important areas of inorganic materials research to which NMR has application, this book should be useful to NMR users whatever their level of expertise and whatever inorganic materials they wish to study.

**Spectroscopic Analyses** - Eram Sharmin 2017-12-06 The book presents developments and applications of these methods, such as NMR, mass, and others, including their applications in pharmaceutical and biomedical analyses. The book is divided into two sections. The first section covers spectroscopic methods, their applications, and their significance as characterization tools; the second section is dedicated to the applications of spectrophotometric methods in pharmaceutical and biomedical analyses. This book would be useful for students, scholars, and scientists engaged in synthesis, analyses, and applications of materials/polymers.

**Solid-State NMR in Zeolite Catalysis** - Jun Xu 2019-05-11 Solid-State NMR Characterization of Heterogeneous Catalysts and Catalytic Reactions provides a comprehensive account of state-of-the-art solid-state NMR techniques and the application of these techniques in heterogeneous catalysts and related catalytic reactions. It includes an introduction to the basic theory of solid-state NMR and various frequently used techniques. Special emphasis is placed on characterizing the framework and pore structure, active site, guest-host interaction, and synthesis mechanisms of heterogeneous catalysts using multinuclear one- and two-dimensional solid-state NMR spectroscopy. Additionally, various in-situ
solid-state NMR techniques and their applications in investigating the mechanism of industrially important catalytic reactions are also discussed. Both the fundamentals and the latest research results are covered, making the book suitable as a reference guide for both experienced researchers in and newcomers to this field. Feng Deng is a Professor at Wuhan Institute of Physics and Mathematics, Chinese Academy of Sciences.

**Solid State NMR Spectroscopy for Biopolymers**-Hazime Saitô 2006-08-05

“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.

**Spin Dynamics**-Malcolm H. Levitt 2013-05-20

Spin Dynamics: Basics of Nuclear Magnetic Resonance, Second Edition is a comprehensive and modern introduction which focuses on those essential principles and concepts needed for a thorough understanding of the subject, rather than the practical aspects. The quantum theory of nuclear magnets is presented within a strong physical framework, supported by figures. The book assumes only a basic knowledge of complex numbers and matrices, and provides the reader with numerous worked examples and exercises to encourage understanding. With the explicit aim of carefully developing the subject from the beginning, the text starts with coverage of quarks and nucleons and progresses through to a detailed explanation of several important NMR experiments, including NMR imaging, COSY, NOESY and TROSY. Completely revised and updated, the Second Edition features new material on the properties and distributions of isotopes, chemical shift anisotropy and quadrupolar interactions, Pake patterns, spin echoes, slice selection in NMR imaging, and a complete new chapter on the NMR spectroscopy of quadrupolar nuclei. New appendices have been included on Euler angles, and coherence selection by field gradients. As in the first edition, all material is heavily supported by graphics, much of which is new to this edition. Written for undergraduates and postgraduate students taking a first course in NMR spectroscopy and for those needing an up-to-date account of the subject, this multi-disciplinary book will appeal to chemical, physical, material, life, medical, earth and environmental scientists. The detailed physical insights will also make the book of interest for experienced spectroscopists and NMR researchers. • An accessible and carefully written introduction, designed to help students to fully understand this complex and dynamic subject • Takes a multi-disciplinary approach, focusing on basic principles and concepts rather than the more practical aspects • Presents a strong pedagogical approach throughout, with emphasis placed on individual spins to aid understanding • Includes numerous worked examples, problems, further reading and additional notes Praise from the reviews of the First Edition: "This is an excellent book... that many teachers of NMR spectroscopy will cherish... It deserves to be a 'classic' among NMR spectroscopy texts." NMR IN BIOMEDICINE "I strongly recommend this book to everyone... it is probably the best modern comprehensive description of the subject." ANGEWANDTE CHEMIE, INTERNATIONAL EDITION

**Solid State NMR of Polymers**-T. Asakura 1998-08-03 In polymer science and technology, the advanced development of various new polymer materials with excellent properties and functions is desirable. For this purpose it is necessary to determine the exact relationship between physical properties and molecular structure-dynamics with powerful techniques.
One such technique is solid state NMR. Recently, high resolution NMR studies of solids have been realized by using advanced pulse and mechanical techniques, which has resulted in a variety of structural and dynamical information on polymer systems. Solid state NMR has provided characteristic information which cannot be obtained by other spectroscopic methods. This book is divided into two parts. The first part covers the principles of NMR, important NMR parameters such as chemical shifts, relaxation times, dipolar interactions, quadrupolar interactions, pulse techniques and new NMR methods. In the second part, applications of NMR to a variety of polymer systems in the solid state are described. Features of this book: • Contains an up-to-date and comprehensive account of solid state NMR of polymers by leading researchers in the field • Provides a compilation of solid state NMR of polymers, which makes it an ideal reference book for both NMR researchers and general polymer scientists. This book will be of interest to the NMR community, and will be invaluable for both the beginner and the expert.

Solid-State NMR: Applications in Biomembrane Structure-Frances Separovic 2020-12-03 This book describes the methodology and applications of solid-state NMR spectroscopy to studies of membrane proteins, membrane-active peptides and model biological membranes. As well as structural studies it contains coverage of membrane interactions and molecular motions. Advances in biological solid-state NMR are very pertinent with high-field developments seeing applications in biological membranes and whole cells. Many of the chapter authors and contributors are world-class experts and leaders in the development and application of biological solid-state NMR. Key Features Addresses principles, methods and applications of solid-state NMR methods to biomembrane studies Introduction to biological solid-state NMR and applications to biological membranes Structure and dynamics of membrane lipids, proteins and peptides NMR studies of membrane interactions and molecular motion

NMR Spectroscopy of Biological Solids-A. Ramamoorthy 2005-09-22 Over the past decade, a myriad of techniques have shown that solid-state nuclear magnetic resonance (NMR) can be used in a broad spectrum of applications with exceptionally impressive results. Solid-state NMR results can yield high-resolution details on the structure and function of many important biological solids, including viruses, fibril-forming molecules, and molecules embedded in the cell membrane. Filling a void in the current literature, NMR Spectroscopy of Biological Solids examines all the recent developments, implementation, and interpretation of solid-state NMR experiments and the advantages of applying them to biological systems. The book emphasizes how these techniques can be used to realize the structure of non-crystalline systems of any size. It explains how these isotropic and anisotropic couplings interactions are used to determine atomic-level structures of biological molecules in a non-soluble state and extrapolate the three-dimensional structure of membrane proteins using magic-angle spinning (MAS). The book also focuses on the use of multidimensional solid-state NMR methods in the study of aligned systems to provide basic information about the mechanisms of action of a variety of biologically active molecules. Addressing principles, methods, and applications, this book provides a critical selection of solid-state NMR methods for solving a wide range of practical problems that arise in both academic and industrial research of biomolecules in the solid state. NMR Spectroscopy of Biological Solids is a forward-thinking resource for students and researchers in analytical chemistry, bioengineering, material sciences, and structural genomics.

Modern Methods in Solid-state NMR-Paul Hodgkinson 2018 The volume focuses on topics relevant to the developing field of "NMR crystallography", that is the use of solids NMR as a complement to diffraction crystallography, and will be of interest to every solid-state NMR researcher working in the chemical sciences.

Solid State NMR of Polymers - L.J. Mathias
1991-10-31 The chapters in this collection are from papers which were presented at a symposium on solid-state NMR of polymers. A two-part program on available NMR techniques applicable to solid polymer analysis was presented at the 3rd Chemical Congress of North American held in Toronto, Ontario, June 5-10, 1988. The program was sponsored by the Division of Polymer Chemistry with support provided by the Division, its Industrial Sponsors, and the Donors of the Petroleum Research Fund administered by the American Chemical Society. Co-organizers included Professor Colin Fyfe of the University of British Columbia (Vancouver, Canada), Professor Hans Spiess of the Max Planck Institut fur Polymerforschung (Mainz, West Germany), and myself. The full-day tutorial, which was free to registered attendees, covered the range of topics. The purpose of the tutorial was to provide a basic introduction to the field so that newcomers to its present and future applications could develop sufficient understanding to learn effectively from the subsequent symposium. The first talk attempted to give listeners a feel for the way a novice spectroscopist can learn to use the various NMR techniques to explore his own areas of interest. Simple experiments can provide unique information about solid polymers that can be useful in interpreting synthetic results and in relating solid-state conformation, morphology and molecular motion to physical properties.

NMR Spectroscopy in Liquids and Solids - Vladimir I. Bakhmutov 2015-04-10 NMR Spectroscopy in Liquids and Solids provides an introduction of the general concepts behind Nuclear Magnetic Resonance (NMR) and its applications, including how to perform adequate NMR experiments and interpret data collected in liquids and solids to characterize molecule systems in terms of their structure and dynamics. The book is composed of ten chapters. The first three chapters consider the theoretical basis of NMR spectroscopy, the theory of NMR relaxation, and the practice of relaxation measurements. The middle chapters discuss the general aspects of molecular dynamics and their relationships to NMR, NMR spectroscopy and relaxation studies in solutions, and special issues related to NMR in solutions. The remaining chapters introduce general principles and strategies involved in solid-state NMR studies, provide examples of applications of relaxation for the determination of molecular dynamics in diamagnetic solids, and discuss special issues related to solid state NMR— including NMR relaxation in paramagnetic solids. All chapters are accompanied by references and recommended literature for further reading. Many practical examples of multinuclear NMR and relaxation experiments and their interpretations are also presented. The book is ideal for scientists new to NMR, students, and investigators working in the areas of chemistry, biochemistry, biology, pharmaceutical sciences, or materials science.

Solid-State NMR IV Methods and Applications of Solid-State NMR - 2011-12-13 Solid-State NMR is a branch of Nuclear Magnetic Resonance which is presently experiencing a phase of strongly increasing popularity. The most striking evidence is the large number of contributions from Solid-State Resonance at NMR meetings, approaching that of liquid state resonance. Important progress can be observed in the areas of methodological developments and applications to organic and inorganic matter. One volume devoted to more or less one of each of these areas has been published in the preceding three issues. This volume can be considered an addendum to this series. Selected methods and applications of Solid-State NMR are featured in three chapters. The first one treats the recoupling of dipolar interactions in solids, which are averaged by fast sample rotation. Following an introduction to effective Hamiltonians and Floquet theory, different types of experiment such as rotary resonance, dipolar chemical shift correlation spectroscopy, rotational resonance and multipulse recoupling are treated in the powerful Floquet formalism. In the second chapter, the different approaches to line narrowing of quadrupolar nuclei are reviewed in a consistent formulation of double resonance (DaR) and dynamic angle spinning (DAS). Practical aspects of probe design are considered as well as advanced 2D experiments, sensitivity enhancement techniques, and spinning sideband manipulations. The use of such techniques dramatically increases the number of nuclei which can be probed in high resolution NMR spectroscopy. The final chapter describes new experimental approaches and results of structural studies of noncrystalline solids.
NMR Methods for Characterization of Synthetic and Natural Polymers-Toshikazu Miyoshi 2019-07-29 Since the introduction of FT-NMR spectroscopy around five decades ago, NMR has achieved significant advances in hardware and methodologies, accompanied with the enhancement of spectral resolution and signal sensitivity. Rapid developments in the polymers field mean that accurate and quantitative characterization of polymer structures and dynamics is the keystone for precisely regulating and controlling the physical and chemical properties of the polymer. This book specifically focuses on NMR investigation of complex polymers for the polymer community as well as NMR spectroscopists, and will push the development of both fields. It covers the latest advances, for example high field DNP and ultrafast MAS methodologies, and show how these novel NMR methods characterize various synthetic and natural polymers.

Current Developments in Solid State NMR Spectroscopy-Norbert Müller 2003-01-31 This book presents some of the latest developments in solid state NMR with potential applications in both materials and biological science. The main emphasis is on a strong link between theory and experiment via numerical simulation of NMR spectra which play a pivotal role in the design and development of pulse schemes in solid state NMR. The papers focus on non-biological topics of solid state NMR spectroscopy making the book useful for scientists and advanced students in chemistry, physics, and materials science striving for deeper understanding of this topic and its application potential. Three invited reviews focus on developments in solid state NMR of quadrupolar nuclei, which are of high interest in areas like materials science and heterogeneous catalysis.

Handbook of Spectroscopy-Günter Gauglitz 2006-03-06 This handbook provides a straightforward introduction to spectroscopy, showing what it can do and how it does it, together with a clear, integrated and objective account of the wealth of information that can be derived from spectra. The sequence of chapters covers a wide range of the electromagnetic spectrum, and the physical processes involved, from nuclear phenomena to molecular rotation processes. - A day-by-day laboratory guide: its design based on practical knowledge of spectroscopists at universities, industries and research institutes - A well-structured information source containing methods and applications sections framed by sections on general topics - Guides users to a decision about which spectroscopic method and which instrumentation will be the most appropriate to solve their own practical problem - Rapid access to essential information - Correct analysis of a huge number of measured spectra data and smart use of such information sources as databases and spectra libraries

Solid-State NMR IV Methods and Applications of Solid-State NMR-B. Blümich 2012-12-06 Solid-State NMR is a branch of Nuclear Magnetic Resonance which is presently experiencing a phase of strongly increasing popularity. The most striking evidence is the large number of contributions from Solid-State Resonance at NMR meetings, approaching that of liquid state resonance. Important progress can be observed in the areas of methodological developments and applications to organic and inorganic matter. One volume devoted to more or less one of each of these areas has been published in the preceding three issues. This volume can be considered an addendum to this series. Selected methods and applications of Solid-State NMR are featured in three chapters. The first one treats the recoupling of dipolar interactions in solids, which are averaged by fast sample rotation. Following an introduction to effective Hamiltonians and Floquet theory, different types of experiment such as rotary resonance, dipolar chemical shift correlation spectroscopy, rotational resonance and multipulse recoupling are treated in the powerful Floquet formalism. In the second chapter, the different approaches to line narrowing of quadrupolar nuclei are reviewed in a consistent formulation of double resonance (DaR) and dynamic angle spinning (DAS). Practical aspects of probe design are considered as well as advanced 2D experiments, sensitivity enhancement techniques, and spinning sideband manipulations. The use of such techniques dramatically increases the number of nuclei which can be probed in high resolution NMR spectroscopy. The final chapter describes new experimental approaches and results of structural studies of noncrystalline solids.
Introduction to advanced solid state NMR for material sciences

NMR Imaging of Materials

Solid-state NMR Spectroscopy of Inorganic Materials

NMR Spectroscopy of Polymers

Solid State Nuclear Magnetic Resonance

Nuclear Magnetic Resonance Spectroscopy
Multidimensional NMR Methods for the Solution State - Gareth A. Morris 2012-12-19

The content of this volume has been added to eMagRes (formerly Encyclopedia of Magnetic Resonance) - the ultimate online resource for NMR and MRI. The literature of multidimensional NMR began with the publication of three papers in 1975, then nine in 1976 and fifteen in 1977, and now contains many tens of thousands of papers. Any attempt to survey the field must therefore necessarily be very selective, not to say partial. In assembling this handbook, the editors have sought to provide both the new researcher and the established scientist with a solid foundation for the understanding of multidimensional NMR, a representative if inevitably limited survey of its applications, an authoritative account of classic techniques such as COSY, NOESY and TOCSY, and an account of the latest progress in the development of multidimensional techniques. This handbook is structured in four parts. The first opens with a historical introduction to, and a brief account of, the practicalities and applications of multidimensional NMR methods, followed by a definitive survey of their conceptual basis and a series of articles setting out the generic principles of methods for acquiring and processing multidimensional NMR data. In the second part, the main families of multidimensional techniques, arranged in approximate order of increasing complexity, are described in detail, from simple J-resolved spectroscopy through to the powerful heteronuclear 3D and 4D methods that now dominate the study of structural biology in solution. The third part offers an illustrative selection from the very wide range of applications of multidimensional NMR methods, including some of the most recent developments in protein NMR. Finally, the fourth part introduces the idea of multidimensional spectra containing non-frequency dimensions, in which properties such as diffusion and relaxation are correlated. About EMR Handbooks / eMagRes Handbooks The Encyclopedia of Magnetic Resonance (up to 2012) and eMagRes (from 2013 onward) publish a wide range of online articles on all aspects of magnetic resonance in physics, chemistry, biology and medicine. The existence of this large number of articles, written by experts in various fields, is enabling the publication of a series of EMR Handbooks / eMagRes Handbooks on specific areas of NMR and MRI. The chapters of each of these handbooks will comprise a carefully chosen...
selection of articles from eMagRes. In consultation with the eMagRes Editorial Board, the EMRHandbooks / eMagRes Handbooks are coherently planned in advance by specially-selected Editors, and new articles are written together with updates of some already existing articles to give appropriate complete coverage. The handbooks are intended to be of value and interest to research students, postdoctoral fellows and other researchers learning about the scientific area in question and undertaking relevant experiments, whether in academia or industry. Have the content of this Handbook and the complete content of eMagRes at your fingertips! Visit:

NMR and Chemistry - J.W. Akitt 2017-12-21
Keeping mathematics to a minimum, this book introduces nuclear properties, nuclear screening, chemical shift, spin-spin coupling, and relaxation. It is one of the few books that provides the student with the physical background to NMR spectroscopy from the point of view of the whole of the periodic table rather than concentrating on the narrow applications of 1H and 13C NMR spectroscopy from the point of view of the whole of the periodic table rather than concentrating on the narrow applications of 1H and 13C NMR spectroscopy. Aids to structure determination, such as decoupling, the nuclear Overhauser effect, INEPT, DEPT, and special editing, and two dimensional NMR spectroscopy are discussed in detail with examples, including the complete assignment of the 1H and 13C NMR spectra of D-amygdalin. The authors examine the requirements of a modern spectrometer and the effects of pulses and discuss the effects of dynamic processes as a function of temperature or pressure on NMR spectra. The book concludes with chapters on some of the applications of NMR spectroscopy to medical and non-medical imaging techniques and solid state chemistry of both I = F1/2 and I > F1/2 nuclei. Examples and problems, mainly from the recent inorganic/organometallic chemistry literature support the text throughout. Brief answers to all the problems are provided in the text with full answers at the end of the book.

NMR of Biomolecules - Ivano Bertini 2012-04-16
NMR is one of the most powerful methods for imaging of biomolecules. This book is the ultimate NMR guide for researchers in the biomedical community and gives not only background and practical tips but also a forward looking view on the future of NMR in systems biology.

Principles of High Resolution NMR in Solids - M. Mehring 2012-12-06
The field of Nuclear Magnetic Resonance (NMR) has developed at a fascinating pace during the last decade. It always has been an extremely valuable tool to the organic chemist by supplying molecular "finger print" spectra at the atomic level. Unfortunately the high resolution achievable in liquid solutions could not be obtained in solids and physicists and physical chemists had to live with unresolved lines open to a wealth of curve fitting procedures and a vast amount of speculations. High resolution NMR in solids seemed to be a paradoxon. Broad structure less lines are usually encountered when dealing with NMR in solids. Only with the recent advent of multiple pulse, magic angle, cross-polarization, two-dimen sional and multiple-quantum spectroscopy and other techniques during the last decade it became possible to resolve finer details of nuclear spin interactions in solids. I have felt that graduate students, researchers and others beginning to get involved with these techniques needed a book which treats the principles, theo retical foundations and applications of these rather sophisticated experimental techniques. Therefore I wrote a monograph on the subject in 1976. Very soon new ideas led to the developement of "two-dimensional spectroscopy" and "multiple-quantum spectroscopy", topics which were not covered in the first edition of my book. Moreover an exponential growth of literature appeared in this area of research leaving the beginner in an awkward situation of tracing back from a current article to the roots of the experiment.

In-cell NMR Spectroscopy - Yutaka Ito 2019-12-09
In-cell NMR spectroscopy is a relatively new field. Despite its short history, recent in-cell NMR-related publications in major journals indicate that this method is receiving significant general attention. This book provides the first informative work specifically focused on in-cell NMR. It details the historical background of in-cell NMR, host cells for in-cell NMR studies, methods for in-cell biological techniques and
NMR spectroscopy, applications, and future perspectives. Researchers in biochemistry, biophysics, molecular biology, cell biology, structural biology as well as NMR analysts interested in biological applications will all find this book valuable reading.

**NMR Spectroscopy in Pharmaceutical Analysis** -Iwona Wawer 2017-07-07 For almost a decade, quantitative NMR spectroscopy (qNMR) has been established as a valuable tool in drug analysis. In all disciplines, i.e. drug identification, impurity profiling and assay, qNMR can be utilized. Separation techniques such as high performance liquid chromatography, gas chromatography, super fluid chromatography and capillary electrophoresis techniques, govern the purity evaluation of drugs. However, these techniques are not always able to solve the analytical problems often resulting in insufficient methods. Nevertheless such methods find their way into international pharmacopoeias. Thus, the aim of the book is to describe the possibilities of qNMR in pharmaceutical analysis. Beside the introduction to the physical fundamentals and techniques the principles of the application in drug analysis are described: quality evaluation of drugs, polymer characterization, natural products and corresponding reference compounds, metabolism, and solid phase NMR spectroscopy for the characterization drug substances, e.g. the water content, polymorphism, and drug formulations, e.g. tablets, powders. This part is accompanied by more special chapters dealing with representative examples. They give more detailed information by means of concrete examples. Combines theory, techniques, and concrete applications—all of which closely resemble the laboratory experience Considers international pharmacopoeias, addressing the concern for licensing Features the work of academics and researchers, appealing to a broad readership

**Understanding NMR Spectroscopy** -James Keeler 2011-09-19 This text is aimed at people who have some familiarity with high-resolution NMR and who wish to deepen their understanding of how NMR experiments actually ‘work’. This revised and updated edition takes the same approach as the highly-acclaimed first edition. The text concentrates on the description of commonly-used experiments and explains in detail the theory behind how such experiments work. The quantum mechanical tools needed to analyse pulse sequences are introduced step by step, but the approach is relatively informal with the emphasis on obtaining a good understanding of how the experiments actually work. The use of two-colour printing and a new larger format improves the readability of the text. In addition, a number of new topics have been introduced: How product operators can be extended to describe experiments in AX2 and AX3 spin systems, thus making it possible to discuss the important APT, INEPT and DEPT experiments often used in carbon-13 NMR. Spin system analysis i.e. how shifts and couplings can be extracted from strongly-coupled (second-order) spectra. How the presence of chemically equivalent spins leads to spectral features which are somewhat unusual and possibly misleading, even at high magnetic fields. A discussion of chemical exchange effects has been introduced in order to help with the explanation of transverse relaxation. The double-quantum spectroscopy of a three-spin system is now considered in more detail. Reviews of the First Edition “For anyone wishing to know what really goes on in their NMR experiments, I would highly recommend this book” – Chemistry World “...I warmly recommend for budding NMR spectroscopists, or others who wish to deepen their understanding of elementary NMR theory or theoretical tools” – Magnetic Resonance in Chemistry

**Nuclear Magnetic Resonance in Agriculture** -Philip E. Pfeffer 1989-04-30 This informative publication presents the broad application of nuclear magnetic resonance to many of today’s problem areas in agriculture. Solid-state NMR methodology is covered, with its applications to the study of intact agricultural matrices such as plant cell walls, photosynthetic chloroplast membranes, forages, wood cellulose, and soils. In vivo solution NMR methodology and its applications to the study of different functioning plant tissues and their biochemical responses to various pathological, physiological, and toxicological stresses are illustrated with examples using 31P, 13C, 23Na, and 15N resonance methods. An introductory chapter presents a review of the in vivo literature and some basic principles and requirements for carrying out such experiments. A special section focuses on state-of-the-art 13C and 1H high-resolution multidimensional methods and their
application to the study of agricultural toxins; biologically active components, including their structures and biosyntheses, and dynamic measurements of relaxation phenomena associated with cross relaxation in water bound to food proteins.

High Resolution NMR Spectroscopy in Solids - M. Mehring 2012-12-06 Manipulation and Dilution Tools for Ruling Abundant Species

"NMR is dead" was the slogan heard in the late 1960s at least among physicists, until John S. Waugh and his co-workers initiated a series of new NMR experiments, which employed the coherent modulation of interactions by strong radiofrequency fields. A wealth of new phenomena was observed, which are summarized in the introduction for the convenience of the unbiased reader, whereas Section 2 collects the basic spin interactions observed in solids. Line-narrowing effects in dipolar coupled solids by the application of multiple pulse experiments are extensively discussed in Section 3. Numerous extensions of the basic Waugh, Huber, and Haeberlen experiment have been developed by different groups and have been applied to the nuclei IH, 9Be, 19F, 27Al, 31p, 63Cu in solids. Application of this technique to a variety of systems is still in progress and should reveal interesting insights into weak spin interactions in solids. It was soon realized that rare spins could be used as monitors for molecular fields in the solid state; however, rare spin observation is difficult because of the small signal-to-noise ratio. Pines, Gibby, and Waugh introduced a new concept of cross-polarization, based on ideas of Hahn and co-workers, which allows the detection of rare spins with increased sensitivity. The dynamics involved are treated in detail. Other sections merely list results obtained by the techniques described and demonstrate their usefulness in the investigation of dynamical problems in molecular and solid state physics.