Introduction To Phase Equilibria In Ceramics

Phase Equilibria in Chemical EngineeringPhase EquilibriaIntroduction to Phase Equilibria in Ceramic SystemsPhase Equilibria, Phase Diagrams and Phase TransformationsIntroduction to Phase Equilibria in Ceramic SystemsHigh Temperature Phase Equilibria and Phase DiagramsThermodynamics of Phase Equilibria in Food EngineeringState-of-the-art Review of Phase EquilibriaPhase Equilibria: Low-Pressure Phase Equilibrium Calculations. 10. Computation of Low-Pressure Vapor-Liquid Equilibria. 11. Dew-Point, Bubble-Point, and Flash Calculations. 12. Prediction of Low-Pressure Vapor-Liquid Equilibrium. 13. Liquid-Liquid Equilibrium CalculationsClassical Thermodynamics of Nonelectrolyte SolutionsAlloy Phase EquilibriaPhase Equilibrium EngineeringPhase Equilibria for Complex Fluid MixturesPrinciples of Phase EquilibriaPhase Diagrams and Heterogeneous EquilibriaPhase EquilibriaPhase Equilibrium in MixturesThe Phase Rule and Its ApplicationsPhase Equilibria and Gas Mixtures PropertiesThe Thermodynamics of Phase and Reaction Equilibria Stanley M. Walas Arnold Reisman Hummel Mats Hillert Hummel Chu-Kun Kuo Camila Gambini Pereira J. David Raal Hendrick C. Van Ness Alan Prince Esteban Alberto Brignole F. E. W. Wetmore Bruno Predel Andre Muhlbauer M. B. King Alexander Findlay Ismail Tosun

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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

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

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

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

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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

thermodynamics of phase equilibria in food engineering is the definitive book on thermodynamics of equilibrium applied to food engineering food is a complex matrix consisting of different groups of compounds divided into macronutrients lipids carbohydrates and proteins and micronutrients vitamins minerals and phytochemicals the quality characteristics of food products associated with the sensorial physical and microbiological attributes are directly related to the thermodynamic properties of specific compounds and complexes that are formed during processing or by the action of diverse interventions such as the environment biochemical reactions and others in addition in obtaining bioactive

substances using separation processes the knowledge of phase equilibria of food systems is essential to provide an efficient separation with a low cost in the process and high selectivity in the recovery of the desired component this book combines theory and application of phase equilibria data of systems containing food compounds to help food engineers and researchers to solve complex problems found in food processing it provides support to researchers from academia and industry to better understand the behavior of food materials in the face of processing effects and to develop ways to improve the quality of the food products presents the fundamentals of phase equilibria in the food industry describes both classic and advanced models including cubic equations of state and activity coefficient encompasses distillation solid liquid extraction liquid liquid extraction adsorption crystallization and supercritical fluid extraction explores equilibrium in advanced systems including colloidal electrolyte and protein systems

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 mist 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

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

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

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

since j w gibbs in 1878 succeeded comprehensively in establishing the basic principles for an understanding of equilibria in heterogeneous systems numer ous 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 ap plications 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 mini mum of formalism the formalistic description however will be made lighter by clear explanations of experimental methods used to determine the constitu tion of a system by application examples as well as by discussing realistic cas es from chemistry metallurgy materials science and mineralogy by this the ne cessity of the knowledge of phase diagrams can be shown on the other hand a practical exercise is possible

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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

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 Äôs 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

this book provides a sound foundation for understanding abstract concepts of phase and reaction equilibria e g partial molar gibbs energy fugacity and activity and shows how to apply these concepts to solve practical problems using numerous clear examples it also presents numerical methods necessary for solving real world problems as well the basic mathematics needed facilitating its use as a self study reference work in the example problems requiring mathcad for the solution the results of the intermediate steps are given enabling the reader to easily track mistakes and understand the order of magnitude of the various quantities involved clear layout coherent and logical organization of the content and presentation suitable for self study provides analytical equations in dimensionless form for the calculation of changes in internal energy enthalpy and entropy as well as departure functions and fugacity coefficients includes up to date information comprehensive in depth content and current examples in each chapter includes many well organized problems with answers which are extensions of the examples enabling conceptual understanding for quantitative real problem solving includes the mathematical background required for solving problems encountered in phase and reaction equilibria

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