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This book describes the modern real-space approach to electronic structures and properties of crystalline and non-crystalline materials in a form readily accessible to undergraduates in materials science, physics, and chemistry. - ;This book describes the modern real-space approach to electronic structures and properties of crystalline and non-crystalline materials in a form readily accessible to undergraduates in materials science, physics, and chemistry. - Materials Principles and Practice deals with materials science in the technological context of making and using materials. Topics covered include the nature of materials such as crystals, an atomic view of solids, temperature effects on materials, and the mechanical and chemical properties of materials. This book is comprised of seven chapters and begins with an overview of the properties of different kinds of material, the ways in which materials can be shaped, and the uses to which they can be put. The next chapter describes the state of matter as a balance between the tendencies of atoms to stick together (by chemical bonding) or rattle apart (by thermal agitation), paying particular attention to ionic bonds and ionic crystals, the structure and properties of polymers, and transition metals. The reader is also introduced to how the structure of materials, especially microstructure, can be manipulated to give desired properties via thermal, mechanical, and chemical agents of change. This text concludes by describing the chemistry of processing and service of various materials. Exercises and self-assessment questions with answers are given at the end of each chapter, together with a set of objectives. This monograph will be a valuable resource for students of materials science and the physical sciences. The unique design of this book provides many helpful features for a sound and proven approach to learning about modern materials science and technology. Interesting case studies, applications, and illustrations, with numerous sample problems and activities, have been provided to facilitate the learning process. The book's extensive index and handy tables qualifies it as a useful "ready reference", on the job or elsewhere. You will learn about engineering materials and many associated topics through an integrated approach centering around innovative trends in design and manufacturing that often focus on environmentally friendly processes and products. Special strategies and clear explanations clarify the relationships among the major facets of materials technology. This book is intended to fill the knowledge gap between the chemical structure and the related physical characteristics of plastics necessary for appropriate material selection, design, and processing. The entire spectrum of plastics is addressed, including thermoplastics, thermosets, elastomers, and blends. It also contains an in-depth presentation of the structure-property relationships of a wide range of plastics. One of the special features is the extensive discussion and explanation of the impact of relationships on processing and, vice-versa, the effect of processing on structure and properties. The book contains several application-oriented examples and is presented at an intermediate level for both practicing plastic engineers and advanced engineering students. This book is intended to fill the knowledge gap between the chemical structure and the related physical characteristics of plastics necessary for appropriate material selection, design, and processing. The entire spectrum of plastics is addressed, including thermoplastics, thermosets, elastomers, and blends. It also contains an in-depth presentation of the structure-property relationships of a wide range of plastics. One of the special features is the extensive discussion and explanation of the impact of relationships on processing and, vice-versa, the effect of processing on structure and properties. The book contains several application-oriented examples and is presented at an intermediate level for both practicing plastic engineers and advanced engineering students. An easy-to-read textbook linking together bond strength and the arrangement of atoms in space with the properties that they control. A snapshot of the central ideas used to control fracture properties of engineered structural metallic materials, Advanced Structural Materials: Properties, Design Optimization, and Applications illustrates the critical role that advanced structural metallic materials play in aerospace, biomedical, automotive, sporting goods, and other industries in the twenty-first century. The book presents an overview of the structure, properties, and applications of these materials, including the basic ideas behind their design. It contains examples and accessible language, elucidating the basic concepts that guide the development of new alloys and composite materials. With in-depth reviews from leading contributors, the text develops an understanding of the breadth and depth of advances in the field. It begins with a broad introduction to advanced structural materials, then examines materials at the frontiers of emerging applications such as biomaterials, MEMS, amorphous materials, and nanotechnology. The chapter authors are experts in their own right and they assume no prior knowledge of a given material system, delineating the fundamental concepts and applications of advanced structural materials. The rich array of carefully selected topics provides useful insights into the structure, properties, and applications of advanced structural materials. This is a concise, up-to-date book that covers a wide range of important ceramic materials used in modern technology. Chapters provide essential information on the nature of these key ceramic raw materials including their structure, properties, processing methods and applications in engineering and technology. Treatment is provided on materials such as alumina, aluminates, Andalusite, kyanite, and sillimanite. The chapter authors are leading experts in the field of ceramic materials. An ideal text for graduate students and practising engineers in ceramic engineering, metallurgy, and materials science and engineering. Covers the art and science of concrete, emphasizing structure-property relations. This new edition gives improved coverage of viscoelastic behaviour and covers treatment of thermal shrinkage and stresses, plastic settlement cracks and crazing, and technology of structural lightweight concrete. Tensors, matrices, symmetry, and structure-property relationships form the main subjects of the book. While tensors and matrices provide the mathematical framework for understanding anistropy, on which the physical and chemical properties of crystals and textured materials often depend, atomistic arguments are also needed to qualify the property coefficients in various directions. The atomistic arguments are partly based on symmetry and party on the basic physics and chemistry of materials. The fascinating world of intermetallics is largely unexplored. There are many exciting physical properties and important technological applications of intermetallics, from magnetism to superconductivity. The main focus of this book is on the statistics, topology and geometry of crystal structures and structure types of intermetallic phases. The underlying physics, in particular chemical bonding, is discussed

whenever it helps understand the stability of structures and the origin of their physical properties. The authors' approach, based on the statistical analysis of more than twenty thousand intermetallic compounds in the data base Pearson's Crystal Data, uncovers important structural relationships and illustrates the relative simplicity of most of the general structural building principles. It also shows that a large variety of actual structures can be related to a rather small number of aristotypes. The text aims to be readable and beneficial in one way or another to everyone interested in intermetallic phases, from graduate students to experts in solid state chemistry and physics, and materials science. For that purpose it avoids the use of enigmatic abstract terminology for the classification of structures. Instead, it focuses on the statistical analysis of crystal structures and structure types in order to draw together a larger overview of intermetallics, and indicate the gaps in it - areas still to be explored, and potential sources of worthwhile research. The text should be read as a reference guide to the incredibly rich world of intermetallic phases. This is a concise, up-to-date book that covers a wide range of important ceramic materials used in modern technology. Chapters provide essential information on the nature of these key ceramic raw materials including their structure, properties, processing methods and applications in engineering and technology. Treatment is provided on materials such as alumina, aluminates, Andalusite, kyanite, and sillimanite. The chapter authors are leading experts in the field of ceramic materials. An ideal text for graduate students and practising engineers in ceramic engineering, metallurgy, and materials science and engineering. Designed for the first year course on Materials Science the book exhaustively covers all the topics taught to students of engineering. The book benefits from an updated treatment of the subject and emphasises on common characteristics of engineering mate. In this new edition of their classic work on Cellular Solids, the authors have brought the book completely up to date, including new work on processing of metallic and ceramic foams and on the mechanical, electrical and acoustic properties of cellular solids. Data for commercially available foams are presented on material property charts; two new case studies show how the charts are used for selection of foams in engineering design. Over 150 references appearing in the literature since the publication of the first edition are cited. The text summarises current understanding of the structure and mechanical behaviour of cellular materials, and the ways in which they can be exploited in engineering design. Cellular solids include engineering honeycombs and foams (which can now be made from polymers, metals, ceramics and composites) as well as natural materials, such as wood, cork and cancellous bone. As a boy I loved to build model airplanes, not the snap-together plastic models of today, but the old-fashioned Spads and Sopwith Camels made of balsa wood and tissue paper. I dreamed of EDDIE RICKENBACKER and dogfights with the Red Baron as I sat there sniffing airplane glue. Mother thought I would never grow up to make an honest living, and mothers are never wrong. Thirty years later I sit in a research laboratory surrounded by crystal models and dream of what it would be like to be 1 A tall, to rearrange atoms with pick and shovel, and make funny things happen inside. Professor VON HIPPEL calls it "Molecular Engineering," the building of materials and devices to order: We begin to design materials with prescribed properties, to under stand the molecular causes of their failings, to build into them safe guards against such failure, and to arrive at true yardsticks of ultimate performance. No longer shackled to presently available materials, we are free to dream and find answers to unprecedented challenges. It is this revolutionary situation which makes scientists and engineers true allies in a great adventure of the human mind [1]. This book is about structure-property relationships, more especially applications of crystal chemistry to engineering problems. Faced with the task of finding new materials, the crystallographer uses ionic radii, crystal fields, anisotropic atomic groupings, and symmetry arguments as criteria in the materials selection process. The ongoing process of bio-evolution has produced materials which are perfectly adapted to fulfil a specific functional role. The natural world provides us with a multitude of examples of materials with durability, strength, mechanisms of programmed self-assembly and biodegradability. The materials industry has sought to observe and appreciate the relationship between structure, properties and function of these biological materials. A multidisciplinary approach, building on recent advances at the forefront of physics, chemistry and molecular biology, has been successful in producing many synthetic structures with interesting and useful properties. Structural Biological Materials: Design and Structure-Property Relationships represents an invaluable reference in the field of biological materials science and provides an incisive view into this rapidly developing and increasingly important topic within materials science. This book focuses on the study of three sub-groups of structural biological materials: • Hard tissue engineering, focussing on cortical bone • Soft tissue engineering • Fibrous materials, particularly engineering with silk fibers. The fundamental relationship between structure and properties, and certain aspects of design and engineering, are explored in each of the sub-groups. The importance of these materials, both in their intrinsic properties and specific functions, are illustrated with relevant examples. These depict the successful integration of material properties, architecture and shape, providing a wide range of optimised designs, tailored to specific functions. Edited by Manuel Elices of the Universidad Politécnica de Madrid, Spain, this book is Volume 4 in the Pergamon Material Series. A comprehensive introduction to the structure, properties, and applications of materials This title provides the first unified treatment for the broad subject of materials. Authors Gersten and Smith use a fundamental approach to define the structure and properties of a wide range of solids on the basis of the local chemical bonding and atomic order present in the material. Emphasizing the physical and chemical origins of material properties, the book focuses on the most technologically important materials being utilized and developed by scientists and engineers. Appropriate for use in advanced materials courses, The Physics and Chemistry of Materials provides the background information necessary to assimilate the current academic and patent literature on materials and their applications. Problem sets, illustrations, and helpful tables complete this well-rounded new treatment. Five sections cover these important topics: * Structure of materials, including crystal structure, bonding in solids, diffraction and the reciprocal lattice, and order and disorder in solids * Physical properties of materials, including electrical, thermal, optical, magnetic, and mechanical properties * Classes of materials, including semiconductors, superconductors, magnetic materials, and optical materials in addition to metals, ceramics, polymers, dielectrics, and ferroelectrics * A section on surfaces, thin films, interfaces, and multilayers discusses the effects of spatial discontinuities in the physical and chemical structure of materials * A section on synthesis and processing examines the effects of synthesis on the structure and properties of various materials This book is enhanced by a Web-based supplement that offers advanced material together with an entire electronic chapter on the characterization of materials. The Physics and Chemistry of Materials is a complete introduction to the structure and properties of materials for students and an excellent reference for scientists and engineers. Many of the most important properties of materials in high-technology applications are strongly influenced or even controlled by the presence of solid interfaces. In this work, leading international authorities review the broad range of subjects in this field focusing on the atomic level properties of solid interfaces. As biomaterials are used in medical devices, meeting needs in such diverse surgical disciplines as ophthalmology, cardiology, neuromuscular surgery, orthopaedics, dentistry, etc., they must have intimate contact with patient's tissue or body fluids, providing a real physical interface which seriously restricts developments. This book is written for those who would like to advance their knowledge of biomaterials. The subject matter of the book is divided into twelve chapters dealing with the structure and relationship of biological and man-made biomaterials. The application of these materials for various medical devices, and recent developments in tissue engineering, are also discussed. Elements of Structures and Defects of Crystalline Materials has been written to cover not only the fundamental principles behind structures and defects, but also to provide deep insights into understanding the relationships of properties, defect chemistry and processing of the concerned materials. Part One deals with structures, while Part Two covers defects. Since the knowledge of the electron configuration of elements is necessary for understanding the nature of chemical bonding, it is discussed in the opening chapter. Chapter Two then describes the bonding formation within the crystal structures of varied materials, with Chapter Three delving into how a material’s structure is formed. In view of the importance of the effects of the structure distortion on the material properties due to the fields, the related topics have been included in section 3.4. Moreover, several materials still under intensive investigation have been illustrated to provide deep insights into understanding the effects of the relationships of processing, structures and defects on the material properties. The defects of materials are explored in Part II. Chapter 4 deals with the point defects of metal and ceramics. Chapter 5 covers the fundamentals of the characteristics of dislocations, wherein physics and the atomic mechanics of several issues have been described in detail. In view of the significant influence of the morphologies including size, shape and distribution of grains, phases on the microstructure evolution, and, in turn, the properties of materials, the final chapter focuses on the fundamentals of interface energies, including single phase (grain) boundary and interphase boundary. Discusses the relationship between properties, defect chemistry and the processing of materials Presents coverage of the fundamental principles behind structures and defects Includes information on two-dimensional and three-dimensional imperfections in solids Materials Science and Technolog A Comprehensive Treatment Edited by R.W. Cahn, P. Haasen, E.J. Kramer The 18 volume series "Materials Science and Technology" is the first in-depth, topic-oriented reference work devoted to this growing interdisciplinary field. A compendium of current, state-of-the-art information, it covers the most important classes of materials: metals, ceramics, glasses, polymers, semiconductors, and composites, from the fundamentals of perfect semiconductors via the physics of defects to "artificial" and amorphous semiconductors. Edited by internationally renowned figures in materials science, this series is sure to establish itself as a seminal work. Volume 13: This self-contained handbook provides an authoritative source of information on the physical background of structure/property relationships in composite materials. This volume is intended as a reference work for physical scientists and engineers and as a source for the teachers of composite science. Topics include: Fibers and Whiskers - Polymer/Metal/Ceramic Matrix Materials - Interfaces - Short Fiber Composites - Morphology Control in Polymer Composites - Elastic Properties - Inelastic Properties - Strength of Fiber Composites - Fracture in Composites - Fatigue in Composites Are You Looking for a Unified and Concise Approach to Teaching and Learning the Structure of Materials? Allen and Thomas present information in a manner consistent with the way future scientists and engineers will be required to think about materials' selection, design, and use. Students will learn the fundamentals of three different states of condensed matter-glasses, crystals, and liquid crystals-and develop a set of tools for describing all of them. Above all, they'll gain a better understanding of the principles of structure common to all materials. Key concepts, such as symmetry theory, are introduced and applied to provide a common viewpoint for describing structures of ceramic, metallic, and polymeric materials. Structure-sensitive properties of real materials are introduced. The text also includes a variety of worked example problems. Other texts available in the MIT Series: Thermodynamics of Materials, Vol I, Ragone, 30885-4 Thermodynamics of Materials, Vol II: Kinetics, Ragone, 30886-2 Physical Ceramics: Principles for Ceramics Science and Engineering, Chiang, Birnie, Kingery, 59873-9 Electronic Properties of Engineering Materials, Livingston, 31627-X Henkel & Pense, STRUCTURE & PROPERTIES OF ENGINEERING MATERIALS 5/e provides an updated look at various engineering materials, including metals, metal alloys, polymers, ceramics and composites. Best suited for a second-level materials course, or a first course focusing on structures & properties, the new edition outlines and describes how structural aspects of materials determine their use in engineering. Numerous photomicrographs, and other illustrations, are used to show the structural characteristics of various materials. Charts and tables are included throughout, and provide a good resource for materials selection referencing. Chapter problems and references have been revised and updated, and a Book Web Site is available for students and professors. Instructor's will also have access to password protected problem solutions. Featuring contributions from experts at some of the world's leading academic and industrial institutions, Advanced Polymeric Materials: Structure Property Relationships brings into book form a wealth of information previously available primarily only within computer programs. In a welcome narrative treatment, it provides comprehensive coverage of polymeric materials, including polymer composites as well as the more commonly addressed polymer blends. Along with discussion on a variety of applications, topics include general aggregate properties, design considerations, characterization and enhancement of physical and mechanical properties, processing and manufacturing, and components failure. Relating Materials Properties to Structure: Handbook and Software for Polymer Calculations and Materials Properties lays the foundation for an understanding of the basic structure of materials and the significant distinguishing features between major classes. It provides a method of comparison between the structure of different classes of materials and their attendant properties. The structural differences between individual polymers and the resultant properties are a primary focus, since this is the only class of materials where data and techniques allow properties to be estimated. This book and CD-ROM software package provides an easy, straightforward technique for estimating polymer properties via simple software. The software permits the user to see the effects of changing a structure, and to estimate the properties of a polymer that might be unavailable or very time-consuming to find. The ability of the software to estimate the miscibility of various polymer blends is one of its most valuable aspects. While most methods that are extremely easy make simplifying assumptions that adversely affect accuracy, in this case, the inaccuracies introduced do not obviate the usefulness of the software or techniques. Relating Materials Properties to Structure: Handbook and Software for Polymer Calculations and Materials Properties Software offers the most comprehensive system presently available. Invaluable to all involved in fundamental polymer research, new product polymer alloy development, investigating polymer/plasticizer miscibility, and those involved in designing and specifying polymeric materials required to meet mechanical, physical, thermal, electrical and blending properties. The knowledge about crystal structure and its correlation with physical properties is the prerequisite for designing new materials with taylored properties. This work provides for researchers and graduates a valuable resource on various techniques for crystal structure determinations. By discussing a broad range of different materials and tools the authors enable the understanding of why a material might be suitable for a particular application. Mechanics of Functionally Graded Material Structures is an authoritative and fresh look at various functionally graded materials, customizing them with various structures. The book is devoted to tailoring material properties to the needed structural performance. The authors pair materials with the appropriate structures based upon their purpose and use. Material grading of structures depending upon thickness, axial and polar directions are discussed. Three dimensional analysis of rectangular plates made of functional graded materials and vibrational tailoring of inhomogeneous beams and circular plates are both covered in great detail. The authors derive novel closed form solutions that can serve as benchmarks that numerical solutions can be compared to. These are published for the first time in the literature. This is a unique book that gives the first exposition of the effects of various grading mechanisms on the structural behavior as well as taking into account vibrations and buckling. Contents:Three-Dimensional Analysis of Rectangular Plates Made of Functionally Graded Materials:Elastic PlatesIntroduction to Functionally Graded MaterialsDynamic Analysis of Plates Made of Functionally Graded

MaterialsStatic Analysis of Plates Made of Functionally Graded MaterialsVibration Tailoring of Inhomogenous Beams and Circular Plates:Beams Made of Functionally Graded MaterialVibration Tailoring of Inhomogeneous Elastically Restrained Vibrating BeamsSome Intriguing Results Pertaining to Functionally Graded ColumnsDesign of Heterogeneous Polar–Orthotropic Clamped Circular Plates with Specified Fundamental Natural FrequencyVibration Tailoring of Simply-Supported Polar Orthotropic Inhomogeneous Circular PlatesVibration Tailoring of Clamped–Clamped Polar Orthotropic Inhomogeneous Circular PlatesVibration Tailoring of a Polar Orthotropic Circular Plate with Translational SpringConclusionAppendices:A Novel Formulation Leading to Closed-Form Solutions for Buckling of Circular PlatesInverse Vibration Problem for Inhomogeneous Circular Plate with Translational SpringApparently First Closed-Form Solutions for Non-Symmetric Vibrations of Inhomogeneous Circular PlatesClosed-Form Solution for Axisymmetric Vibration of Inhomogeneous Simply-Supported Circular Plates Readership: Graduate students, academics, professional and researchers interested in the effects of various grading mechanisms on structural behavior as well as vibration and buckling.Key Features:This book deals with material grading of structures in (a) thickness, (b) axial and (c) polar directionsIt derives novel closed-form solutions that can serve as benchmarks with which numerical solutions can be compared withIt contains extensive bibliography in this fascinating topicKeywords:Materials;Structures;Vibrations;Three-Dimensional Analysis