Diffusion In Through Solids

This special issue contains selected peer-reviewed papers which were presented at the Third International Conference on Diffusion in Solids and Liquids (DSL-2007), held at the Hotel Pestana Alvor Praia, Algarve, Portugal during the 4th-6th July, 2007.

This resource volume, written especially for teachers of introductory chemistry courses, is in a ready-to-use format that will enable instructors to integrate materials chemistry into their curriculum. The book collects a critical mass of text, demonstrations, and laboratory experiments. The first ten chapters present a general introduction to solids; numerous easy-to-do teacher demonstrations are integrated into the material. The second part of the volume consists of fifteen laboratory experiments for students. Examples from cutting-edge research, as well as everyday life, spark student interest while illustrating the basic ideas that are important to an understanding of chemistry.

Fluid-Solid Reactions, Second Edition takes a detailed and thorough look at the scope of fluid-solid reaction systems, focusing on the four phenomena: external mass transfer, pore diffusion, chemical reaction, and adsorption/desorption. This completely revised new edition builds on the classic original edition through the introduction of cutting-edge new theories and applications, including the formulation and application of a new and convenient law that governs fluid-solid reaction kinetics. This book will be of primary interest to practicing engineers engaged in process research, development, and design in the many fields where fluid-solid reactions are critical to workflow and research. Fluid-solid reactions play a major role in the technology of most industrialized nations. These reactions encompass a very broad field, including the extraction of metals from their ores, the combustion of solid fuels, coal gasification, and the incineration of solid refuse. Features 50% new and revised content, arming researchers with the latest developments in the field Details a new unified approach to modeling the rates of fluid-solid reaction systems Authored by one of the world's foremost experts on fluid-solid reactions and their applications in the field

Phase transformations are among the most intriguing and technologically useful phenomena in materials, particularly with regard to controlling microstructure. After a review of thermodynamics, this book has chapters on Brownian motion and the diffusion equation, diffusion in solids based on transition-state theory, spinodal decomposition, nucleation and growth, instabilities in solidification, and diffusionless transformations. Each chapter includes exercises whose solutions are available in a separate manual. This book is based on the notes from a graduate course taught in the Centre for Doctoral Training in the Theory and Simulation of Materials. The course was attended by students with undergraduate degrees in physics, mathematics, chemistry, materials science, and engineering. The notes from this course, and this book, were written to accommodate these diverse backgrounds.

Gas-Solid Reactions describes gas-solid reaction systems, focusing on the four phenomena—external mass transfer, pore diffusion, adsorption/desorption, and chemical reaction. This book consists of eight chapters. After the introduction provided in Chapter 1, the basic components of gas-solid reactions are reviewed in Chapter 2. Chapter 3 describes the reactions of individual nonporous solid particles, while Chapter 4 elaborates the reaction of single porous particles. Solid-solid reactions proceeding through gaseous intermediates are considered in Chapter 5. Chapter 6 deals with the experimental approaches to the study of gas-solid reaction systems. How information on single-particle behavior may be used for the design of multiparticle, large-scale assemblies, and packed- and fluidized-bed reaction systems is deliberated in Chapter 7. The last chapter covers the specific gas-solid reaction systems, including some statistical indices indicating the economic importance of the systems and processes it's based on. This publication is recommended for practicing engineers engaged in process research, development, and design in the many fields where gas-solid reactions are important.

Diffusion in Solids: Recent Developments provides an overview of diffusion in crystalline solids. This book discusses the various aspects of the theory of diffusion. Organized into nine chapters, this volume starts with a discussion on the process of diffusion in solids. This book then examines the tools that supplement the conventional diffusion measurements, including electromigration, ionic conductivity, isotope effects, and vacancy wind effects. This text explores the molecular dynamic calculation by which the interatomic forces must be assumed. Other chapters discuss the method of measurement of the isotope effect on diffusion, which is the most powerful method of determining relevant information about the correlation factor. This volume extensively discusses diffusion in organic and amorphous materials, as well as interstitial diffusion in solids. The final chapter deals with ionic motion and diffusion in various groups of materials called fast ionic conductors. Solid-state physicists, materials scientists, physical chemists, and electrochemists will find this book extremely useful.

An Introduction to Solid State Diffusion
Methods, Materials, Models
Diffusion in Solids - Past, Present and Future
Recent Developments
Diffusion in Zeolites and Other Microporous Solids
Teaching General Chemistry
Fluid Transport in Porous Solids and Heterogeneous Materials
Atom movements - Diffusion and mass transport in solids
A Materials Science Companion

Diffusion in Crystalline Solids addresses some of the most active areas of research on diffusion in crystalline solids. Topics covered include measurement of tracer diffusion coefficients in solids, diffusion in silicon and germanium, atom transport in oxides of the fluorite structure, tracer diffusion in concentrated alloys, diffusion in dislocations, grain boundary diffusion mechanisms in metals, and the use of the Monte Carlo Method to simulate diffusion kinetics. This book is made up of eight chapters and begins with an introduction to the measurement of diffusion coefficients with radioisotopes. The following three chapters consider diffusion in materials of substantial technological importance such as silicon and germanium. Atomic transport in oxides of the fluorite structure is described, and diffusion in concentrated alloys, including intermetallic compounds, is analyzed. The next two chapters delve into diffusion along short-circuiting paths, focusing on the effect of diffusion down dislocations on the form of the tracer concentration profile. The book also discusses the mechanisms of diffusion in grain boundaries in metals by invoking considerable work done on grain-boundary structure. The last two chapters are concerned with computer simulation, paying particular attention to machine calculations and the Monte Carlo method. The book concludes by exploring the fundamental atomic migration process and presenting some state-of-the-art calculations for defect energies and the topology of the saddle surface. Students and researchers of material science will find this book extremely useful.

This book offers detailed descriptions of the methods available to predict the occurrence of diffusion in alloys subjected to various processes. Major topic areas covered include diffusion equations, atomic theory of diffusion, diffusion in dilute alloys, diffusion in a concentration gradient, diffusion in non-metals, high diffusivity paths, and thermo- and electro-transport.

This book describes the central aspects of diffusion in solids, and goes on to provide easy access to important information about diffusion in metals, alloys, semiconductors, ion-conducting materials, glasses and nanomaterials. Coverage includes diffusion-controlled phenomena including ionic conduction, grain-boundary and dislocation pipe diffusion. This book will benefit graduate students in such disciplines as solid-state physics, physical metallurgy, materials science, and geophysics, as well as scientists in academic and industrial research laboratories.

Handbook of Solid State Diffusion, Volume 2: Diffusion Analysis in Material Applications covers the basic fundamentals, techniques, applications, and latest developments in the area of solid-state diffusion, offering a pedagogical understanding for students, academicians, and development engineers. Both experimental techniques and computational methods find equal importance in the second of this two volume set. Volume 2 covers practical issues on diffusion phenomena in bulk, thin film, and in nanomaterials. Diffusion related problems and analysis of methods in industrial applications, such as electronic industry, high temperature materials, nuclear materials, and superconductor materials are discussed. Presents a handbook with a short mathematical background and detailed examples of concrete applications of the sophisticated methods of analysis Enables readers to learn the basic concepts of experimental approaches and the computational methods involved in solid-state diffusion Covers bulk, thin film, and nanomaterials Introduces the problems and analysis in important materials systems in various applications Collates contributions from academic and industrial problems from leading scientists involved in developing key concepts across the globe

The field of matter transport is central to understanding the processing of materials and their subsequent mechanical properties. While thermodynamics determines the final state of a material system, it is the kinetics of mass transport that governs how it gets there. This book, first published in 2000, gives a solid grounding in the principles of matter transport and their application to a range of engineering problems. The author develops a unified treatment of mass transport applicable to both solids and liquids. Traditionally matter transport in fluids is considered as an extension of heat transfer and can appear to have little relationship to diffusion in solids. This unified approach clearly makes the connection between these important fields. This book is aimed at advanced undergraduate and beginning graduate students of materials science and engineering and related disciplines. It contains numerous worked examples and unsolved problems. The material can be covered in a one semester course.

This second edition is an updated and revised version of the original text. It offers detailed descriptions of the methods available to predict the occurrence of diffusion in alloys subjected to various processes. Major topic areas covered include diffusion equations, atomic theory of diffusion, diffusion in dilute alloys, diffusion in a concentration gradient, diffusion in non-metals, high diffusivity paths, and thermo- and electro-transport. This is an excellent textbook for use in metallurgical and materials science and engineering education.

2nd International Conference on Diffusion in Solids and Liquids, Mass Transfer-heat Transfer-microstructure & Properties, DSL-2006, 26-28 July 2006, University of Aveiro, Portugal
Mass Transport in Solids and Fluids
Diffusion in Solids and Liquids VI
The Diffusion of Gases Through Solids and Special Problems in Radioactivity
Atomic Transport in Solids
Diffusion in Solid Metals and Alloys / Diffusion in festen Metallen und Legierungen
An Investigation of Diffusion in and Through Porous Solids
Gas-Solid Reactions
Diffusion in Crystalline Solids

The goal of this special collection of peer-reviewed papers was to provide an unique opportunity to exchange information, to present the latest results and to review relevant issues in contemporary diffusion research. The result is a work which will provide valuable insights into this subject. Volume is indexed by Thomson Reuters CPCI-S (WoS)

With the increasing role of porous solids in conventional and newly emerging technologies, there is an urgent need for a deeper understanding of fluid behaviour confined to pore spaces of these materials especially with regard to their transport properties. From its early years, NMR has been recognized as a powerful experimental technique enabling direct access to this information. In the last two decades, the methodological development of different NMR techniques to assess dynamic properties of adsorbed ensembles has been progressed. This book will report on these recent advances and look at new broader applications in engineering and medicine. Having both academic and industrial relevance, this unique reference will be for specialists working in the research areas and for advanced graduate and postgraduate studies who want information on the versatility of diffusion NMR.

A thorough introduction to fundamental principles andapplications From its beginnings in metallurgy and ceramics, materials sciencenow encompasses such high- tech fields as microelectronics,polymers, biomaterials, and nanotechnology. Electronic MaterialsScience presents the fundamentals of the subject in a detailedfashion for a multidisciplinary audience. Offering a higher-leveltreatment than an undergraduate textbook provides, this textbenefits students and practitioners not only in electronics andoptical materials science, but also in additional cutting-edgefields like polymers and biomaterials. Readers with a basic understanding of physical chemistry or physicswill appreciate the text's sophisticated presentation of today'smaterials science. Instructive derivations of important formulae,usually omitted in an introductory text, are included here. Thisfeature offers a useful glimpse into the foundations of how thediscipline understands such topics as defects, phase equilibria,and mechanical properties. Additionally, concepts such asreciprocal space, electron energy band theory, and thermodynamicsenter the discussion earlier and in a more robust fashion than inother texts. Electronic Materials Science also features: * An orientation towards industry and academia drawn from theauthor's experience in both arenas * Information on applications in semiconductors, optoelectronics,photocells, and nanoelectronics * Problem sets and important references throughout * Flexibility for various pedagogical needs Treating the subject with more depth than any other introductorytext, Electronic Materials Science prepares graduate andupper-level undergraduate students for advanced topics in thediscipline and gives scientists in associated disciplines a clearreview of the field and its leading technologies.

This book offers a modern treatment of diffusion in solids, covering such core topics as the transport of mass through the lattice of a crystalline solid. Part I of the book develops basic concepts in diffusion field theory and illustrates them with several applications, while Part II focuses on key solid-state principles needed to apply diffusion theory to real materials.

In this book basic and some more advanced thermodynamics and phase as well as stability diagrams relevant for diffusion studies are introduced. Following, Fick's laws of diffusion, atomic mechanisms, interdiffusion, intrinsic diffusion, tracer diffusion and the Kirkendall effect are discussed. Short circuit diffusion is explained in detail with an emphasis on grain boundary diffusion. Recent advances in the area of interdiffusion will be introduced. Interdiffusion in multi-component systems is also explained. Many practical examples will be given, such that researches working in this area can learn the practical evaluation of various diffusion parameters from experimental results. Large number of illustrations and experimental results are used to explain the subject. This book will be appealing for students, academicians, engineers and researchers in academic institutions, industry research and development laboratories.

This book provides the fundamental statistical theory of atomic transport in crystalline solids, that is the means by which processes occurring at the atomic level are related to macroscopic transport coefficients and other observable quantities. The cornerstones of the authors' treatment are (i) the physical concepts of lattice defects, (ii) the phenomenological description provided by non-equilibrium thermodynamics and (iii) the various methods of statistical mechanics used to link these (kinetic theory, random-walk theory, linear response theory etc.). The book is primarily concerned with transport in the body of crystal lattices and not with transport on surfaces, within grain boundaries or along dislocations, although much of the theory here presented can be applied to these low-dimensional structures when they are atomically well ordered and regular.

Diffusion in Solids and Liquids Mass Diffusion
Fluid-Solid Reactions
Fundamentals, Methods, Materials, Diffusion-Controlled Processes
diffusion in an through solids
Diffusion in and Through Solids /by Richard M. Barrer
The Mechanics of Diffusion in Solids
Diffusion in Solids, liquids, gases : With addendum
Basic Equations of the Mass Transport Through a Membrane Layer
Unsteady-state Diffusion in Solids

This comprehensive, handbook-style survey of diffusion in condensed matter gives detailed insight into diffusion as the process of particle transport due to stochastic movement. It is understood and presented as a phenomenon of crucial relevance for a large variety of processes and materials. In this book, all aspects of the theoretical fundamentals, experimental techniques, highlights of current developments and results for solids, liquids and interfaces are presented.

The energetics and mechanisms of diffusion control the kinetics of such diverse phenomena as the fabrication of semiconductors and superconductors, the tempering of steel, geological metamorphism, the precipitation hardening of nonferrous alloys and corrosion of metals and alloys. This work explains the fundamentals of diffusion in the solid state at a level suitable for upper-level undergraduate and beginning graduate students in materials science, metallurgy, mineralogy, and solid state physics and chemistry. A knowledge of physical chemistry such as is generally provided by a one-year undergraduate course is a prerequisite, though no detailed knowledge of solid state physics or crystallography is required.

Summarizes and reviews both the major experimental techniques and theories that have been developed and applied in the study of diffusion in microporous solids. Covers the most important works--including those published in eastern bloc countries that have received limited coverage in the west--available on the subject today. Provides a theoretical framework, experimental methods and a comprehensive review of experimental data that illustrates the application of those methods. Additionally, it offers a summary of technological aspects of diffusion limited processes. S.I. Units as well as Torr and the atmosphere as units of pressure are used throughout.

Current water-treatment technologies require considerable energy consumption. Thus, closely linked to the problem of water shortage is the impending energy crisis. Therefore, intensive research is being aimed at developing water purification processes that are based upon using renewable energy, such as solar energy, rather than energy generated using fossil fuels. There has been an accumulation of reports on the development of photocatalysts, which enable water purification using solar energy as the only driving force. Such photocatalysts, based upon oxide semiconductors, permit the conversion of solar energy into the chemical energy that is required for the oxidation of toxic organic compounds in water. The most promising photocatalyst is titanium dioxide, TiO2, and its solid solutions. The research on TiO2 photocatalysis is multidisciplinary, and progress in this area requires the application of concepts of catalysis and photocatalysis as well as concepts of solid-state chemistry.

Handbook of Solid State Diffusion, Volume 1: Diffusion Fundamentals and Techniques covers the basic fundamentals, techniques, applications, and latest developments in the area of solid-state diffusion, offering a pedagogical understanding for students, academicians, and development engineers. Both experimental techniques and computational methods find equal importance in the first of this two-volume set. Volume 1 covers the fundamentals and techniques of solid-state diffusion, beginning with a comprehensive discussion of defects, then different analyzing methods, and finally concluding with an exploration of the different types of modeling techniques. Presents a handbook with a short mathematical background and detailed examples of concrete applications of the sophisticated methods of analysis Enables readers to learn the basic concepts of experimental approaches and the computational methods involved in solid-state diffusion Covers bulk, thin film, and nanomaterials Introduces the problems and analysis in important materials systems in various applications Collates contributions from academic and industrial problems from leading scientists involved in developing key concepts across the globe

The present book is the result of diverse courses on diffusion. It is intended to give as complete an overview as possible of diffusion in solid media, while relating the process of diffusion to both their physical bases and their applications. A series of a real situations is covered in this account, from self-diffusion of radiotracers to the more complex cases of mass flow under chemical or thermal gradients or under electric fields, or diffusion in structures of lower dimensionality (surfaces and interfaces). In all these analyses, no category of materials was favored; metals, ionic crystals, oxydes, and semiconductors all had their turn. Only polymers were not specifically touched. One chapter is specifically devoted to techniques for studying diffusion, including methods of numerical simulation, and a last and long chapter gives a number of metallurgical phenomena in which diffusion plays a fundamental role.

Handbook of Solid State Diffusion: Volume 2
Diffusion Fundamentals and Techniques
Diffusion Analysis in Material Applications
Diffusion in Solids
Diffusion NMR of Confined Systems
Transport Phenomena in Materials Processing
Diffusion in and through solids
Diffusion in Condensed Matter
Handbook of Solid State Diffusion: Volume 1

The interest in diffusion in solids is as old as physical metallurgy or materials science. It stems from application-oriented as well as from scientific reasons. First, a knowledge of diffusion is basic to an understanding of many microstructural changes that occur in solid matter at elevated temperatures. For processes like phase transformations, precipitation or dissolution of a second phase, recrystallization, oxidation, creep, annealing etc., solid state diffusion is fundamental and ubiquitous. The second reason for studying diffusion is to learn more about how atoms move in solid matter. Volume III/26 presents for the first time a comprehensive collection of diffusion data for solid metals and alloys. The critical compilation of data has resulted in tables and series of diagrams which show in 13 chapters data for the following properties: Self- and impurity-diffusion in metallic elements, self-diffusion in homogeneous binary alloys, chemical diffusion in binary and ternary alloys, diffusion in amorphous alloys, diffusion of interstitial foreign atoms like hydrogen, carbon, oxygen and nitrogen in metallic elements, mass and pressure dependence of diffusion, diffusion along dislocations, grain and interphase boundary diffusion, and diffusion on surfaces.

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With a detailed analysis of the mass transport through membrane layers and its effect on different separation processes, this book provides a comprehensive look at the theoretical and practical aspects of membrane transport properties and functions. Basic equations for every membrane are provided to predict the mass transfer rate, the concentration distribution, the convective velocity, the separation efficiency, and the effect of chemical or biochemical reaction taking into account the heterogeneity of the membrane layer to help better understand the mechanisms of the separation processes. The reader will be able to describe membrane separation processes and the membrane reactors as well as choose the most suitable membrane structure for separation and for membrane reactor. Containing detailed discussion of the latest results in transport processes and separation processes, this book is essential for chemistry students and practitioners of chemical engineering and process engineering. Detailed survey of the theoretical and practical aspects of every membrane process with specific equations Practical examples discussed in detail with clear steps Will assist in planning and preparation of more efficient membrane structure separation

Handbook of Solid State Diffusion: Volume 2: Diffusion Analysis in Material Applications covers the basic fundamentals, techniques, applications, and latest developments in the area of solid-state diffusion, giving readers a pedagogical understanding that is ideal for students, academicians, and development engineers. Both experimental techniques and computational methods find equal importance within these second of two volumes. Volume 2 covers practical issues on diffusion phenomena in bulk, thin film, and in nanomaterials. Diffusion related problems and analyzing methods in industrial applications, such as electronic industry, high temperature materials, nuclear materials, Li-ion batteries, and superconductor materials are also discussed. Presents a handbook with a short mathematical background and detailed examples of concrete applications of the sophisticated methods of analysis Enables readers to learn the basic concepts of experimental approaches and the computational methods involved in solid-state diffusion Covers bulk, thin film, and nanomaterials Introduces the problems and analysis in important materials systems in various applications Collates contributions from academic and industrial problems from leading scientists involved in developing key concepts across the globe

This text provides a teachable and readable approach to transport phenomena (momentum, heat, and mass transport) by providing numerous examples and applications, which are particularly important to metallurgical, ceramic, and materials engineers. Because the authors feel that it is important for students and practicing engineers to visualize the physical situations, they have attempted to lead the reader through the development and solution of the relevant differential equations by applying the familiar principles of conservation to numerous situations and by including many worked examples in each chapter. The book is organized in a manner characteristic of other texts in transport phenomena. Section I deals with the properties and mechanics of fluid motion; Section II with thermal properties and heat transfer; and Section III with diffusion and mass transfer. The authors depart from tradition by building on a presumed understanding of the relationships between the structure and properties of matter, particularly in the chapters devoted to the transport properties (viscosity, thermal conductivity, and the diffusion coefficients). In addition, generous portions of the text, numerous examples, and many problems at the ends of the chapters apply transport phenomena to materials processing.

The topic of diffusion science becomes more and more important: this collection of timely papers is divided into seven chapters. The first three are dedicated to macroscopic and microscopic theories of diffusion. Volume is indexed by Thomson Reuters CPCI-S (WoS).

Handbook of Gas Diffusion in Solids and Melts
Thermodynamics, Diffusion and the Kirkendall Effect in Solids
Transformations of Materials
Electronic Materials Science
Diffusion in Solids and Liquids V
Diffusion in Solids and Liquids III
Field Theory, Solid-State Principles, and Applications
A Comparison of the Material Loss Rate from the Sphere, Cylinder, and Flat Plate