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Handbook of Superconducting Materials Superconducting Materials and Their Applications Superconducting Materials Handbook of Superconducting Materials Handbook of Superconductivity Superconducting Materials Superconducting Materials Handbook of Superconducting Materials, 2nd Edition (3-Volume Set) Metallurgy of Superconducting Materials Handbook of Superconducting Materials Superconductivity Handbook of Superconducting Materials, 2nd Edition (Volume 1) Advances in High Temperature Superconductors and their applications High-Temperature Superconductors: Materials, Properties, and Applications Superconductivity Concise Encyclopedia of Magnetic and Superconducting Materials Magnetic and Superconducting Materials Discovering Superconductivity Handbook of Superconductivity High Temperature Superconductor Bulk Materials Superconductor Materials Science: Metallurgy, Fabrication, and Applications Superconducting Materials and Their Applications Superconductors Handbook of Superconductivity Superconducting Materials Superconductivity Superconductivity

in New Materials Manufacture of Superconducting Materials Superconductivity and Superconducting Materials Iron-based Superconductors Engineering Properties of Superconducting Materials Superconductivity High-Temperature Superconducting Materials Frontiers in Superconducting Materials Superconductivity Superconductor Materials Science: Metallurgy, Fabrication, and Applications Superconductivity Numerical Modelling of Bulk Superconductor Magnetisation High-temperature Superconducting Materials Science and Engineering Superconductors in the Power Grid

This book explores the fascinating field of high-temperature superconductivity. Basic concepts-including experimental techniques and theoretical issues-are discussed in a clear, systematic manner. In addition, the most recent research results in the measurements, materials synthesis and processing, and characterization of physical properties of high-temperature superconductors are presented. Researchers and students alike can use this book as a comprehensive introduction not only to superconductivity but also to materials-related research in electromagnetic ceramics. Special features of the book: presents recent developments in vortex-state properties, defects characterization, and phase equilibrium introduces basic concepts for experimental techniques at low temperatures and high magnetic fields provides a valuable reference for materials-related research discusses potential industrial applications of high-temperature superconductivity includes novel processing technologies for thin film and bulk materials suggests areas of research and specific problems whose solution can make high-Tc superconductors a practical reality This volume consists of lectures highlighting fundamentals of advances in superconducting materials, related technologies and

applications. Theory, fundamental aspects, advances in materials synthesis, processing and properties are featured, as well as current developments of superconducting components and devices.Both HTC and LTC superconducting materials are discussed. Several years after the discovery of high Tc superconductivity and a multinational effort in its study, this book collects the main results on the subject and presents a state-of-the-art view of the correlations between crystal chemistry and physical properties. Frontiers in Superconducting Materials gives a state-of-the-art report of the most important topics of the current research in superconductive materials and related phenomena. It comprises 30 chapters written by renowned international experts in the field. It is of central interest to researchers and specialists in Physics and Materials Science, both in academic and industrial research, as well as advanced students. It also addresses electronic and electrical engineers. Even non-specialists interested in superconductivity might find some useful answers. This book provides readers with a comprehensive overview of the science of superconducting materials. It serves as a fundamental information source on the actual techniques and methodologies involved in superconducting materials growth, characterization and processing. This book includes coverage of several categories of medium and high-temperature superconducting materials: cuprate oxides, borides, and iron-based chalcogenides and pnictides. Provides a single-source reference on superconducting materials growth, characterization and processing; Bridges the gap between materials science and applications of superconductors; Discusses several categories of superconducting materials such as cuprate oxides, borides, and iron-based chalcogenides and pnictides; Covers synthesis, characterization, and processing of superconducting materials,

as well as the nanoengineering approach to tailor the properties of the used materials at the nanoscale level. Completely revised and updated, the second edition of the Handbook of Superconducting Materials is now available in three stand-alone volumes. As a whole they cover the depth and breadth of the field, drawing on an international pool of respected academics and industrial engineers. The three volumes provide hands-on guidance to the manufacturing and processing technologies associated with superconducting materials and devices. A comprehensive reference, the handbook supplies a tutorial on techniques for the beginning graduate student and a source of ancillary information for practicing scientists. Plastic (and microplastic) pollution has been described as one of the greatest environmental challenges of our time, and a hallmark of the human-driven epoch known as the Anthropocene. It has gained the attention of the general public, governments, and environmental scientists worldwide. To date, the main focus has been on plastics in the marine environment, but interest in the presence and effects of plastics in freshwaters has increased in the recent years. The occurrence of plastics within inland lakes and rivers, as well as their biota, has been demonstrated. Experiments with freshwater organisms have started to explore the direct and indirect effects resulting from plastic exposure. There is a clear need for further research, and a dedicated space for its dissemination. This book is devoted to highlighting current research from around the world on the prevalence, fate, and effects of plastic in freshwater environments. This book consists of over 600 selected descriptions and abstracts of books, book chapters, patents and journal articles from throughout the world dealing with this high-profile topic. Each citation contains complete bibliographic data plus key words. The entries are grouped under the headings of: Theory of Superconductivity;

Superconducting Devices; Superconducting Properties of Materials; Applications of Superconductors: Author Index; Subject Index. The discovery by J. G. Bednorz and K. A. Mtllier in 1986 that the superconducting state can exist in oxides at temperatures above 30 K stimulated research in the field of superconductivity and opened up a new field of research. Within a few years a large number of cuprate superconductors with transition temperatures well above the boiling point of liquid nitrogen have been found. The possibility of using liquid nitrogen as coolant re-stimulated interest in power applications of supercon ductivity. In this book an overview of the known high-Te superconductors and their physical properties is presented. Aspects related to conductor fabrication and high-current applications are emphasised. The material should be suitable for use in graduate level courses on superconductivity. Researchers in the field may profit from the large number of tables and references describing its status at the end of 1997. An introduction to high-To superconductivity must be based on the fundamental physical principles of normal-state electrical conductivity and the well-known characteristics of conventional superconductors. In Chapter 2 this background is provided. Crystal structures, anisotropic properties and general trends of the critical temperatures of the cuprate superconductors are described in Chapters 3 and 4. The processing of superconductor powders addressed in Chapter 5 affects considerably the current-carrying capacity of high-T. wires. In Chapter 6 several fabrication techniques for superconducting wires are described. In addition, the factors limiting the transport critical currents ofhigh-Te wires are discussed. The great breakthroughs in the science and technology of superconducting and magnetic materials in recent years promoted many outstanding representatives of various scientific disciplines (physics,

chemistry and materials science) to present their latest findings in a scientific atmosphere of the highest standard at the MSM-99 conference. Over 200 eminent scientists from 50 countries gathered to discuss the physics, materials science and application of magnetic and superconducting materials, and to foster research and development collaborations between the scientists and technologists of the regional countries and also with the international scientific community. The main topics of this book are the physics, materials science and application of magnetic and superconducting materials having a close relationship between the strong correlated electron system and magnetism. "Completely revised and updated, the second edition of the Handbook of Superconductivity is now available in three stand-alone volumes. As a whole they cover the depth and breadth of the field, drawing on an international pool of respected academics and industrial engineers. The three volumes provide hands-on guidance to the manufacturing and processing technologies associated with superconducting materials and devices. A comprehensive reference, the handbook supplies a tutorial on techniques for the beginning graduate student and a source of ancillary information for practicing scientists. The past twenty years have seen rapid progress in superconducting materials, which exhibit one of the most remarkable physical states of matter ever to be discovered. Superconductivity brings quantum mechanics to the scale of the everyday world where a single, coherent quantum state may extend over a distance of metres, or even kilometres, depending on the size of a coil or length of superconducting wire. Viable applications of superconductors rely fundamentally on an understanding of this intriguing phenomena and the availability of a range of materials with bespoke properties to meet practical needs. This first volume covers the fundamentals of superconductivity and the

various classes of superconducting materials, which sets the context for volumes 2 and 3. Volume 1 ends with a tutorial on phase diagrams, and a glossary relevant to all 3 volumes"-- This book presents the basics and applications of superconducting magnets. It explains the phenomenon of superconductivity, theories of superconductivity, type II superconductors and high-temperature cuprate superconductors. The main focus of the book is on the application to superconducting magnets to accelerators and fusion reactors and other applications of superconducting magnets. The thermal and electromagnetic stability criteria of the conductors and the present status of the fabrication techniques for future magnet applications are addressed. The book is based on the long experience of the author in studying superconducting materials, building magnets and numerous lectures delivered to scholars. A researcher and graduate student will enjoy reading the book to learn various aspects of magnet applications of superconductivity. The book provides the knowledge in the field of applied superconductivity in a comprehensive way. The applications of superconducting materials have the potential to change our world, but descriptions of superconductivity in literature tend to be complex for non-physicists. This text provides an accessible account of superconductivity and its applications for an interdisciplinary readership. This book covers the characteristics of superconducting materials, particularly those with commercial applications, including MRI, MEG, high-field magnets, magnetometers, gradiometers, SQUID sensors and Josephson junctions. The applications and concepts are discussed at a level suitable for those with a basic background in physics, without using complex mathematics. This is a valuable reference text for researchers and practitioners working with devices made from superconducting materials. The text also acts

as useful supplementary reading for courses related to superconductivity and superconducting materials. The book presents the current status of superconductor science and technology. It focuses on the design, properties and applications of superconductor materials. The superconductor categories covered include type-I, type-II, bulk, hard, soft, oxide, fermions, organic, iron, Lanthanide-based superconductors, high temperature superconductors and superconducting metamaterials. Keywords: Superconductors, Large-Scale Applications, Bulk Superconductors, Soft Superconductors, Oxide Superconductors, Lanthanide-based Superconductors, High Temperature Superconductors, Superconducting Metamaterials, Medical Applications, Magnetic Imaging Resonance Applications. "Completely revised and updated, the second edition of the Handbook of Superconductivity is now available in three stand-alone volumes. As a whole they cover the depth and breadth of the field, drawing on an international pool of respected academics and industrial engineers. The three volumes provide hands-on guidance to the manufacturing and processing technologies associated with superconducting materials and devices. A comprehensive reference, the handbook supplies a tutorial on techniques for the beginning graduate student and a source of ancillary information for practicing scientists. The past twenty years have seen rapid progress in superconducting materials, which exhibit one of the most remarkable physical states of matter ever to be discovered. Superconductivity brings quantum mechanics to the scale of the everyday world where a single, coherent quantum state may extend over a distance of metres, or even kilometres, depending on the size of a coil or length of superconducting wire. Viable applications of superconductors rely fundamentally on an understanding of this intriguing phenomena and the availability

of a range of materials with bespoke properties to meet practical needs. This first volume covers the fundamentals of superconductivity and the various classes of superconducting materials, which sets the context for volumes 2 and 3. Volume 1 ends with a tutorial on phase diagrams, and a glossary relevant to all 3 volumes"-- Superconductors offer high throughput with low electric losses and have the potential to transform the electric power grid. Transmission networks incorporating cables of this type could, for example, deliver more power and enable substantial energy savings. Superconductors in the Power Grid: Materials and Applications provides an overview of superconductors and their applications in power grids. Sections address the design and engineering of cable systems and fault current limiters and other emerging applications for superconductors in the power grid, as well as case studies of industrial applications of superconductors in the power grid. Expert editor from highly respected US government-funded research centre Unique focus on superconductors in the power grid Comprehensive coverage From fundamental physics point of view, iron-based superconductors have properties that are more amenable to band structural calculations. This book reviews the progress made in this fascinating field. With contributions from leading experts, the book provides a guide to understanding materials, physical properties, and superconductivity mechanism aspects, and is important for students and beginners to have an overall view of the recent progress in this active field. With its comprehensive review of the current knowledge and the future requirements in the field, this book presents all the features of bulk high temperature superconducting materials. Starting from physical and chemical fundamentals, the authors move on to portray methods and problems of materials processing, thoroughly working out the

characteristic properties of bulk superconductors in contrast to long conductors and films. They provide a wide range of specific materials characteristics with respect to the latest developments and future applications guiding from fundamentals to practical engineering examples. The authors are all leading international specialists involved in the field of high TC superconductor bulk materials since the beginning. Of utmost interest to engineers, scientists, and PhD students working in this field. This book presents current research from across the globe in the study of superconductivity theory, materials and applications. Topics discussed include tunnelling spectroscopy of novel layered superconductors; stability conditions of high-Tc superconductors; a study of the superconducting phase in metallic superconductors; numerical calculation of trapped magnetic field for bulk superconductors; ion modified high-Tc Josephson junctions and SQUIDS; and vortices in high temperature superconductors. This book encompasses the science, measurement, fabrica tion, and use of superconducting materials in large scale and small scale technologies. The present book is in some sense a continuation and completion of a series of two earlier books based on NA TO Advanced Study Institutes held over the last decade. The first book in the series entitled Superconducting Machines ~nd Devices: Large Systems Appli cations edited by S. Foner and B. B. Schwartz (1974) represented a compilation of all the applications of superconducting technology. The second book entitled Superconductor Applications: Squids and Machines, edited by B. B. Schwartz and S. Foner (1977) reviewed small scale applications and up-dated the large scale applications of superconductiv ity at that time. These two books are both introductions and advanced reference volumes for almost all aspects of the applications of super conductivity. The growth of

applied superconductivity has mushroomed in the decade of the 1970's. Technologies which were discussed in the beginning of the 1970's are now beyond the prototype stage. Materials development and performance in operating systems is the basis of the continued applications and economic viability of super conducting technology. In this book, a complete review of all materials technology is presented by leading authorities who were instrumental in the development of superconducting materials technology. The present book is based on the NATO Advanced Study vi PREFACE Institute entitled Superconducting Materials: Science and Technology which was held from August 20 to August 30, 1980 in Sintra, Portugal. The applications of superconducting materials have the potential to change our world, but descriptions of superconductivity in literature tend to be complex for non-physicists. This text provides an accessible account of superconductivity and its applications for an interdisciplinary readership. This book covers the characteristics of superconducting materials, particularly those with commercial applications, including MRI, MEG, high-field magnets, magnetometers, gradiometers, SQUID sensors and Josephson junctions. The applications and concepts are discussed at a level suitable for those with a basic background in physics, without using complex mathematics. This is a valuable reference text for researchers and practitioners working with devices made from superconducting materials. The text also acts as useful supplementary reading for courses related to superconductivity and superconducting materials. This book presents an overview of the science of superconducting materials. It covers the fundamentals and theories of superconductivity. Subjects of special interest involving mechanisms of high temperature superconductors, tunneling, transport properties, magnetic properties, critical states, vortex

dynamics, etc. are present in the book. It assists as a fundamental resource on the developed methodologies and techniques involved in the synthesis, processing, and characterization of superconducting materials. The book covers numerous classes of superconducting materials including fullerenes, borides, pnictides or iron-based chalcogen superconductors ides, alloys and cuprate oxides. Their crystal structures and properties are described. Thereafter, the book focuses on the progress of the applications of superconducting materials into superconducting magnets, fusion reactors, and accelerators and other superconducting magnets. The applications also cover recent progress in superconducting wires, power generators, powerful energy storage devices, sensitive magnetometers, RF and microwave filters, fast fault current limiters, fast digital circuits, transport vehicles, and medical applications. The field of superconductivity has tremendous potential for growth and further development in industrial applications. The subject continues to occupy physicists, chemists, and engineers interested in both the phenomena itself and possible financially viable industrial devices utilizing the physical concepts. For the past five years, within the publications of the American Physical Society, for example, 40%-60% of all articles submitted to major journals in the area of Solid State Physics have been on the subject of superconductivity, including the newer, extremely important subfield of high temperature superconductivity (high Tc). The present volume is the first handbook to address this field. It covers both "classic" superconductivity-related topics and high Tc. Numerous properties, including thermal, electrical, magnetic, mechanical, phase diagrams, and spectroscopic crystallographic structures are presented for many types of superconductors. Critical fields, critical currents, coherence

lengths, penetration depths, and transition temperatures are tabulated. First handbook on Superconductivity Coherence lengths and depths are tabulated Crystallographic structures of over 100 superconductor types Main results of several theories are submitted Phase diagrams for synthesizing new superconductors are included This is the first of three volumes of the extensively revised and updated second edition of the Handbook of Superconductivity. The past twenty years have seen rapid progress in superconducting materials, which exhibit one of the most remarkable physical states of matter ever to be discovered. Superconductivity brings quantum mechanics to the scale of the everyday world where a single, coherent quantum state may extend over a distance of metres, or even kilometres, depending on the size of a coil or length of superconducting wire. Viable applications of superconductors rely fundamentally on an understanding of this intriguing phenomena and the availability of a range of materials with bespoke properties to meet practical needs. This first volume covers the fundamentals of superconductivity and the various classes of superconducting materials, which sets the context and background for Volumes 2 and 3. Key Features: Covers the depth and breadth of the field Includes contributions from leading academics and industry professionals across the world Provides hands-on guidance to the manufacturing and processing technologies A comprehensive reference, this handbook is suitable for both graduate students and practitioners in experimental physics, materials science and multiple engineering disciplines, including electronic and electrical, chemical, mechanical, metallurgy and others. This book provides readers with a comprehensive overview of the science of superconducting materials. It serves as a fundamental information source on the actual techniques and methodologies involved in superconducting materials

growth, characterization and processing. This book includes coverage of several categories of medium and high-temperature superconducting materials: cuprate oxides, borides, and iron-based chalcogenides and pnictides. Provides a single-source reference on superconducting materials growth, characterization and processing; Bridges the gap between materials science and applications of superconductors; Discusses several categories of superconducting materials such as cuprate oxides, borides, and iron-based chalcogenides and pnictides; Covers synthesis, characterization, and processing of superconducting materials, as well as the nanoengineering approach to tailor the properties of the used materials at the nanoscale level. With the advent of high temperature superconductivity and the increasing reliability of fabrication techniques, superconductor technology has moved firmly into the mainstream of academic and industrial research. There is a wealth of information on the subject but until now there has been no single source of practical information required by people working in the field. The Handbook of Superconducting Materials fills that gap by providing sensible advice and guidance on best-practice and reliable, proven fabrication and characterization techniques. It is a definitive collection of material for researchers and graduate students in materials science and electrical engineering, and practicing engineers involved in the manufacture and processing of superconducting materials. This handbook is a comprehensive guide to the techniques used to fabricate, characterize, and measure superconducting materials. Over 100 articles have been provided by more than 150 contributors, all of whom are leading researchers in their field. International editorial and advisory boards have ensured that the coverage of the handbook is unrivalled and the content is of the highest quality. Articles are written at a level suitable for graduate students as well as

experienced researchers. It has been carefully edited to ensure that all the contributions are well integrated and extensive cross referencing helps the reader to navigate through the book. The handbook is an essential purchase whichever part of the field you work in and whether you are at your bench top or desk it will become a central point of reference you will not want to be without. This book is a collection of proceedings of a symposium organized by the North Carolina Section of the American Chemical Society on the preparations, properties, and processing of high-temperature superconducting materials. The proceedings include papers of new results presented at the symposium. Treatise on Materials Science and Technology, Volume 14: Metallurgy of Superconducting Materials covers the practical use of metallurgy of superconducting materials. The book discusses the phenomenon of superconductivity; the theory of superconductors; the applications of superconductivity and the demands these applications make on materials' properties and requirements. The text also describes the metallurgy of niobium-titanium alloy conductors; the physical metallurgy of A15 compounds; and the electron microscopy of superconducting materials. The metallurgy of conductors made from A15 material, the properties required, as well as the development of superconductors for ac power transmission are considered. The book further tackles the metallurgy of niobium surfaces, and the effects of radiation on superconductors. Metallurgists, physicists, materials scientists, materials engineers, and graduate students studying superconductors will find the book invaluable. This book provides readers with numerical analysis techniques to model the magnetisation of bulk superconductors based on the finite element method. How to model bulk superconducting materials and their various magnetisation processes are presented along with an in-depth

summary of the current state-of-the-art in the field, and example models, implemented in the software package COMSOL Multiphysics(R), are provided so that readers may carry out modelling of their own. With the increased interest in superconductivity applications through out the world and the necessity of obtaining a firmer understanding of the basic concepts of superconductivity, the editors of the In ternational Cryogenics Monograph series are extremely grateful for the opportunity to add Superconducting Materials to this series. This comprehensive review and summary of superconducting ma terials was originally prepared by the Russian authors in 1969 and has been specifically updated for this series. It is the most thorough review of the literature on this subject that has been made to date. Since advances in the development and use of new superconducting materials are largely associated with the general state and level in the development of the physical theory of superconductivity, the physical chemistry of metals, metallography, metal physics, tech nical physics, and manufacturing techniques, it is hoped that this monograph will provide the stimulus for further advances in all aspects of this exciting field. The editors express their appreciation to the authors, the translators, and Plenum Publishing Corporation for their assistance and continued interest in making this worthy addition to the series possible. The discoveries of new superconducting materials, most of them during the last 30 years, have served very much as the context for further developments in theory which continue to the present. In many of these cases, the observations of superconductivity in new materials were completely unexpected and therefore may be regarded as real discoveries. Even the most visible progress, which followed a search using, to some extent, conventional wisdom, was finally rather unexpected – the discovery of high-

Tc superconductivity in copper oxides. This book presents superconductivity in this materials context and displays some of the underlying simplicity in the materials record that provided fuel for the theoretical developments. Not only is the phenomenon deeply interesting, the metallic systems where it plays out are as well, and superconductivity gives a very interesting window from which to view the nature of electrically conducting materials. The level is not advanced, yet allows the serious reader to access the current developments in the literature. Addresses in detail the exciting developments after 1980. Demonstrates that progress in superconductivity is to a large extent due to progress in materials synthesis and characterization. Gateway to the current developments in the literature. Superconductivity, 2E is an encyclopedic treatment of all aspects of the subject, from classic materials to fullerenes. Emphasis is on balanced coverage, with a comprehensive reference list and significant graphicsfrom all areas of the published literature. Widely used theoretical approaches are explained in detail. Topics of special interest include high temperature superconductors, spectroscopy, critical states, transport properties, and tunneling. This book covers the whole field of superconductivity from both the theoretical and the experimental point of view. - Comprehensive coverage of the field of superconductivity - Very up-to date on magnetic properties, fluxons, anisotropies, etc. - Over 2500 references to the literature - Long lists of data on the various types of superconductors Magnetic and superconducting materials pervade every avenue of the technological world – from microelectronics and mass-data storage to medicine and heavy engineering. Both areas have experienced a recent revitalisation of interest due to the discovery of new materials, and the re-evaluation of a wide range of basic mechanisms and phenomena.

This Concise Encyclopedia draws its material from the award-winning Encyclopedia of Materials and Engineering, and includes updates and revisions not available in the original set -- making it the ideal reference companion for materials scientists and engineers with an interest in magnetic and superconducting materials. * Contains in excess of 130 articles, taken from the award-winning Encyclopedia of Materials: Science and Technology, including ScienceDirect updates not available in the original set. * Each article discusses one aspect of magnetic and superconducting materials and includes photographs, line drawings and tables to aid the understanding of the topic at hand. * Cross-referencing guides readers to articles covering subjects of related interest. Superconductivity is a quantum phenomenon that manifests itself in materials showing zero electrical resistance below a characteristic temperature resulting in the potential for an electric current to run continually through such a material without the need for a power source. Such materials are used extensively in medical and power applications, e.g. MRI and NMR machines. Discovering Superconductivity uses a series of practical and investigative activities, which can be used as tutor demonstrations or as student lab exercises. This highly illustrated text features the following sections: Introduction - including a brief history of superconductivity Superconductivity - an explanation of the phenomenon and its effects Superconducting materials – including High & Low temperature superconductors Applications – how superconductivity is used in medical imaging, at CERN and in the Maglev trains This text will serve as an excellent introduction for students, with or without a physics background, to superconductivity. With a strong practical, experimental emphasis, it provides readers with an overview of the topic preparing them for more advanced texts

used in advanced undergraduate and post-graduate courses. PowerPoint files of the figures presented within this text are available at: booksupport.wiley.com A word from the author: "The intention of this text is to introduce the reader to the study of superconductivity via a minds-on approach .... The minds-on approach takes this a stage further by requiring the learner to engage with the process to a greater extent." Prof. Heike Kamerlingh Onnes discovered superconductivity while measuring resistivity of mercury. Surprisingly the resistivity of mercury ceased at 4.2 K and this phenomenon was known as superconductivity. He realized the importance of this discovery in producing large magnetic fieldspl. delateIt was realized that superconductivity is in a new thermodynamic state with peculiar electric and magnetic properties. This paved the way to discover more superconductors. Simple elements such as Tin, Indium or lead showed the highest critical temperature (Tc) 7.2 K. They were called as Type 1 superconductors. Niobium-nitride was found to superconduct at 16 K at 1941 and Vanadium-silicon showed superconductive properties at 17.5 K at 1953. Nb alloys and binary or more complex compounds such as Nb3Sn (Tc – 18 K), Nb-Ti (Tc -9 K), Ga, V with Tc,23 K became type II superconductors. Thereafter, there was not much improvement in the development of superconductor although wonderful applications were expected from superconductors. After three decades, Fullerenes, like ceramic superconductors, are discovered. A decade ago MgB2 was discovered with Tc = 39 K. These superconductors were routinely produced into formof wires for producing larger magnetic fields. In all these cases cooling was effectively done by liquid Helium. A comprehensive microscopic theory of superconductivity in metals was proposed in 1957 by John Bardeen, Leon Cooper and Robert Schrieffer (the so-called “BCS” theory) for which they

received the Nobel Prize in Physics. In a major breakthrough, George Bednorz and Karl Mueller discovered a brittle ceramic superconductivity in the family of cuprates at 30 K in 1986 and a new era began. Inspired by the work of Bednorz and Mueller on high temperature superconductivity (HTS), Paul Chu and his associates at the University of Houston discovered in 1987, 123 compounds. That is, YBCO (Yttrium1- Barium2-Copper3-Oxygen7) and iso-structural RBCO (Rare-earth1-Barium2-Copper3-Oxygen7) have a Tc of 93 K. Prior to 1987, all superconducting materials had lower critical temperatures (Tc's) and therefore functioned only at temperatures near the boiling point of liquid helium (4.2 K) or liquid hydrogen (20.28 K), with the highest being Nb3Ge at 23 K. They were known as low temperature superconductors. YBCO was the first material to become superconducting above 77 K, (boiling point of liquid nitrogen) and subsequently a series of high temperature superconducting materials were discovered. These superconducting materials are widely known as High temperature superconductors as these Tc's exceeded the limit prescribed by BCS theory. HTSCs are potentially valuable as liquid nitrogen is cheaper than liquid helium. YBCO possesses superior superconducting and physical properties. YBCO receiver coils in NMR-spectrometers have improved the resolution NMR spectrometers by a factor of 3 compared to that achievable with conventional coils. Paul Chu's group holds the current Tc-record of 164 K in the mercury barium based cuprate superconductor under pressure. Their work led to a rapid succession of new high temperature superconducting materials, ushering in a new era in material science, chemistry and technology. Added to this the structure of Bi2Sr2Ca2Cu2O10(BiSCCO) high temperature superconductive compound having T= 110 K was reported. In 1993, mercuric-

cuprates, perovskite ceramic superconductors with the transition temperatures Tc =138 K was also reported. With the increased interest in superconductivity applications through out the world and the necessity of obtaining a firmer understanding of the basic concepts of superconductivity, the editors of the In ternational Cryogenics Monograph series are extremely grateful for the opportunity to add Superconducting Materials to this series. This comprehensive review and summary of superconducting ma terials was originally prepared by the Russian authors in 1969 and has been specifically updated for this series. It is the most thorough review of the literature on this subject that has been made to date. Since advances in the development and use of new superconducting materials are largely associated with the general state and level in the development of the physical theory of superconductivity, the physical chemistry of metals, metallography, metal physics, tech nical physics, and manufacturing techniques, it is hoped that this monograph will provide the stimulus for further advances in all aspects of this exciting field. The editors express their appreciation to the authors, the translators, and Plenum Publishing Corporation for their assistance and continued interest in making this worthy addition to the series possible. This book encompasses the science, measurement, fabrica tion, and use of superconducting materials in large scale and small scale technologies. The present book is in some sense a continuation and completion of a series of two earlier books based on NA TO Advanced Study Institutes held over the last decade. The first book in the series entitled Superconducting Machines ~nd Devices: Large Systems Appli cations edited by S. Foner and B. B. Schwartz (1974) represented a compilation of all the applications of superconducting technology. The second book entitled Superconductor Applications: Squids and

Machines, edited by B. B. Schwartz and S. Foner (1977) reviewed small scale applications and up-dated the large scale applications of superconductiv ity at that time. These two books are both introductions and advanced reference volumes for almost all aspects of the applications of super conductivity. The growth of applied superconductivity has mushroomed in the decade of the 1970's. Technologies which were discussed in the beginning of the 1970's are now beyond the prototype stage. Materials development and performance in operating systems is the basis of the continued applications and economic viability of super conducting technology. In this book, a complete review of all materials technology is presented by leading authorities who were instrumental in the development of superconducting materials technology. The present book is based on the NATO Advanced Study vi PREFACE Institute entitled Superconducting Materials: Science and Technology which was held from August 20 to August 30, 1980 in Sintra, Portugal. With the advent of High Temperature Superconductivity and the increasing reliability of fabrication techniques, superconductor technology has moved firmly into the mainstream of academic and industrial research. There is currently no single source of practical information giving guidance on which technique to use for any particular category of superconductor. An increasing number of materials scientists and electrical engineers require easy access to practical information, sensible advice and guidance on 'best-practice' and reliable, proven fabrication and characterisation techniques.The Handbook will be the definitive collection of material describing techniques for the fabrication and analysis of superconducting materials. In addition to the descriptions of techniques, authoritative discussions written by leading researchers will give guidance on the most appropriate technique for a particular situation.Characterisation and

measurement techniques will form an important part of the Handbook, providing researchers with a standard reference for experimental techniques. The tutorial style description of these techniques makes the Handbook particularly suitable for use by graduate students.The Handbook will be supported by a comprehensive web site which will be updated with new data as it emerges.The Handbook has six main sections: -- Fundamentals of Superconductivity - characteristic properties, elementary theory, critical current of type II superconductors-- Processing - bulk materials, wires and tapes, thick and think films, contact techniques-- Characterisation Techniques - structure/microstructure, measurement and interpretation of electromagnetic properties,measurement of physics properties-- Materials - characteristic properties of low and high Tc materials-- Applications - high current applications, trapped flux devices, high frequency devices, josephson junction devic