

Introduction To Phase Equilibria In Ceramics

Phase Equilibria, Phase Diagrams and Phase Transformations
Phase Equilibria in Chemical Engineering
High Temperature Phase Equilibria and Phase Diagrams
Equilibrium Between Phases of Matter
Phase Equilibria for Complex Fluid Mixtures
Introduction to Phase Equilibria in Ceramic Systems
Phase Diagrams and Heterogeneous Equilibria
Introduction to Phase Equilibria in Ceramic Systems
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Introduction to Phase Equilibria in Ceramics
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phase equilibria basic principles applications experimental techniques presents an analytical treatment in the study of the theories and principles of phase equilibria the book is organized to afford a deep and thorough understanding of such subjects as the method of species model systems condensed phase vapor phase equilibria and vapor transport reactions zone refining techniques and nonstoichiometry physicists physical chemists engineers and materials scientists will find the book a good reference material

advanced undergraduate graduate level textbook which treats the theoretical basis of chemical equilibria and chemical changes

phase equilibria in chemical engineering is devoted to the thermodynamic basis and practical aspects of the calculation of equilibrium conditions of multiple phases that are pertinent to chemical engineering processes efforts have been made throughout the book to provide guidance to adequate theory and practice the book begins with a long chapter on equations of state since it is intimately bound up with the development of thermodynamics following material on basic thermodynamics and nonidealities in terms of fugacities and activities individual chapters are devoted to equilibria primarily between pairs of phases a few topics that do not fit into these categories and for which the state of the art is not yet developed quantitatively have been relegated to a separate chapter the chapter on chemical equilibria is pertinent since many processes involve simultaneous chemical and phase equilibria also included are chapters on the evaluation of enthalpy and entropy changes of nonideal substances and mixtures and on experimental methods this book is intended as a reference and self study as well as a textbook either for full courses in phase equilibria or as a supplement to related courses in the chemical engineering curriculum practicing engineers concerned with separation technology and process design also may find the book useful

high temperature phase equilibria studies play an increasingly important role in materials science and engineering it is especially significant in the research into the properties of the material and the ways in which they can be improved this is achieved by observing equilibrium and by examining the phase relationships at high temperature the study of high temperature phase diagrams of nonmetallic systems began in the early 1900s when silica and mineral systems containing silica were focussed upon since then technical ceramics emerged and more emphasis has been placed on high temperature studies this book covers many aspects from the fundamentals of phase diagrams experimental and computational methods applications to the results of research it provides an excellent source of information for a range of scientists such as materials scientists especially ceramicists metallurgists solid state physicists and chemists and mineralogists

about the book the project equilibrium between phases of matter phenomenology and thermodynamics is a textbook in which the phenomenology the thermodynamic theory and the practical use of phase diagrams are presented in three levels that diverge in nature in particular as regards the role of thermodynamics the book has been written from a chemical and geological teaching background each of the three levels of the book is representative of a particular course in a curriculum level 0 an introduction to phase diagrams the philosophy behind the ground level is that most of the characteristics of equilibrium between phases can be understood without the use of thermodynamics realizing that in a common sense manner the experimental observations on equilibria and spontaneous changes and elementary notions about interactions indicate the way to go in spite of all this the central figure in level zero right from the beginning is the chemical potential a concept firmly rooted in thermodynamics equilibrium conditions in terms of chemical potentials and the variables necessary to define a system in equilibrium are the basic elements of the system formulation

after defining complex mixtures attention is given to the canonical procedure used for the thermodynamics of fluid mixtures first we establish a suitable idealized reference system and then we establish a perturbation or excess function which corrects the idealized system for real behavior for complex mixtures containing identified components e g alcohols ketones water discussion is directed at possible techniques for extending to complex

mixtures our conventional experience with reference systems and perturbations for simple mixtures possible extensions include generalization of the quasi chemical approximation local compositions and superposition of chemical equilibria association and solvation on a physical equation of state for complex mixtures containing unidentified components e g coal derived fluids a possible experimental method is suggested for characterization conventional procedures can then be used to calculate phase equilibria using the concept of pseudocomponents whose properties are given by the characterization data finally as an alternative to the pseudocomponent method a brief introduction is given to phase equilibrium calculations using continuous thermodynamics

written by a leading practitioner and teacher in the field of ceramic science and engineering this outstanding text provides advanced undergraduate and graduate level students with a comprehensive up to date introduction to phase equilibria in ceramic systems building upon a concise definition of the phase rule the book logically proceeds from one and two component systems through increasingly complex systems enabling students to utilize the phase rule in real applications unique because of its emphasis on phase diagrams timely because of the rising importance of ceramic applications practical because of its pedagogical approach introduction to phase equilibria in ceramic systems offers end of chapter review problems extensive reading lists a solid thermodynamic foundation and clear perspectives on the special properties of ceramics as compared to metals this authoritative volume fills a broad gap in the literature helping undergraduate and graduate level students of ceramic engineering and materials science to approach this demanding subject in a rational confident fashion in addition introduction to phase equilibria in ceramic systems serves as a valuable supplement to undergraduate level metallurgy programs

since j w gibbs in 1878 succeeded comprehensively in establishing the basic principles for an understanding of equilibria in heterogeneous systems numerous books concerning constitution diagrams have been written some of them providing a formal treatment of phase equilibria down to the small detail the purpose of the present book is to provide an introduction to the practical applications of phase diagrams in the first instance it is intended for students of chemistry metallurgy mineralogy and materials science but also for engineers and students of science and engineering disciplines concerned with materials to facilitate the start of an involvement with heterogeneous equilibria reactions and dynamic equilibria will be treated first since these are familiar to chemists and metallurgists of course a description of phase equilibria is not possible without a minimum of formalism the formalistic description however will be made lighter by clear explanations of experimental methods used to determine the constitution of a system by application examples as well as by discussing realistic cases from chemistry metallurgy materials science and mineralogy by this the necessity of the knowledge of phase diagrams can be shown on the other hand a practical exercise is possible

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this new book provides for the first time a thorough survey of the techniques and equipment for both high and low pressure phase equilibrium measurement and addresses the equally challenging task of accurately modeling or predicting the equilibria the book is unique because it combines in depth and authoritative coverage of both experimental and theoretical procedures in a single volume written as a reference for practicing engineers and scientists in the chemical engineering field this book will also be useful as an advanced graduate level text

phase equilibrium in mixtures deals with phase equilibrium and the methods of correlating checking and predicting phase data topics covered range from latent heat and vapor pressure to dilute solutions ideal and near ideal solutions and consistency tests molecular considerations and their use for the prediction and correlation of data are also discussed comprised of nine chapters this volume begins with an introduction to the role of thermodynamics and the criteria for equilibrium between phases along with fugacity and the thermodynamic functions of mixing the discussion then turns to some of the phase phenomena which may be encountered in chemical engineering practice methods of correlating and extending vapor pressure data and practical techniques for calculating latent heats from these data the behavior of dilute solutions both at low and high pressures for reacting and non reacting systems and the behavior of ideal and near ideal solutions the remaining chapters explore non ideal solutions at normal pressures practical methods for testing the thermodynamic consistency of phase data and the extent to which the broad aspects of phase behavior may be interpreted in the light of simple molecular considerations this book is intended primarily for graduate chemical engineers but should also be of interest to those graduates in physics or chemistry who need to use phase equilibrium data

high pressure phase equilibrium calculations using an equation of state are more sensitive to the mixing rules than to details in the effect of density or temperature on pressure attention must be given to the problem of how to extend equations of state to mixtures one possible technique is provided by perturbation theory another by superposition of chemical equilibria at low or moderate pressures vapor phase corrections are often important when specific intermolecular forces produce formation of molecular aggregates strong deviations from ideal gas behavior can be significant even at pressures well below 1 bar when vapor liquid equilibrium data are reduced using conventional expressions for the excess gibbs energy the resulting binary parameters tend to be partially correlated it difficult but no impossible to calculate ternary liquid liquid equilibria using binary parameters only new models for calculating properties of liquid phase mixtures must allow for changes in free volume to give consideration to the effect of mixing on changes in rotational and vibrational degrees of freedom liquid phase volumetric effects are also important in describing the solubilities of gases in solvent

mixtures therefore future liquid phase models should incorporate a liquid phase equation of state either of the van der waals type or perhaps as given by the direct correlation function theory of liquids

in the phase rule and its applications alexander findlay intricately explores the thermodynamic principles underlying the phase rule offering a comprehensive analysis of its applications across various scientific fields the book is characterized by a meticulous yet accessible literary style employing clear language supported by rigorous mathematical formulations findlay contextualizes the phase rule within the broader framework of physical chemistry demonstrating its significance in understanding phase equilibria and transitions in both simple and complex systems alexander findlay was a prominent chemist whose academic pursuits were fueled by a profound interest in the interplay between physical principles and chemical phenomena his extensive research on phase behavior in heterogeneous systems positioned him as a significant figure in the field findlay's commitment to making complex concepts approachable is evident throughout the work reflecting his belief in the importance of education in the sciences this essential text is recommended for students educators and industry professionals alike its thorough explanations and practical applications make it a vital resource for anyone seeking to deepen their understanding of thermodynamics and phase behavior in materials science

a step by step guide on how to use and interpret phase diagrams whether used as a textbook or a reference source this book is the most thorough and complete tool available for users of phase information

this work provides coverage of experimental and theoretical procedures for vapour liquid equilibria vle a survey of the different models and approaches in recent literature enables the reader to choose the appropriate action

traditionally the teaching of phase equilibria emphasizes the relationships between the thermodynamic variables of each phase in equilibrium rather than its engineering applications this book changes the focus from the use of thermodynamics relationships to compute phase equilibria to the design and control of the phase conditions that a process needs phase equilibrium engineering presents a systematic study and application of phase equilibrium tools to the development of chemical processes the thermodynamic modeling of mixtures for process development synthesis simulation design and optimization is analyzed the relation between the mixture molecular properties the selection of the thermodynamic model and the process technology that could be applied are discussed a classification of mixtures separation process thermodynamic models and technologies is presented to guide the engineer in the world of separation processes the phase condition required for a given reacting system is studied at subcritical and supercritical conditions the four cardinal points of phase equilibrium engineering are the chemical plant or process the laboratory the modeling of phase equilibria and the simulator the harmonization of all these components to obtain a better design or operation is the ultimate goal of phase equilibrium engineering methodologies are discussed using relevant industrial examples the molecular nature and composition of the process mixture is given a key role in process decisions phase equilibrium diagrams are used as a drawing board for process implementation

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