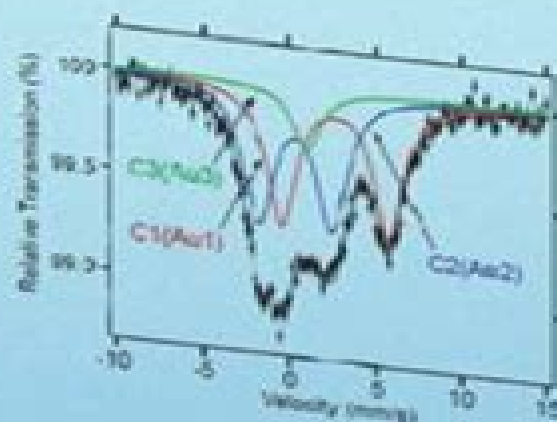
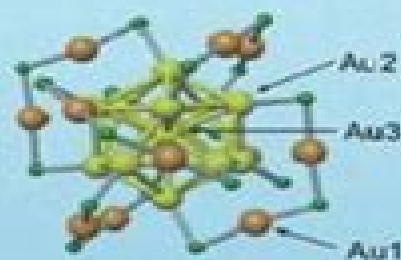


Edited by  
Yann Garcia, Junhu Wang, and Tao Zhang

# Mössbauer Spectroscopy

Applications in Chemistry and  
Materials Science



# Mssbauer Spectroscopy

**Virender K. Sharma, Gostar  
Klingelhofer, Tetsuaki Nishida**



## Mossbauer Spectroscopy:

**Mössbauer Spectroscopy and Transition Metal Chemistry** P. Gütlich, R. Link, A. Trautwein, 2013-11-11 Two decades have passed since the original discovery of recoilless nuclear gamma resonance by Rudolf Mossbauer the spectroscopic method based on this resonance effect referred to as Mossbauer spectroscopy has developed into a powerful tool in solid state research The users are chemists physicists biologists geologists and scientists from other disciplines and the spectrum of problems amenable to this method has become extraordinarily broad In the present volume we have confined ourselves to applications of Mossbauer spectroscopy to the area of transition elements We hope that the book will be useful not only to non Mossbauer specialists with problem oriented activities in the chemistry and physics of transition elements but also to those actively working in the field of Mossbauer spectroscopy on systems compounds as well as alloys of transition elements The first five chapters are directed to introducing the reader who is not familiar with the technique to the principles of the recoilless nuclear resonance effect the hyperfine interactions between nuclei and electronic properties such as electric and magnetic fields some essential aspects about measurements and the evaluation of Mossbauer spectra Chapter 6 deals with the interpretation of Mossbauer parameters of iron compounds Here we have placed emphasis on the information about the electronic structure in correlation with quantum chemical methods because of its importance for chemical bonding and magnetic properties *Mössbauer Spectroscopy* U. Gonser, 1975 *Mössbauer Spectroscopy* Virender K. Sharma, Gostar Klingelhofer, Tetsuaki Nishida, 2013-08-13 Providing a modern update of the field Mossbauer Spectroscopy focuses on applications across a broad range of fields including analysis of inorganic elements nanoparticles metalloenzymes biomolecules including proteins glass coal and iron Ideal for a broad range of scientists this one stop reference presents advances gained in the field over past two decades including a detailed theoretical description of Mossbauer spectroscopy an extensive treatment of Mossbauer spectroscopy in applied areas and challenges and future opportunities for the further development of this technique *Mössbauer Spectroscopy in Materials Science* Marcel Miglierini, Dimitris Petridis, 1999-02-28 Material science is one of the most evolving fields of human activities Invention and consequent introduction of new materials for practical and or technological purposes requires as complete knowledge of the physical chemical and structural properties as possible to ensure proper and optimal usage of their new features In order to understand the macroscopic behaviour one has to search for their origin on a microscopic level A good deal of microscopic information can be obtained through hyperfine interactions Mossbauer spectroscopy offers a unique possibility for hyperfine interaction studies via probing the nearest order of resonant atoms Materials which contain the respective isotope as one of the constituent elements e g iron tin but also those which even do not contain them can be investigated In the latter case the probe atoms are incorporated into the material of interest in minor quantities ca 0.1 at % to act as probes on a nuclear level This Workshop has covered the most evolving topics in the field of Mossbauer spectroscopy applied to materials science

During four working days SO participants from 19 countries discussed the following areas Chemistry Mineralogy and Metallurgy Artificial and Structured Materials Nanosized Materials and Quasicrystals and Experimental Techniques and Data Processing A total of 42 contributions 30 keynote talks reviewed the current state of art of the method its applications for technical purposes as well as trends and perspectives A total of 39 papers are included in the present volume Applications in Chemistry

**Mössbauer Spectroscopy** Yann Garcia, Junhu Wang, Tao Zhang, 2023-09-25 Mössbauer Spectroscopy Unique and comprehensive overview of versatile applications of Mössbauer spectroscopy in chemistry and material sciences Mössbauer Spectroscopy provides a comprehensive overview of relevant applications of this physical analysis method in chemistry and material sciences The book shows the versatility of Mössbauer spectroscopy in finding useful information on electronic structure structural insights and solid state effects of chemical systems A wide range of chemical applications and applied concepts are covered as well as numerous examples selected from recent literature To aid in reader comprehension and accessibility contents are well structured and divided in different sections covering energy catalysis coordination chemistry spin crossover sensing photomagnetism Edited by prominent scientists in the field and authored by a group of international experts Mössbauer Spectroscopy covers sample topics such as Li ion batteries catalysts fuel cells Fe based silicides and iron phosphates containing minerals Gold clusters and gold mixed valence complexes Molecule based magnets photoswitchable spin crossover coordination polymers and molecular sensors for meat freshness control With comprehensive coverage of the developments in the technique Mössbauer Spectroscopy is a beneficial resource for researchers professionals and academics in chemistry related fields such as material science sustainable environment and molecular electronics It can be used by newcomers as well as for educational purposes at the master and PhD levels

*Mössbauer Spectroscopy and Its Chemical Applications* John Gehret Stevens, 1981

*Mössbauer Spectroscopy of Environmental Materials and Their Industrial Utilization* Enver Murad, John Cashion, 2011-06-28 Mössbauer Spectroscopy of Environmental Materials and their Industrial Utilization provides a description of the properties of materials formed on the earth's surface their synthetic analogs where applicable and the products of their modifications in the course of natural processes such as weathering or in industrial processing as reflected in their Mössbauer spectra Particular emphasis is placed on the way in which these processes can be observed and elucidated through the use of Mössbauer spectroscopy The first chapter covers the basic theory of the Mössbauer effect and Chapters 2 and 3 deal with the nuts and bolts of experimental Mössbauer spectroscopy The principles of these first three chapters illustrated with many case studies are applied to different areas of interest in Chapters 4 through 12 The book is directed to a broad audience ranging from graduate students in environmental sciences or chemical engineering with little or no expertise in Mössbauer spectroscopy to researchers from other disciplines who are familiar with this technique but wish to learn more about possible applications to environmental materials and issues

**An Introduction to Mössbauer Spectroscopy** Leopold May, 2012-12-06 The initial impetus for this text occurred when we

were searching for a single book that could be recommended to the attendees at the Mossbauer Spectroscopy Institute at The Catholic University of America This Institute is an introductory course on the theory and interpretation of Mossbauer spectroscopy for workers in industrial academic and government laboratories None of the books available adequately covered the breadth and scope of the lectures in the Institute A list of these books and review articles is included in Appendix C To meet our needs we undertook the creation of this text The chapters are based upon the lectures given at the various Institutes from 1967 to 1969 Most of the lectures were recorded and transcripts sent to the lecturers who then prepared the manuscripts using the transcripts as a guide so as to retain the style developed during the lecture Each chapter is written in the style of the authors As the editor my main task was to maintain uniformity of format and nomenclature A list of nomenclature used in this volume is reproduced in Appendix A We hope that this list will be used particularly by new investigators and teachers of Mossbauer spectroscopy so that future literature will employ a uniform system

**Mössbauer Spectroscopy and its Applications** T. E. Cranshaw, B. W. Dale, G. O. Longworth, C. E. Johnson, 1986-01-23 The technique of Mossbauer spectroscopy is important in the study of the bonding structural magnetic nuclear and dynamical properties of various systems Although used mainly by physicists and chemists the method has also become a common means of investigation for materials scientists geologists biologists surface scientists and others This book describes the principles of the technique and discusses its applications in various fields It will be invaluable for anyone using the technique of Mossbauer spectroscopy for the first time

**Mössbauer Spectroscopy Applied to Magnetism and Materials Science** G.J Long, F. Grandjean, 2013-06-29 During the past 30 years materials science has developed into a full fledged field for basic and applied scientific enquiry Indeed materials scientists have devoted their efforts to creating new materials with improved electronic magnetic thermal mechanical and optical properties Often unnoticed these new materials are rapidly invading our homes and automobiles and may be found in our utensils electronic equipment textiles home appliances and electric motors Even though they may go unnoticed these new materials have either improved the efficiency and lifetime of these items or have reduced their weight or cost In particular magnetically ordered materials are useful in various applications such as motors magnetic imaging magnetic recording and magnetic levitation Hence much effort has been devoted to the development of better hard magnetic materials magnetic thin films and molecular magnets During the same period of time Mossbauer effect spectroscopy has grown from a laboratory curiosity to a mature spectroscopic technique a technique that probes solid state materials at specific atomic sites and yields microscopic information on the magnetic and electronic properties of these materials Iron 57 is the most commonly and easily used Mossbauer effect isotope and of course is particularly relevant for the study of magnetic materials Various applications of Mossbauer spectroscopy to magnetic materials are discussed in the first six chapters of this volume Other isotopes such as zinc 67 and gadolinium 155 have recently been used to study the electronic properties of zinc compounds and the electronic and magnetic properties of rare earth transition metal compounds

**Mössbauer Spectroscopy** Yutaka Yoshida, Guido Langouche, 2012-11-08 Tutorials on Mössbauer Spectroscopy Since the discovery of the Mössbauer Effect many excellent books have been published for researchers and for doctoral and master level students However there appears to be no textbook available for final year bachelor students nor for people working in industry who have received only basic courses in classical mechanics electromagnetism quantum mechanics chemistry and materials science The challenge of this book is to give an introduction to Mössbauer Spectroscopy for this level The ultimate goal of this book is to give this audience not only a scientific introduction to the technique but also to demonstrate in an attractive way the power of Mössbauer Spectroscopy in many fields of science in order to create interest among the readers in joining the community of Mössbauer spectroscopists This is particularly important at times where in many Mössbauer laboratories succession is at stake This book will be used as a textbook for the tutorial sessions organized at the occasion of the 2011 International Conference on the Application of Mössbauer Spectroscopy ICAME2011 in Tokyo **Mössbauer**

**Spectroscopy and Its Applications**, 1972 Principles of Mössbauer Spectroscopy Terence Gibb, 2012-12-06 The emergence of Mössbauer spectroscopy as an important experimental technique for the study of solids has resulted in a wide range of applications in chemistry physics metallurgy and biophysics This book is intended to summarize the elementary principles of the technique at a level appropriate to the advanced student or experienced chemist requiring a moderately comprehensive but basically non mathematical introduction Thus the major part of the book is concerned with the practical applications of Mössbauer spectroscopy using carefully selected examples to illustrate the concepts The references cited and the bibliography are intended to provide a bridge to the main literature for those who subsequently require a deeper knowledge The text is complementary to the longer research monograph Mössbauer Spectroscopy which was written a few years ago in co authorship with Professor N N Greenwood and to whom I am deeply indebted for reading the preliminary draft of the present volume I also wish to thank my many colleagues over the past ten years and in particular Dr R Greatrex for the many stimulating discussions which we have had together However my greatest debt is to my wife who not only had to tolerate my eccentricities during the gestation period but being a chemist herself was also able to provide much useful criticism of the penultimate draft

**Mössbauer Spectroscopy** N. N. Greenwood, 2012-12-06 Rudolph Mössbauer discovered the phenomenon of recoil free nuclear resonance fluorescence in 1957 58 and the first indications of hyperfine interactions in a chemical compound were obtained by Kistner and Sunyar in 1960 From these beginnings the technique of Mössbauer spectroscopy rapidly emerged and the astonishing versatility of this new technique soon led to its extensive application to a wide variety of chemical and solid state problems This book reviews the results obtained by Mössbauer spectroscopy during the past ten years in the belief that this will provide a firm basis for the continued development and application of the technique to new problems in the future It has been our aim to write a unified and consistent treatment which firstly presents the basic principles underlying the phenomena involved then outlines the experimental techniques

used and finally summarises the wealth of experimental and theoretical results which have been obtained We have tried to give some feeling for the physical basis of the Mossbauer effect with out extensive use of mathematical formalism and some appreciation of the experimental methods employed without embarking on a detailed discussion of electronics and instrumentation However full references to the original literature are provided and particular points can readily be pursued in more detail if required

**Mössbauer Spectroscopy II** U. Gonser, 2013-04-18 Some newly discovered effects lose their glamor after a short period of euphoria Others however retain their fascination for a long time and even as they mature display unexpected features The Mossbauer effect belongs to the second category Rudolf Mossbauer s discovery of recoilless gamma ray emission in 1957 immediately caused a flurry of attention and confirming work appeared almost at once Since then the flow of publications has steadily increased Most studies follow predictabl e paths the essential aspects of these conventional experiments have been described in the first volume of the present work Mossbauer Spectroscopy Topics in Applied Physics Vol 5 These straightforward investigations have not however exhausted the field boredom has not set in and unexpected applications continue to appear In the present volume Uli Gonser has collected contributions that display the exotic side of the Mossbauer effect They range from a masterly de scription of the red shift experiment to a clear exposition of a powerful solution to the old and painful phase problem in crystallography Each of the contributions exhibits a different side of recoilless gamma ray emission Together they show that the field is very much alive and continues to delight us with elegant solutions to old problems unanticipated glimpses at new phenomena clever uses of new technical possibilities and ingenious applications to fields far away from physics I believe that novel features of the Mossbauer effect will continue to appear and that new applications will still be found

**Chemical Mössbauer Spectroscopy** R.H. Herber, 2012-12-06 The past twenty five years roughly the period from 1960 to 1985 have been by all measures among the most exciting and challenging times of our science The increasing sensitivity of chemical instrumentation the introduction of the routine use of computers for data reduction and of microprocessors for instrumental control the wide spread utilization of lasers and the disappearance of traditional disciplinary boundaries between scientific fields are but a few of the examples one could cite to support the introductory contention Almost all of these developments have had their impact on the development of Mossbauer Effect Spectroscopy into a technique par excellence for the elucidation of problems in all areas of chemistry and its associated sister sciences Indeed because this spectroscopy is based on fundamental phenomena in nuclear physics is described in terms of the theory of the solid state and structural chemistry is useful in the understanding of chemical reactivity and biological phenomena and can serve to supplement information developed by many other experimental techniques it has provided an unparalleled opportunity for the exchange of ideas among practitioners of a very wide variety of subfields of the physical and biological sciences The present collection of contributions is the direct result of such an interaction

Mössbauer Effect Methodology Irwin J. Gruverman, 2013-04-17 This is the fifth volume of a series which

provides a continuing forum for publication of developments in Mossbauer effect methodology and of spectroscopy and its applications Mossbauer Effect Methodology Volume 5 records the proceedings of the Fifth Symposium on Mossbauer Effect Methodology The symposium was sponsored by the New England Nuclear Corporation and was centered on the themes of spectroscopy new applications and methodology The symposium was held in the Mercury Ballroom of the New York Hilton hotel on February 2 1969 Dr P A Flinn of Carnegie Mellon Institute was chairman of the afternoon and evening sessions About three hundred participants attended and this degree of interest leads us to anticipate a sixth symposium early in 1970 Elron Electronic Industries and Reuter Stokes Electronic Components Company demonstrated lines of equipment for Mossbauer investigators The evident high quality of the commercial instrumentation available is a tribute to the growth of Mossbauer technology and to the manufacturers Mössbauer Spectroscopy and Its Chemical Applications, 1981

**Mössbauer Effect Methodology** Irwin J. Gruverman, 2013-11-21 The continued growth of Mossbauer effect methodology and its virtuosity in encompassing new elements and new applications are amply illustrated by the contents of this volume The degree of maturity of Mossbauer spectroscopy is attested to by the increasing reliance of chemists upon Mossbauer investigation as a primary tool to be confirmed by more conventional measurements An exciting development has been the use of neutron and Coulomb excitation techniques to produce Mossbauer levels This promises to lead Mossbauer spectroscopy toward the very desirable universal spectroscopy category The prospect of extending the technique to many elements which do not possess useful precursor radionuclides is exciting indeed While attention is being focused primarily on spectroscopy and applications methodology is not being neglected Another generation of drive designs is being reported and commercial spectrometers are becoming more reliable more competitive and offer a reasonable selection of features at a wide range in prices Several of the equipment companies who participated in the Third Mossbauer Methodology Symposium demonstrated approaches to Mossbauer spectrometer design e g Austin Science Associates and Linear Alpha Corporation Elron A unique new very high count rate acceptance system demonstrated by Austin Science Associates was developed entirely in response to the need of Mossbauer spectroscopists for data acquisition rates beyond existing proportional counting capabilities The range of proportional detectors available and a simple inexpensive demonstration spectrometer were exhibited by Reuter Stokes Electronic Components Inc *Material Research in Atomic Scale by Mössbauer Spectroscopy* Miroslav Mashlan, Marcel Miglierini, Peter Schaaf,



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