Thermo Mechanical Processing Of Metallic Materials

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Recrystallization: Types, Techniques and Applications - Ke Huang 2020-03-16
A very large part of metallic materials is used in the wrought form. Several thermomechanical processing (TMP) steps are usually employed to produce the intermediate or final products, during which recrystallization and its related phenomena such as work hardening, recovery and grain growth may take place. The sophisticated controlling of recrystallization is one of the most effective ways to tailor the microstructures and mechanical properties of metallic components. Recrystallization: Types, Techniques and Applications is the joint work of several well-known active scientists within this field, and each one focuses on the latest developments of their specific topics. This book covers the deformation structure and recovery, recrystallization and grain growth phenomena, characterization of recrystallization, interaction between recrystallization and solute/second phase particles, the competition between phase transformation and recrystallization, as well as numerical modelling of recrystallization. It is a standard reference for practicing engineers and researchers involved in hot deformation and heat treatment of metallic materials.
Thermo-Mechanical Processing of Metallic Materials - Bert Verlinden 2007-06-07
Thermo-Mechanical Processing of Metallic Materials describes the science and technology behind modern thermo-mechanical processing (TMP), including detailed descriptions of successful examples of its application in the industry. This graduate-level introductory resource aims to fill the gap between two scientific approaches and illustrate their successful linkage by the use of suitable modern case studies. The book is divided into three key sections focusing on the basics of metallic materials processing. The first section covers the microstructural science base of the subject, including the microstructure determined mechanical properties of metals. The second section deals with the current mechanical technology of plastic forming of metals. The concluding section demonstrates the interaction of the first two disciplines in a series of case studies of successful current TMP processing and looks ahead to possible new developments in the field. This text is designed for use by graduate students coming into the field, for a graduate course textbook, and for Materials and Mechanical Engineers working in this area in the industry. * Covers both physical metallurgy and metals processing * Links basic science to real everyday applications * Written by four internationally-known experts in the field
Recent developments in the processing and applications of structural metals and alloys : selected, peer reviewed papers from the International Conference on Recent Developments in the Processing and Applications of Structural Metals and

Alloys, conference organized to celebrate the 70th birthday of Enrico Evangelista, Dept. of Mechanical Engineering, Marche Polytechnic University, Italy, Como (Italy) from 22nd to 25th June 2008 - Marcello Cabibbo 2009

This volume brings together the most exciting ideas of international, and especially European, researchers concerning the latest developments in severe plastic deformation techniques and in the thermomechanical processing of materials for both structural and functional applications. The areas of interest include not only the conventional hot- and cold-deformation of metals but also recently developed severe plastic deformation processes for the production of ultra-fine and nanostructured materials. In particular, the following specific topics are covered: Multifunctional nanostructured coatings, Modelling and recrystallization, Nanostructured materials and Severe plastic deformation, Hot plastic deformation, 26 Process Mechanics and Microstructure. It is to be noted that this volume honors Prof. Enrico Evangelista on the occasion of his 70th birthday. The professor has been working in the field of materials science for more than 30 years and been a faculty member of the Marche Polytechnic University of Ancona since 1982. He is a fellow of ASM International and has been very active in a range of research activities; publishing over 300 papers in collaboration with other highly-regarded scientists throughout the world. The quality of the present papers reflects the exacting standards of the professor.

ASM Ready Reference - Fran Cverna 2002-01-01

A quick and easy to use source for qualified thermal properties of metals and alloys. The data tables are arranged by material hierarchy, with summary tables sorted by property value. Values are given for a range of high and low temperatures. Short technical discussions at the beginning of each chapter are designed to refresh the reader's understanding of the properties and units covered in that section

Advanced Machining Processes of Metallic Materials - Wit Grzesik 2016-11-15

Advanced Machining Processes of Metallic Materials: Theory, Modelling and Applications, Second Edition, explores the metal cutting processes with regard to theory and industrial practice. Structured into three parts, the first section provides information on the fundamentals of machining, while the second and third parts include an overview of the effects of the theoretical and experimental considerations in high-level machining technology and a summary of production outputs related to part quality. In particular, topics discussed include: modern tool materials, mechanical, thermal and tribological aspects of machining, computer simulation of various process phenomena, chip control, monitoring of the cutting state, progressive and hybrid machining operations, as well as practical ways for improving machinability and generation and modeling of surface integrity. This new edition addresses the present state and future development of machining technologies, and includes expanded coverage on machining operations, such as turning, milling, drilling, and broaching, as well as a new chapter on sustainable machining processes. In addition, the book provides a comprehensive description of metal cutting theory and experimental and modeling techniques, along with basic machining processes and their effective use in a wide range of manufacturing applications. The research covered here has contributed to a more generalized vision of machining technology, including not only traditional manufacturing tasks, but also potential (emerging) new applications, such as micro and nanotechnology. Includes new case studies illuminate experimental methods and outputs from different sectors of the manufacturing industry Presents metal cutting processes that would be applicable for various technical, engineering, and scientific levels Includes an updated knowledge of standards, cutting tool materials and tools, new machining technologies, relevant machinability records, optimization techniques, and surface integrity

Soviet Technology on Thermal-mechanical Treatment of Metals - Joseph G. Dunleavy 1969

One of the most promising methods for strengthening metallic materials that has evolved in the past 15 years is the process of thermal mechanical treatment (TMT). This process, which involves plastic deformation at

elevated temperatures and retention of the 'worked' structured at ambient temperature is unique--increases in strength may be attained with a gain or little loss is ductility. There are, of course, definite problems associated with the process such as the degree of temperature control required in plant operations and the negation of the TMT effect in welding processes. This report reviews the trend of Sovient efforts.

Nanostructured Metals and Alloys - S H Whang 2011-03-22

Tensile strength, fatigue strength and ductility are important properties of nanostructured metallic materials, which make them suitable for use in applications where strength or strength-to-weight ratios are important. Nanostructured metals and alloys reviews the latest technologies used for production of these materials, as well as recent advances in research into their structure and mechanical properties. One of the most important issues facing nanostructured metals and alloys is how to produce them. Part one describes the different methods used to process bulk nanostructured metals and alloys, including chapters on severe plastic deformation, mechanical alloying and electrodeposition among others. Part two concentrates on the microstructure and properties of nanostructured metals, with chapters studying deformation structures such as twins, microstructure of ferrous alloys by equal channel angular processing, and characteristic structures of nanostructured metals prepared by plastic deformation. In part three, the mechanical properties of nanostructured metals and alloys are discussed, with chapters on such topics as strengthening mechanisms, nanostructured metals based on molecular dynamics computer simulations, and surface deformation. Part four focuses on existing and developing applications of nanostructured metals and alloys, covering topics such as nanostructured steel for automotives, steel sheet and nanostructured coatings by spraying. With its distinguished editor and international team of contributors, Nanostructured metals and alloys is a standard reference for manufacturers of metal components, as well as those with an academic research interest in metals and materials with enhanced properties.

Mechanical Properties in Progressive Mechanically Processed Metallic Materials - Radim Kocich 2021-02-24

The demands on innovative materials given by the ever-increasing requirements of contemporary industry require the use of high-performance engineering materials. The properties of materials and alloys are a result of their structures, which can primarily be affected by the preparation/production process. However, the production of materials featuring high levels of the required properties without the necessity to use costly alloying elements or time- and money-demanding heat treatment technologies typically used to enhance the mechanical properties of metallic materials (especially specific strength) still remains a challenge. The introduction of thermomechanical treatment represented a breakthrough in grain refinement, consequently leading to significant improvement of the mechanical properties of metallic materials. Contrary to conventional production technologies, the main advantage of such treatment is the possibility to precisely control structural phenomena that affect the final mechanical and utility properties. Thermomechanical treatment can only decrease the grain size to the scale of microns. However, further research devoted to pushing materials' performance beyond the limits led to the introduction of severe plastic deformation (SPD) methods providing producers with the ability to acquire ultra-fine-grained and nanoscaled metallic materials with superior mechanical properties. SPD methods can be performed with the help of conventional forming equipment; however, many newly designed processes have also been introduced.

Refractory Metal Alloys Metallurgy and Technology - I. Machlin 2012-12-06

This publication documents Proceedings of the Symposium on Metal lurgy and Technology of Refractory Metal Alloys, held in Washington, D.C. at the Washington Hilton Hotel on April 25-26, 1968, under sponsorship of the Refractory Metals Committee, Institute of Metals Division, of the Metallurgical Society of AIME, and the National Aeronautics and Space Administration. The Symposium presented critical reviews of selected topics in refractory metal alloys, thereby contributing to an in-depth understanding of the state-of-the-art, and

establishing a base line for further research, development, and application. This Symposium is fifth in a series of conferences on refractory metals, sponsored by the Metallurgical Society of AlME. Publications issuing from the conferences are valuable technical and historical source books, tracing the evolution of refractory metals from early laboratory alloying studies to their present status as useful engineering materials. Refractory metals are arbitrarily defined by melting point. A 0 melting temperature of over 3500 F was selected as the minimum for this Symposium, thus excluding chromium and vanadium, which logically could be treated with other refractory metals in Groups VA and VIA of the periodic table. The Refractory Metals Committee is planning reviews of chromium and vanadium in subsequent conferences.

Metallurgy and Design of Alloys with Hierarchical Microstructures - Krishnan K. Sankaran 2017-06-14

Metallurgy and Design of Alloys with Hierarchical Microstructures covers the fundamentals of processing-microstructure-property relationships and how multiple properties are balanced and optimized in materials with hierarchical microstructures widely used in critical applications. The discussion is based principally on metallic materials used in aircraft structures; however, because they have sufficiently diverse microstructures, the underlying principles can easily be extended to other materials systems. With the increasing microstructural complexity of structural materials, it is important for students, academic researchers and practicing engineers to possess the knowledge of how materials are optimized and how they will behave in service. The book integrates aspects of computational materials science, physical metallurgy, alloy design, process design, and structure-properties relationships, in a manner not done before. It fills a knowledge gap in the interrelationships of multiple microstructural and deformation mechanisms by applying the concepts and tools of designing microstructures for achieving combinations of engineering properties—such as strength, corrosion resistance, durability and damage tolerance in multi-component materials—used for critical structural applications. Discusses the science behind the properties and performance of advanced metallic materials Provides for the efficient design of materials and processes to satisfy targeted performance in materials and structures Enables the selection and development of new alloys for specific applications based upon evaluation of their microstructure as illustrated in this work

Hot Deformation and Processing of Aluminum Alloys - Hugh J. McQueen 2011-09-28

A comprehensive treatise on the hot working of aluminum and its alloys, Hot Deformation and Processing of Aluminum Alloys details the possible microstructural developments that can occur with hot deformation of various alloys, as well as the kind of mechanical properties that can be anticipated. The authors take great care to explain and differentiate hot working in the context of other elevated temperature phenomena, such as creep, superplasticity, cold working, and annealing. They also pay particular attention to the fundamental mechanisms of aluminum plasticity at hot working temperatures. Using extensive analysis derived from polarized light optical microscopy (POM), transmission electron microscopy (TEM), x-ray diffraction (XRD) scanning electron-microscopy with electron backscatter imaging (SEM-EBSD), and orientation imaging microscopy (OIM), the authors examine those microstructures that evolve in torsion, compression, extrusion, and rolling. Further microstructural analysis leads to detailed explanations of dynamic recovery (DRV), static recovery (SRV), discontinuous dynamic recrystallization (dDRX), discontinuous static recrystallization (dSRX), grain defining dynamic recovery (gDRV) (formerly geometric dynamic recrystallization, or gDRX), and continuous dynamic recrystallization involving both a single phase (cDRX/1-phase) and multiple phases (cDRX/2-phase). A companion to other works that focus on modeling, manufacturing involving plastic and superplastic deformation, and control of texture and phase transformations, this book provides thorough explanations of microstructural development to lay the foundation for further study of the mechanisms of thermomechanical processes and their application.

Thermal-Mechanical Modelling of the Flat

Rolling Process - Maciej Pietrzyk 2012-12-06
Flat rolling is considered to be one of the most important and most widely used metal forming processes. This book emphasizes the importance of mathematical simulation of this process in the light of the ever in- creasing need for quality improvements through automation.
Mathematical models of the hot, warm and cold rolling processes are discussed, compared and critically evaluated. Engineers in the steel industry will find this book particularly useful in their everyday work.

Thermomechanical Processing of High-Strength Low-Alloy Steels - Imao Tamura 2013-10-22
Thermomechanical Processing of High-Strength Low-Alloy Steels considers some advanced techniques and metallurgical bases for controlled-rolling. This book contains 12 chapters. In Chapter 1, the purpose of thermomechanical processing and historical survey is described, while in Chapter 2, the kinetics of phase transformations and refinement of grain size in steels are elaborated. The techniques and metallurgical bases for controlled-rolling in the recrystallization, non-recrystallization, and (? + y) regions are reviewed in Chapters 3 to 5. Chapters 6 and 7 discuss the deformation resistance during hot-rolling and restoration processes. The phase transformations during cooling following hot-rolling are mentioned in Chapter 8, followed by a summarization of the effects of alloying elements in Chapter 9. Chapters 10 and 11 deal with the mechanical properties of controlled-rolled steel and prediction and control of microstructure and properties by thermomechanical processes. The problems faced and possibilities for future developments are stated in the last chapter. This publication is recommended for physicists, metallurgists, and researchers concerned with controlled-rolling, including non-specialists who have some knowledge of metallurgy.

Flat Rolling Fundamentals - Vladimir B. Ginzburg 2000-06-30
This volume compiles information from physics, metallurgy, and mechanical and electrical engineering to epitomize the fundamental characteristics of flat rolling steel. Flat Rolling Fundamentals is drawn from in-depth analyses of metal properties and behaviors to technologies in application. The book provides a full characterization of steel, including structure, chemical composition, classifications, physical properties, deformation, and plasticity. The authors present different types of rolling mills and the defining physical analytical parameters.They also discuss the effects of hot rolling on steel and the role of lubrication and thermomechanical treatments to minimize these effects. This book presents qualitative and quantitative advances in cost-effective steel production.

Unit Manufacturing Processes - National Research Council 1995-01-03
Manufacturing, reduced to its simplest form, involves the sequencing of product forms through a number of different processes. Each individual step, known as an unit manufacturing process, can be viewed as the fundamental building block of a nation's manufacturing capability. A committee of the National Research Council has prepared a report to help define national priorities for research in unit processes. It contains an organizing framework for unit process families, criteria for determining the criticality of a process or manufacturing technology, examples of research opportunities, and a prioritized list of enabling technologies that can lead to the manufacture of products of superior quality at competitive costs. The study was performed under the sponsorship of the National Science Foundation and the Defense Department's Manufacturing Technology Program.

Thermomechanical Processing of Steels - Jose M. Rodriguez-Ibabe 2020-11-18
This book gathers a collection of papers summarizing some of the latest developments in the thermomechanical processing of steels. The replacement of conventional rolling plus post-rolling heat treatments by integrated controlled forming and cooling strategies implies important reductions in energy consumption, increases in productivity and more compact facilities in the steel industry. The metallurgical challenges that this integration implies, though, are relevant and impressive developments that have been achieved over the last 40 years. The frequency of the development of new steel grades and processing technologies devoted to thermomechanically processed products is

increasing, and their implementation is being expended to higher value added products and applications. In addition to the metallurgical peculiarities and relationships between chemical composition, process and final properties, the relevance impact of advanced characterization techniques and innovative modelling strategies provides new tools to achieve the further deployment of the TMCP technologies. The contents of the book cover low carbon microalloyed grades, ferritic stainless steels and Fe–Al–Cr alloys, medium-Mn steels, and medium carbon grades. Authors of the chapters of this "Thermomechanical Processing of Steels" book represent some of the most relevant research groups from both the steel industry and academia.

Metals and Materials - R. E. Smallman 2013-10-22

Metals and Materials: Science, Processes, Applications aims to present the science of materials in a readable and concise form that leads naturally to an explanation of the ways in which materials are processed and applied. The science of metals, or physical metallurgy, has developed naturally into the wider and more diverse discipline of materials science. The study of metals and alloys still forms a large and important part of this relatively new discipline, but it’s common to find that fundamental principles and concepts of physical metallurgy can be adapted to explain the behavior of a variety of non-metallic materials. As an aid to fully study this discipline, each chapter has been supplemented with a list of specialized references. These references include images and diagrams that illustrate the subtleties of materials, such as micrographs of grain structures and fine-scale defects, phase diagrams for metals and ceramics, electron diffraction patterns revealing atomic arrangements, specific property diagrams correlating the behavior of different materials, and slip vector diagrams for deforming crystals. Throughout this book, sufficient background and theory is provided to assist students in answering questions about a large part of a typical degree course in materials science and engineering. Some sections provide a background or point of entry for postgraduate studies and courses.

Self-diffusion and Impurity Diffusion in Pure Metals - Gerhard Neumann 2011-08-19

Diffusion in metals is an important phenomenon, which has many applications, for example in all kinds of steel and aluminum production, and in alloy formation (technical applications e.g. in superconductivity and semiconductor science). In this book the data on diffusion in metals are shown, both in graphs and in equations. Reliable data on diffusion in metals are required by researchers who try to make sense of results from all kinds of metallurgical experiments, and they are equally needed by theorists and computer modelers. The previous compilation dates from 1990, and measurements relying on the electron microprobe and the recent Rutherford backscattering technique were hardly taken into account there. This reference book, containing all results on self-diffusion and impurity diffusion in pure metals with an indication of their reliability, will be useful to everyone in this field for the theory, fundamental research and industrial applications covered. • Up-to-date and complete (including EPMA and RBS investigations) • Indication of reliability of the measurements • Reassessment of many early results • Data can easily be extracted from Tables and Graphs

Magnetically and Capillary Driven Grain Boundary Motion in Zinc Bicrystals - Christoph Günster 2013-06-05

In der vorliegenden Dissertation wurden neue Erkenntnisse auf dem Gebiet der experimentellen Erforschung der Korngrenzenbewegung vorgestellt. Im Rahmen der Arbeit wurde anhand von in-situ Messungen mittels einer eigens dazu entwickelten Polarisationsmikroskopiesonde mit integriertem Heiztisch die Abhängigkeit der Korngrenzenbeweglichkeit vom Desorientierungs- und Inklinationswinkel der Korngrenze, sowie der Temperatur an speziell gezüchteten Bikristallen aus 99,995% Zink mit symmetrischen und asymmetrischen Kippkorngrenzen und gemischten Korngrenzen im Temperaturbereich zwischen 330°C und 415°C in Hochmagnetfeldern von 10 bis 28 Tesla Stärke als Triebkraft untersucht. Dabei wurde die jeweilige Wanderungsgeschwindigkeit v der Korngrenzen bei verschiedenen Temperaturen und treibenden Kräften gemessen. Aus den so

erhaltenen Messdaten wurden die Aktivierungsparameter der Korngrenzenbewegung für die jeweils untersuchte Korngrenze bestimmt.Weiter wurde im Rahmen der Experimente in Hochfeldmagneten gezeigt, dass die Polarisationsmikroskopiesonde zur Bestimmung der Korngrenzenenergie in magnetisch anisotropen Metallen verwendet werden kann. Zu kleinerem Anteil wurden auch Versuche zu krümmungsgetriebener Korngrenzenbewegung durchgeführt. Alle Ergebnisse zeigten eine starke Inklinations- und Desorientierungsabhängigkeit der Korngrenzenbeweglichkeit, wobei für asymmetrische Korngrenzen höhere Aktivierungsparameter ermittelt wurden als für symmetrische. Dies wurde auf Unterschiede zwischen der atomistischen Struktur von asymmetrischen und symmetrischen Korngrenzen zurückgeführt. Weiterhin wurde auch die Auswirkung einer Glühung im Hochmagnetfeld auf Textur- und Mikrostrukturentwicklung von Zinkpolykristallen untersucht, wobei gezeigt wurde, dass das Magnetfeld ein geeignetes Werkzeug zur Beeinflussung der Mikrostruktur in Zink ist.

Thermo-Mechanical Modeling of Additive Manufacturing - Michael Gouge 2017-08-03

Thermo-mechanical Modeling of Additive Manufacturing provides the background, methodology and description of modeling techniques to enable the reader to perform their own accurate and reliable simulations of any additive process. Part I provides an in depth introduction to the fundamentals of additive manufacturing modeling, a description of adaptive mesh strategies, a thorough description of thermal losses and a discussion of residual stress and distortion. Part II applies the engineering fundamentals to direct energy deposition processes including laser cladding, LENS builds, large electron beam parts and an exploration of residual stress and deformation mitigation strategies. Part III concerns the thermo-mechanical modeling of powder bed processes with a description of the heat input model, classical thermo-mechanical modeling, and part scale modeling. The book serves as an essential reference for engineers and technicians in both industry and academia, performing both research and full-scale production. Additive manufacturing processes are revolutionizing production throughout industry. These technologies enable the cost-effective manufacture of small lot parts, rapid repair of damaged components and construction of previously impossible-to-produce geometries. However, the large thermal gradients inherent in these processes incur large residual stresses and mechanical distortion, which can push the finished component out of engineering tolerance. Costly trial-and-error methods are commonly used for failure mitigation. Finite element modeling provides a compelling alternative, allowing for the prediction of residual stresses and distortion, and thus a tool to investigate methods of failure mitigation prior to building. Provides understanding of important components in the finite element modeling of additive manufacturing processes necessary to obtain accurate results Offers a deeper understanding of how the thermal gradients inherent in additive manufacturing induce distortion and residual stresses, and how to mitigate these undesirable phenomena Includes a set of strategies for the modeler to improve computational efficiency when simulating various additive manufacturing processes Serves as an essential reference for engineers and technicians in both industry and academia

Light Metals 2020 - Alan Tomsett 2020-01-28

The Light Metals symposia at the TMS Annual Meeting & Exhibition present the most recent developments, discoveries, and practices in primary aluminum science and technology. The annual Light Metals volume has become the definitive reference in the field of aluminum production and related light metal technologies. The 2020 collection includes papers from the following symposia: • Alumina and Bauxite• Aluminum Alloys, Processing and Characterization• Aluminum Reduction Technology• Cast Shop Technology• Cast Shop Technology: Recycling and Sustainability Joint Session• Electrode Technology for Aluminum Production

Modelling the Deformation, Recrystallization and Microstructure-Related Properties in Metals - Jurij J Sidor 2021-11-15

In the special issue related to Modelling the

Deformation, Recrystallization and Microstructure-Related Properties in Metals, we presented a wide spectrum of articles dealing with modelling of microstructural aspects involved in deformation and recrystallization as well as simulation of microstructure-based and texture-based properties in various metals. The latest advances in the theoretical interpretation of mesoscopic transformations based on experimental observations were partially discussed in the current special issue. The studies dealing with the modelling of structure-property relationships are likewise analyzed in the present collection of manuscripts. The contributions in the current collection evidently demonstrate that the properties of metallic materials are microstructure dependent and therefore the thermomechanical processing (TMP) of the polycrystalline aggregates should be strictly controlled to guarantee the desired bunch of qualities. Given this, the assessment of microstructure evolution in metallic systems is of extraordinary importance. Since the trial-error approach is a time-consuming and quite expensive methodology, the materials research community tends to employ a wide spectrum of computational approaches to simulate each chain of TMP and tune the processing variables to ensure the necessary microstructural state which will provide desired performance in the final product. Although many hidden facets of various technological processes and related microstructural changes were revealed in the submitted works by employing advanced computational approaches, nevertheless, the contributions collected in this issue clearly show that further efforts are required in the field of modelling to understand the complexity of material's world. The final goal of modelling efforts might be a development of a comprehensive model, which will be capable of describing many aspects of microstructure evolution during thermomechanical processing.

Thermo-Mechanical Behaviour of Structural Lightweight Alloys - Guillermo Requena 2019-09-23

The need to reduce the ecological footprint of water/land/air vehicles in this era of climate change requires pushing the limits regarding the development of lightweight structures and materials. This requires a thorough understanding of their thermomechanical behavior at several stages of the production chain. Moreover, during service, the response of lightweight alloys under the simultaneous influence of mechanical loads and temperature can determine the lifetime and performance of a multitude of structural components. The present Special Issue, comprising eight original research articles, is dedicated to disseminating current efforts around the globe aimed at advancing understanding of the thermomechanical behavior of structural lightweight alloys under processing or service conditions.

Severe Plastic Deformation and Thermomechanical Processing: Nanostructuring and Properties - Andrea Bachmaier 2021-02-11

Severe plastic deformation (SPD) is a very attractive research field for metallic materials because it provides new possibilities for manufacturing nanostructured materials in large quantities and allows microstructural design on different hierarchical levels. The papers included in this issue address the following topics: novel SPD processes as well as recent advancements in established processing methods, microstructure evolution and grain refinement in single- and multi-phase alloys as well as composites, strategies to enhance the microstructure stability at elevated temperatures, mechanically driven phase transformations, surface nanostructuring, gradient and multilayered materials, and mechanical and physical properties of SPD-processed materials.

Physical Metallurgy - Gregory N. Haidemenopoulos 2018-02-07

Physical metallurgy is one of the main fields of metallurgical science dealing with the development of the microstructure of metals in order to achieve desirable properties required in technological applications. Physical Metallurgy: Principles and Design focuses on the processing–structure–properties triangle as it applies to metals and alloys. It introduces the fundamental principles of physical metallurgy and the design methodologies for alloys and processing. The first part of the book discusses the structure and change of structure through phase transformations. The latter part of the books deals with plastic deformation,

strengthening mechanisms, and mechanical properties as they relate to structure. The book also includes a chapter on physical metallurgy of steels and concludes by discussing the computational tools, involving computational thermodynamics and kinetics, to perform alloy and process design.

ASM Metals Reference Book, 3rd Edition - Michael Bauccio 1993-01-01

This reference book makes it easy for anyone involved in materials selection, or in the design and manufacture of metallic structural components to quickly screen materials for a particular application. Information on practically all ferrous and nonferrous metals including powder metals is presented in tabular form for easy review and comparison between different materials. Included are chemical compositions, physical and mechanical properties, manufacturing processes, applications, pertinent specifications and standards, and test methods. Contents Overview: Glossary of metallurgical terms Selection of structural materials (specifications and standards, life cycle and failure modes, materials properties and design, and properties and applications) Physical data on the elements and alloys Testing and inspection Chemical composition and processing characteristics

Mechanical Behavior of Materials - Marc André Meyers 2008-11-06

A balanced mechanics-materials approach and coverage of the latest developments in biomaterials and electronic materials, the new edition of this popular text is the most thorough and modern book available for upper-level undergraduate courses on the mechanical behavior of materials. To ensure that the student gains a thorough understanding the authors present the fundamental mechanisms that operate at micro- and nano-meter level across a wide-range of materials, in a way that is mathematically simple and requires no extensive knowledge of materials. This integrated approach provides a conceptual presentation that shows how the microstructure of a material controls its mechanical behavior, and this is reinforced through extensive use of micrographs and illustrations. New worked examples and exercises help the student test their understanding. Further resources for this title, including lecture slides of select illustrations and solutions for exercises, are available online at www.cambridge.org/97800521866758.

Dynamics of Systems on the Nanoscale - Ilia A. Solov'yov 2022

This book presents the structure formation and dynamics of animate and inanimate matter on the nanometre scale. This is a new interdisciplinary field known as Meso-Bio-Nano (MBN) science that lies at the intersection of physics, chemistry, biology and material science. Special attention in the book is devoted to investigations of the structure, properties and dynamics of complex MBN systems by means of photonic, electronic, heavy particle and atomic collisions. This includes problems of fusion and fission, fragmentation, surfaces and interfaces, reactivity, nanoscale phase and morphological transitions, irradiation-driven transformations of complex molecular systems, collective electron excitations, radiation damage and biodamage, channeling phenomena and many more. Emphasis in the book is placed on the theoretical and computational physics research advances in these areas and related state-of-the-art experiments. Particular attention in the book is devoted to the utilization of advanced computational techniques and high-performance computing in studies of the dynamics of systems.

Microstructure and Mechanical Properties of Titanium Alloys - Artur Shugurov 2021-10-26

Titanium and its alloys are widely used engineering materials within the aerospace, automotive, energy and chemical industries. Their unique combination of high strength-to-weight ratio, strong resistance to creep, excellent corrosion resistance, and low heat conductivity makes them suitable for a wide range of applications. A large variety of microstructures, including lamellar, martensite, equiaxed globular and bimodal (duplex) microstructures can be obtained in titanium alloys depending on the thermomechanical processing routes. Despite a large amount of work in the field of investigation of microstructure evolution and mechanical properties of titanium alloys, detailed studies of the effect of their microstructure on the mechanical behavior are still necessary because of ever-increasing demands for structural

materials to optimize their properties for different applications by varying processing parameters and resulting microstructures. This Special Issue is focused on various aspects of microstructure evolution in titanium alloy samples obtained using traditional and additive technologies and subjected to different processing techniques as well as on the relation between their microstructure and mechanical behavior. The presented original articles cover the areas of preparation and experimental characterization of titanium alloys as well as computer simulation of their mechanical behavior under different loading conditions.

Titanium Alloys - Maciej Motyka 2019-11-27

Titanium alloys, due to unique physical and chemical properties (mainly high relative strength combined with very good corrosion resistance), are considered as an important structural metallic material used in hi-tech industries (e.g. aerospace, space technology). This book provides information on new manufacturing and processing methods of single- and two-phase titanium alloys. The eight chapters of this book are distributed over four sections. The first section (Introduction) indicates the main factors determining application areas of titanium and its alloys. The second section (Manufacturing, two chapters) concerns modern production methods for titanium and its alloys. The third section (Thermomechanical and surface treatment, three chapters) covers problems of thermomechanical processing and surface treatment used for single- and two-phase titanium alloys. The fourth section (Machining, two chapters) describes the recent results of high speed machining of Ti-6Al-4V alloy and the possibility of application of sustainable machining for titanium alloys.

Mechanics of Materials in Modern Manufacturing Methods and Processing Techniques - Vadim V. Silberschmidt 2020-04-03

Mechanics of Materials in Modern Manufacturing Methods and Processing Techniques provides a detailed overview of the latest developments in the mechanics of modern metal forming manufacturing. Focused on mechanics as opposed to process, it looks at the mechanical behavior of materials exposed to loading and environmental conditions related to modern manufacturing processes, covering deformation as well as damage and fracture processes. The book progresses from forming to machining and surface-treatment processes, and concludes with a series of chapters looking at recent and emerging technologies. Other topics covered include simulations in autofrettage processes, modeling strategies related to cutting simulations, residual stress caused by high thermomechanical gradients and pultrusion, as well as the mechanics of the curing process, forging, and cold spraying, among others. Some non-metallic materials, such as ceramics and composites, are covered as well. Synthesizes the latest research in the mechanics of modern metal forming processes Suggests theoretical models and numerical codes to predict mechanical responses Covers mechanics of shot peening, pultrusion, hydroforming, magnetic pulse forming Considers applicability of different materials and processes for optimum performance

Magnesium Technology 2019 - Vineet V. Joshi 2019-02-13

The Magnesium Technology Symposium, the event on which this collection is based, is one of the largest yearly gatherings of magnesium specialists in the world. Papers represent all aspects of the field, ranging from primary production to applications to recycling. Moreover, papers explore everything from basic research findings to industrialization. Magnesium Technology 2019 covers a broad spectrum of current topics, including alloys and their properties; cast products and processing; wrought products and processing; forming, joining, and machining; corrosion and surface finishing; and structural applications. In addition, there is coverage of new and emerging applications.

Thermo-mechanical Processing of Metallic Materials - Bert Verlinden 2007

Modern metallic materials are used extensively in a wide variety of applications, some of which are quite obvious (vehicles, cables, buildings and packaging) and others perhaps less so as in the critical structures of planes, skyscrapers, micro-electronic devises, nuclear and other energy plants. Many of the alloys used for these applications have undergone major

transformations over the last 20 years. These transformations have been implemented to improve the material performances at minimum cost to the user. In many cases, if not most, they have resulted from advances in Thermo-Mechanical Processing – the set of operations by which basic materials are transformed into high quality components. Divided into three sections, the first section covers the microstructural science base of the subject, including the microstructure determined mechanical properties of metals. The second section deals with the current mechanical technology of plastic forming of metals. The concluding section illustrates the interaction of the first two disciplines in a series of case studies of successful current TMP processing and also looks ahead to possible new developments in the field. This book aims to fill this gap between two scientific approaches and illustrate also their successful linkage by the use of suitable modern case studies. * Covers both physical metallurgy and metals processing * Links basic science to real everyday applications * Written by four internationally-known experts in the field

Process Modelling of Metal Forming and Thermomechanical Treatment - Claudio R. Boer 2012-12-06

It is the objective of the series IIMaterials Research and Engineeringll to publish information on technical facts and pro cesses together with specific scientific models and theories. Fundamental considerations assist in the recognition of the origin of properties and the roots of processes. By providing a higher level of understanding, such considerations form the basis for further improving the quality of both traditional and future engineering materials, as well as the efficiency of industrial operations. In a more general sense, theory helps to integrate facts into a framework which ties relations between physical equilibria and mechanisms on the one hand, product development and econo mical competition on the other. Aspects of environmental compati bili ty, conservation of resources and of socio-cul tural inter action form the final horizon - a subject treated in the first ll volume of this series, IIMaterials in World Perspective . The four authors of the present book endeavor to present a comprehensive picture of process modelling in the important field of metal forming and thermomechanical treatment. The reader will be introduced to the rapidly-growing new field of application of computer-aided numerical methods to the quanti tative simulation of complex technical processes. Extensive use is made of the state of scientific knowledge related to materials behavior under mechanical stress and thermal treat ment.

Comprehensive Materials Processing - 2014-04-07

Comprehensive Materials Processing provides students and professionals with a one-stop resource consolidating and enhancing the literature of the materials processing and manufacturing universe. It provides authoritative analysis of all processes, technologies, and techniques for converting industrial materials from a raw state into finished parts or products. Assisting scientists and engineers in the selection, design, and use of materials, whether in the lab or in industry, it matches the adaptive complexity of emergent materials and processing technologies. Extensive traditional article-level academic discussion of core theories and applications is supplemented by applied case studies and advanced multimedia features. Coverage encompasses the general categories of solidification, powder, deposition, and deformation processing, and includes discussion on plant and tool design, analysis and characterization of processing techniques, high-temperatures studies, and the influence of process scale on component characteristics and behavior. Authored and reviewed by world-class academic and industrial specialists in each subject field Practical tools such as integrated case studies, user-defined process schemata, and multimedia modeling and functionality Maximizes research efficiency by collating the most important and established information in one place with integrated applets linking to relevant outside sources

Smithells Metals Reference Book - William F. Gale 2003-12-09

Smithells is the only single volume work which provides data on all key apsects of metallic materials. Smithells has been in continuous publication for over 50 years. This 8th Edition represents a major revision. Four new chapters

have been added for this edition. these focus on; * Non conventional and emerging materials - metallic foams, amorphous metals (including bulk metallic glasses), structural intermetallic compounds and micr/nano-scale materials. * Techniques for the modelling and simulation of metallic materials. * Supporting technologies for the processing of metals and alloys. * An Extensive bibliography of selected sources of further metallurgical information, including books, journals, conference series, professional societies, metallurgical databases and specialist search tools. * One of the best known and most trusted sources of reference since its first publication more than 50 years ago * The only single volume containing all the data needed by researchers and professional metallurgists * Fully updated to the latest revisions of international standards

Magnesium Technology 2015 - Michele Manuel 2016-12-26

The Magnesium Technology Symposium, the event on which this collection is based, is one of the largest yearly gatherings of magnesium specialists in the world. Papers represent all aspects of the field, ranging from primary production to applications to recycling. Moreover, papers explore everything from basic research findings to industrialization. Magnesium Technology 2015 covers a broad spectrum of current topics, including alloys and their properties; cast products and processing; wrought products and processing; forming, joining, and machining; corrosion and surface finishing; ecology; and structural applications. In addition, there is coverage of new and emerging applications.

Thermomechanical Processing and Mechanical Properties of Hypereutectoid Steels and Cast Irons - D. R. Lesuer 1996

Recent advances in metallurgy of hypereutectoid steels and cast irons show that unique properties, such as ultrahigh hardness and strength, and superplasticity, are achievable. This book focuses on the mechanical properties of hypereutectoid steels and cast irons as influenced by thermomechanical processing and microstructure.

New Materials for Next-Generation Commercial Transports - National Research Council 1996-03-15

The major objective of this book was to identify issues related to the introduction of new materials and the effects that advanced materials will have on the durability and technical risk of future civil aircraft throughout their service life. The committee investigated the new materials and structural concepts that are likely to be incorporated into next generation commercial aircraft and the factors influencing application decisions. Based on these predictions, the committee attempted to identify the design, characterization, monitoring, and maintenance issues that are critical for the introduction of advanced materials and structural concepts into future aircraft.

Intermetallic Chemistry - Riccardo Ferro 2010-03

Intermetallic science is closely related to physics, chemistry, metallurgy, materials science & technology, and engineering. This book emphasizes the chemical aspects of this science, and therefore the mutual reactivity of metals and the characteristics of intermetallic compounds. Topics included are: OCo Phase diagrams of alloy systems. Many intermetallic systems form several compounds, generally not obeying common simple stoichiometric rules, which are often homogeneous in a certain range of compositions. The stability and extension of these phases are conveniently presented through phase diagrams. OCo Selected aspects of intermetallics structural chemistry, with emphasis on the solid state. The general structural characteristics of intermetallic phases are considered, with attention to nomenclature and to alternative and complementary methods of presenting crystal-chemical data. A brief account is given of derivative and degenerate structures, modular aspects of crystal structures, and of a few special groups of alloys such as quasicrystals and amorphous alloys. A number of selected structural prototypes with typical features, their possible grouping in structural OC familieso and their distribution among different types of alloys are provided. OCo Intermetallic reactivity trends in the Periodic Table. Attention is given to a few selected elemental parameters such as electron configuration and valence electron number and to their changes along the Table, which act as reference factors of the intermetallic behaviour.

As an example, the relationships are considered between crystal structure and the number of valence electrons per atom (or per formula) in various classes of compounds or solid solution phases. OCo Alloying behaviour systematics of intermetallic systems with a description of the intermetallic reactivity of each element, or group of elements, in the order of their position in the Periodic Table. For each pair of metallic elements, their capability to form intermediate phases is summarised by maps and schemes. OCo A description of small scale preparation methods of intermetallics. A number of interesting and significant peculiarities are, e.g., those related to their high melting points, insolubility in common solvents, etc. A Systematic treatment of alloying behaviour A Wide overview of intermetallic chemistry A Illustrated, with many examples"