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Ohio State University Bulletin - 1950

Nature-Inspired Computing: Concepts, Methodologies, Tools, and Applications -
Management Association, Information Resources
2016-07-26
As technology continues to become more

sophisticated, mimicking natural processes and phenomena also becomes more of a reality. Continued research in the field of natural computing enables an understanding of the world around us, in addition to opportunities for man-made computing to mirror the natural processes and systems that have existed for

centuries. *Nature-Inspired Computing: Concepts, Methodologies, Tools, and Applications* takes an interdisciplinary approach to the topic of natural computing, including emerging technologies being developed for the purpose of simulating natural phenomena, applications across industries, and the future outlook of biologically and nature-inspired technologies. Emphasizing critical research in a comprehensive multi-volume set, this publication is designed for use by IT professionals, researchers, and graduate students studying intelligent computing.

PHYSICAL METALLURGY: PRINCIPLES AND PRACTICE, Third Edition - RAGHAVAN, V. 2015-11-10

This well-established book, now in its Third Edition, presents the principles and applications of engineering metals and alloys in a highly readable form. This new edition retains all the basic topics covered in earlier editions such as phase diagrams, phase transformations, heat

treatment of steels and nonferrous alloys, shape memory alloys, solidification, fatigue, fracture and corrosion, as well as applications of engineering alloys. A new chapter on 'Nanomaterials' has been added (Chapter 8). The field of nano-materials is interdisciplinary in nature, covering many disciplines including physical metallurgy. Intended as a text for undergraduate courses in Metallurgical and Materials Engineering, the book is also suitable for students preparing for associate membership examination of the Indian Institute of Metals (AMIIM) and other professional examinations like AMIE.

MATERIALS SCIENCE AND ENGINEERING : PROBLEMS WITH SOLUTIONS - SHETTY, M.N. 2015-12-01

This book, with analytical solutions to 260 select problems, is primarily designed for the second year core course on materials science. The treatment of the book reflects the author's experience of teaching this course

comprehensively at IIT-Kanpur for a number of years to the students of engineering and 5-year integrated disciplines. The problems have been categorised into five sections covering a wide range of solid state properties. Section 1 deals with the dual representation of a wave and a particle and then comprehensively explains the behaviour of particles within potential barriers. It provides solutions to the problems that how the energy levels of a free atom lead to the formation of energy bands in solids. The statistics of the distribution of particles in different energy states in a solid has been detailed leading to the derivation of Maxwell-Boltzmann, Bose-Einstein, and Fermi-Dirac statistics and their mutual relationships. Quantitative derivation of the Fermi energy has been obtained by considering free electron energy distribution in solids and then considering Fermi-Dirac distribution as a function of temperature. The derivation of the Richardson's equation and the related work

function has been quantitatively dealt with. The phenomenon of tunnelling has been dealt with in terms of quantum mechanics, whereas the band structure and electronic properties of materials are given quantitative treatment by using Fermi-Dirac distribution function. Section 2 deals with the nature of the chemical bonds, types of bonds and their effect on properties, followed by a detailed presentation of crystal structures of some common materials and a discussion on the structures of C60 and carbon nanotubes. Coordination and packing in crystal structures are considered next followed by a detailed X-ray analysis of simple crystal structures, imperfections in crystals, diffusion, phase equilibria, and mechanical behaviour. Section 3 deals with thermal and electrical properties and their mutual relationships. Calculations of Debye frequency, Debye temperature, and Debye specific heat are presented in great detail. A brief section on superconductivity considers both the

conventional and the high-TC superconductors. Sections 4 and 5 deal with the magnetic and dielectric materials, considering magnetic properties from the point of view of the band theory of solids. Crystal structures of some common ferrites are given in detail. Similarly, the displacement characteristics in dielectrics are considered from their charge displacements giving rise to some degree of polarization in the materials.

Physical Metallurgy Principles - SI Version - Reza Abbaschian 2009-05-01

This comprehensive, student friendly text is intended for use in an introductory course in physical metallurgy and is designed for all engineering students at the junior or senior level. The approach is largely theoretical but all aspects of physical metallurgy and behavior of metals and alloys are covered. The treatment used in this textbook is in harmony with a more fundamental approach to engineering education. An extensive revision has been done to insure

that the content remains the standard for metallurgy engineering courses worldwide. Important Notice: Media content referenced within the product description or the product text may not be available in the ebook version. **Solutions to the Problems in Principles of Physical and Chemical Metallurgy** - Giles F. Carter 1982

Solutions Manual for Physical Metallurgy Principles - Robert E. Reed-Hill 1964*

Modern Physical Metallurgy - R. E. Smallman 2016-06-24

Modern Physical Metallurgy, Fourth Edition discusses the fundamentals and applications of physical metallurgy. The book is comprised of 15 chapters that cover the experimental background of a metallurgical phenomenon. The text first talks about the structure of atoms and crystals, and then proceeds to dealing with the physical examination of metals and alloys. The

third chapter tackles the phase diagrams and solidifications, while the fourth chapter covers the thermodynamics of crystals. Next, the book discusses the structure of alloys. The next four chapters deal with the deformations and defects of crystals, metals, and alloys. Chapter 10 discusses work hardening and annealing, while Chapters 11 and 12 cover phase transformations. The succeeding two chapters talk about creep, fatigue, and fracture, while the last chapter covers oxidation and corrosion. The text will be of great use to undergraduate students of materials engineering and other degrees that deal with metallurgical properties.

High Entropy Alloys - T.S. Srivatsan

2020-07-20

This book provides a cohesive overview of innovations, advances in processing and characterization, and applications for high entropy alloys (HEAs) in performance-critical and non-performance-critical sectors. It covers manufacturing and processing, advanced

characterization and analysis techniques, and evaluation of mechanical and physical properties. With chapters authored by a team of internationally renowned experts, the volume includes discussions on high entropy thermoelectric materials, corrosion and thermal behavior of HEAs, improving fracture resistance, fatigue properties and high tensile strength of HEAs, HEA films, and more. This work will be of interest to academics, scientists, engineers, technologists, and entrepreneurs working in the field of materials and metals development for advanced applications. Features Addresses a broad spectrum of HEAs and related aspects, including manufacturing, processing, characterization, and properties Emphasizes the application of HEAs Aimed at researchers, engineers, and scientists working to develop materials for advanced applications T.S. Srivatsan, PhD, Professor of Materials Science and Engineering in the Department of Mechanical Engineering at the University of

Akron (Ohio, USA), earned his MS in Aerospace Engineering in 1981 and his PhD in Mechanical Engineering in 1984 from the Georgia Institute of Technology (USA). He has authored or edited 65 books, delivered over 200 technical presentations, and authored or co-authored more than 700 archival publications in journals, book chapters, book reviews, proceedings of conferences, and technical reports. His RG score is 45 with a h-index of 53 and Google Scholar citations of 9000, ranking him to be among the top 2% of researchers in the world. He is a Fellow of (i) the American Society for Materials International, (ii) the American Society of Mechanical Engineers, and (iii) the American Association for Advancement of Science. Manoj Gupta, PhD, is Associate Professor of Materials at NUS, Singapore. He is a former Head of Materials Division of the Mechanical Engineering Department and Director Designate of Materials Science and Engineering Initiative at NUS, Singapore. In August 2017, he was

highlighted among the Top 1% Scientists of the World by the Universal Scientific Education and Research Network and in the Top 2.5% among scientists as per ResearchGate. In 2018, he was announced as World Academy Championship Winner in the area of Biomedical Sciences by the International Agency for Standards and Ratings. A multiple award winner, he actively collaborates/visits as an invited researcher and visiting and chair professor in Japan, France, Saudi Arabia, Qatar, China, the United States, and India.

Titanium: Physical Metallurgy, Processing, and Applications - F.H. Froes 2015-02-01
This new book covers all aspects of the history, physical metallurgy, corrosion behavior, cost factors and current and potential uses of titanium. The history of titanium is traced from its early beginnings through the work of Kroll, to the present day broadening market place. Extensive detail on extraction processes is discussed, as well as the various beta to alpha

transformations and details of the powder metallurgy techniques.

Computational Approaches to Materials

Design: Theoretical and Practical Aspects -

Datta, Shubhabrata 2016-06-16

The development of new and superior materials is beneficial within industrial settings, as well as a topic of academic interest. By using computational modeling techniques, the probable application and performance of these materials can be easily evaluated. Computational Approaches to Materials Design: Theoretical and Practical Aspects brings together empirical research, theoretical concepts, and the various approaches in the design and discovery of new materials. Highlighting optimization tools and soft computing methods, this publication is a comprehensive collection for researchers, both in academia and in industrial settings, and practitioners who are interested in the application of computational techniques in the field of materials engineering.

Principles of Physical Metallurgy - Frederick Leo Coonan 1943

Modern Physical Metallurgy - R. E. Smallman
2013-09-17

Modern Physical Metallurgy, Third Edition discusses the fundamental principles of physical metallurgy and demonstrates how the application of the principles leads to a clearer understanding of many technologically important metallurgical phenomena. This book covers the substantial developments in the microstructural examination of metals using X-ray microanalysis, strengthening of metals, and surface and interface behavior. Numerical problems on crystallography, constitution and microstructure, diffraction, diffusion, defect theory, and thermodynamics are also provided in this publication. This edition is useful for all undergraduate degree courses in metallurgy and materials in both universities and polytechnics. The large range of topics included, from

superconductivity to superplasticity and from macroscopic plasticity to fracture toughness, gives students sufficient background to the fundamental principles and practical details for examination requirements.

High-Entropy Alloys - Michael C. Gao 2016-04-27

This book provides a systematic and comprehensive description of high-entropy alloys (HEAs). The authors summarize key properties of HEAs from the perspective of both fundamental understanding and applications, which are supported by in-depth analyses. The book also contains computational modeling in tackling HEAs, which help elucidate the formation mechanisms and properties of HEAs from various length and time scales.

Introduction to Aerospace Materials - Adrian P Mouritz 2012-05-23

The structural materials used in airframe and propulsion systems influence the cost, performance and safety of aircraft, and an understanding of the wide range of materials

used and the issues surrounding them is essential for the student of aerospace engineering. Introduction to aerospace materials reviews the main structural and engine materials used in aircraft, helicopters and spacecraft in terms of their production, properties, performance and applications. The first three chapters of the book introduce the reader to the range of aerospace materials, focusing on recent developments and requirements. Following these introductory chapters, the book moves on to discuss the properties and production of metals for aerospace structures, including chapters covering strengthening of metal alloys, mechanical testing, and casting, processing and machining of aerospace metals. The next ten chapters look in depth at individual metals including aluminium, titanium, magnesium, steel and superalloys, as well as the properties and processing of polymers, composites and wood. Chapters on performance issues such as

fracture, fatigue and corrosion precede a chapter focusing on inspection and structural health monitoring of aerospace materials. Disposal/recycling and materials selection are covered in the final two chapters. With its comprehensive coverage of the main issues surrounding structural aerospace materials, Introduction to aerospace materials is essential reading for undergraduate students studying aerospace and aeronautical engineering. It will also be a valuable resource for postgraduate students and practising aerospace engineers. Reviews the main structural and engine materials used in aircraft, helicopters and space craft in terms of their properties, performance and applications. Introduces the reader to the range of aerospace materials, focusing on recent developments and requirements, and discusses the properties and production of metals for aerospace structures. Chapters look in depth at individual metals including aluminium, titanium, magnesium, steel

and superalloys

Mechanical Metallurgy - Marc A. Meyers 1984

Basic Metallurgy: Principles of physical metallurgy for ferrous castings. v.2.

Principles of production metallurgy for ferrous castings - Clyde B Jenni 1970

Kinetics in Materials Science and Engineering - Dennis W. Readey 2017-01-27

"A pedagogical gem.... Professor Readey replaces 'black-box' explanations with detailed, insightful derivations. A wealth of practical application examples and exercise problems complement the exhaustive coverage of kinetics for all material classes." -Prof. Rainer Hebert, University of Connecticut "Prof. Readey gives a grand tour of the kinetics of materials suitable for experimentalists and modellers.... In an easy-to-read and entertaining style, this book leads the reader to fundamental, model-based understanding of kinetic processes critical to

development, fabrication and application of commercially-important soft (polymers, biomaterials), hard (ceramics, metals) and composite materials. It is a must-have for anyone who really wants to understand how to make materials and how they will behave in service." -- Prof. Bill Lee, Imperial College London, Fellow of the Royal Academy of Engineering "A much needed text filling the gap between an introductory course in materials science and advanced materials-specific kinetics courses. Ideal for the undergraduate interested in an in-depth study of kinetics in materials." --Prof. Mark E. Eberhart, Colorado School of Mines This book provides an in-depth introduction to the most important kinetic concepts in materials science, engineering, and processing. All types of materials are addressed, including metals, ceramics, polymers, electronic materials, biomaterials, and composites. The expert author with decades of teaching and practical experience gives a lively and accessible

overview, explaining the principles that determine how long it takes to change material properties and make new and better materials. The chapters cover a broad range of topics extending from the heat treatment of steels, the processing of silicon integrated microchips, and the production of cement, to the movement of drugs through the human body. The author explicitly avoids "black box" equations, providing derivations with clear explanations.

Physical Metallurgy - William F. Hosford
2005-03-29

For students ready to advance in their study of metals, Physical Metallurgy combines theoretical concepts, real alloy systems, processing procedures, and examples of real-world applications. The author uses his experience in teaching physical metallurgy at the University of Michigan to convey this topic with greater depth and detail than most introductory materials courses offer. The book follows its introduction of metals with topics that are common to all

metals, including solidification, diffusion, surfaces, solid solutions, intermediate phases, dislocations, annealing, and phase transformations. Other chapters focus on specific nonferrous alloy systems and their significant metallurgical properties and applications, the treatment of steels includes separate chapters on iron-carbon alloys, hardening, tempering and surface treatment, special steels and low carbon sheet steel, followed by a separate chapter on cast irons. Concluding chapters treat powder metallurgy, corrosion, welding and magnetic alloys. There are appendices on microstructural analysis, stereographic projection, and the Miller-Bravais system for hexagonal crystals. These chapters cover ternary phase diagrams, diffusion in multiphase systems, the thermodynamic basis for phase diagrams, stacking faults and hydrogen embrittlement. Physical Metallurgy uses engaging historical and contemporary examples that relate to the applications of

concepts in each chapter. With ample references and sample problems throughout, this text is a superb tool for any advanced materials science course.

Physical Metallurgy and Advanced Materials

- R. E. Smallman 2011-02-24

Physical Metallurgy and Advanced Materials is the latest edition of the classic book previously published as Modern Physical Metallurgy and Materials Engineering. Fully revised and expanded, this new edition is developed from its predecessor by including detailed coverage of the latest topics in metallurgy and material science. It emphasizes the science, production and applications of engineering materials and is suitable for all post-introductory materials science courses. This book provides coverage of new materials characterization techniques, including scanning tunneling microscopy (STM), atomic force microscopy (AFM), and nanoindentation. It also boasts an updated coverage of sports materials, biomaterials and

nanomaterials. Other topics range from atoms and atomic arrangements to phase equilibria and structure; crystal defects; characterization and analysis of materials; and physical and mechanical properties of materials. The chapters also examine the properties of materials such as advanced alloys, ceramics, glass, polymers, plastics, and composites. The text is easy to navigate with contents split into logical groupings: fundamentals, metals and alloys, nonmetals, processing and applications. It includes detailed worked examples with real-world applications, along with a rich pedagogy comprised of extensive homework exercises, lecture slides and full online solutions manual (coming). Each chapter ends with a set of questions to enable readers to apply the scientific concepts presented, as well as to emphasize important material properties. Physical Metallurgy and Advanced Materials is intended for senior undergraduates and graduate students taking courses in metallurgy,

materials science, physical metallurgy, mechanical engineering, biomedical engineering, physics, manufacturing engineering and related courses. Renowned coverage of metals and alloys, plus other materials classes including ceramics and polymers. Updated coverage of sports materials, biomaterials and nanomaterials. Covers new materials characterization techniques, including scanning tunneling microscopy (STM), atomic force microscopy (AFM), and nanoindentation. Easy to navigate with contents split into logical groupings: fundamentals, metals and alloys, nonmetals, processing and applications. Detailed worked examples with real-world applications. Rich pedagogy includes extensive homework exercises.

Corrosion and Corrosion Prevention of Low Density Metals and Alloys - B. A. Shaw 2001

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.

Physical Metallurgy - Gregory N.

Haidemenopoulos 2018-02-07

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Stress Corrosion Cracking of Pipelines - Y. Frank Cheng 2013-02-13

Explains why pipeline stress corrosion cracking happens and how it can be prevented Pipelines sit at the heart of the global economy. When they are in good working order, they deliver fuel to meet the ever-growing demand for energy around the world. When they fail due to stress corrosion cracking, they can wreak environmental havoc. This book skillfully explains the fundamental science and engineering of pipeline stress corrosion cracking based on the latest research findings and actual case histories. The author explains how and why pipelines fall prey to stress corrosion cracking and then offers tested and proven strategies for preventing, detecting, and monitoring it in order to prevent pipeline failure. Stress Corrosion Cracking of Pipelines begins with a brief introduction and then explores general principals of stress corrosion cracking, including two detailed case studies of pipeline failure.

Next, the author covers: Near-neutral pH stress corrosion cracking of pipelines High pH stress corrosion cracking of pipelines Stress corrosion cracking of pipelines in acidic soil environments Stress corrosion cracking at pipeline welds Stress corrosion cracking of high-strength pipeline steels The final chapter is dedicated to effective management and mitigation of pipeline stress corrosion cracking. Throughout the book, the author develops a number of theoretical models and concepts based on advanced microscopic electrochemical measurements to help readers better understand the occurrence of stress corrosion cracking. By examining all aspects of pipeline stress corrosion cracking—the causes, mechanisms, and management strategies—this book enables engineers to construct better pipelines and then maintain and monitor them to ensure safe, reliable energy supplies for the world.

Modern Physical Metallurgy and Materials Engineering - R. E. Smallman 1999-12-08

The sixth edition of Modern Physical Metallurgy provides a comprehensive overview of the structure of matter, the physical properties of materials and their mechanical behaviour and some of the most recent advances in physical metallurgy.

Aerospace Alloys - Stefano Gialanella
2019-10-30

This book presents an up-to-date overview on the main classes of metallic materials currently used in aeronautical structures and propulsion engines and discusses other materials of potential interest for structural aerospace applications. The coverage encompasses light alloys such as aluminum-, magnesium-, and titanium-based alloys, including titanium aluminides; steels; superalloys; oxide dispersion strengthened alloys; refractory alloys; and related systems such as laminate composites. In each chapter, materials properties and relevant technological aspects, including processing, are presented. Individual chapters focus on coatings

for gas turbine engines and hot corrosion of alloys and coatings. Readers will also find consideration of applications in aerospace-related fields. The book takes full account of the impact of energy saving and environmental issues on materials development, reflecting the major shifts that have occurred in the motivations guiding research efforts into the development of new materials systems. Aerospace Alloys will be a valuable reference for graduate students on materials science and engineering courses and will also provide useful information for engineers working in the aerospace, metallurgical, and energy production industries.

Elements of Metallurgy and Engineering Alloys -
Flake C. Campbell 2008

This practical reference provides thorough and systematic coverage on both basic metallurgy and the practical engineering aspects of metallic material selection and application.

Engineering Metallurgy: Applied physical

metallurgy - Raymond Aurelius Higgins 1983

Kinetics of Materials - Robert W. Balluffi
2005-12-07

KINETICS OF MATERIALS A CLASSROOM-TESTED TEXTBOOK PROVIDING A FUNDAMENTAL UNDERSTANDING OF BASIC KINETIC PROCESSES IN MATERIALS This textbook, reflecting the hands-on teaching experience of its three authors, evolved from Massachusetts Institute of Technology's first-year graduate curriculum in the Department of Materials Science and Engineering. It discusses key topics collectively representing the basic kinetic processes that cause changes in the size, shape, composition, and atomistic structure of materials. Readers gain a deeper understanding of these kinetic processes and of the properties and applications of materials. Topics are introduced in a logical order, enabling students to develop a solid foundation before advancing to more sophisticated topics. Kinetics of

Materials begins with diffusion. offering a description of the elementary manner in which atoms and molecules move around in solids and liquids. Next, the more complex motion of dislocations and interfaces is addressed. Finally, still more complex kinetic phenomena, such as morphological evolution and phase transformations, are treated. Throughout the textbook, readers are instilled with an appreciation of the subjects analytic foundations and, in many cases, the approximations commonly used in the field. The authors offer many extensive derivations of important results to help illuminate their origins. While the principal focus is on kinetic phenomena in crystalline materials, select phenomena in noncrystalline materials are also discussed. In many cases, the principles involved apply to all materials. Exercises with accompanying solutions are provided throughout Kinetics of Materials, enabling readers to put their newfound knowledge into practice. In addition,

bibliographies are offered with each chapter, helping readers to investigate specialized topics in greater detail. Several appendices presenting important background material are also included. With its unique range of topics, progressive structure, and extensive exercises, this classroom- tested textbook provides an enriching learning experience for first-year graduate students.

The Ohio State University Bulletin - Ohio State University 1955

The Principles of Physical Metallurgy - Gilbert Everett Doan 1953

Physical Metallurgy Principles - Robert E. Reed-Hill 1972

Principles of Physical Metallurgy - Morton Charles Smith 1956

Mechanical Behavior of Materials - William F.

Hosford 2010

This is a textbook on the mechanical behavior of materials for mechanical and materials engineering. It emphasizes quantitative problem solving. This new edition includes treatment of the effects of texture on properties and microstructure in Chapter 7, a new chapter (12) on discontinuous and inhomogeneous deformation, and treatment of foams in Chapter 21.

Phase Transformations and Heat Treatments of Steels - Bankim Chandra Ray 2020-06-01

The perpetual flow of understanding between phase transformation that controls grain/microstructures and heat treatment which decides the size of grains/microstructures of steels is not well articulated in the perspective of undergraduate students. In *Phase Transformations and Heat Treatments of Steels*, theories of phase transformation have been used to obtain a desirable phase or combination of phases by performing appropriate heat

treatment operations, leading to unification of both the concepts. Further, it includes special and critical heat treatment practices, case studies, local and in-service heat treatments, curative and preventive measures of heat treatment defects for several common and high-performance applications. Features: Presents fundamentals of phase transformation in steels Analyzes basics of phase transformation due to heat treatment of steel under various environmental conditions Explains application of heat treatment for different structural components Discusses heat treatment defects and detection Emphasizes heat treatment of special steels and in-situ heat treatment practices

Powder Metallurgy of Superalloys - G. H. Gessinger 2013-10-22

Powder Metallurgy of Superalloys details the advancement of powder metallurgy in the context of producing superalloys. The book is comprised of nine chapters that cover the

underlying principles of superalloys produced through powder metallurgy. The text first covers concerns in pre-alloyed dispersion-free powders, such as powder production and characterization; powder consolidation methods; and quality control and non-destructive evaluation of P/M superalloys. The next chapter talks about oxide-dispersion-strengthened superalloys. Next, the book discusses joining techniques for P/M superalloys and the practical applications of P/M superalloys. The title will be of great use to professionals in the materials manufacturing industry.

Welding Metallurgy and Weldability of Nickel-Base Alloys - John C. Lippold 2011-09-20

The most up-to-date coverage of welding metallurgy aspects and weldability issues associated with Ni-base alloys *Welding Metallurgy and Weldability of Nickel-Base Alloys* describes the fundamental metallurgical principles that control the microstructure and properties of welded Ni-base alloys. It serves as

a practical how-to guide that enables engineers to select the proper alloys, filler metals, heat treatments, and welding conditions to ensure that failures are avoided during fabrication and service. Chapter coverage includes: Alloying additions, phase diagrams, and phase stability Solid-solution strengthened Ni-base alloys Precipitation strengthened Ni-base alloys Oxide dispersion strengthened alloys and nickel aluminides Repair welding of Ni-base alloys Dissimilar welding Weldability testing High-chromium alloys used in nuclear power applications With its excellent balance between

the fundamentals and practical problem solving, the book serves as an ideal reference for scientists, engineers, and technicians, as well as a textbook for undergraduate and graduate courses in welding metallurgy.

Physical Metallurgy Principles - Robert E. Reed-Hill 1968

An Introduction to the Science of Metals - Marc H. Richman 1967

Physical Chemistry Solutions Manual - William B. Bunger 1972