Introduction To Phase Equilibria In Ceramics

Phase Equilibria in Chemical EngineeringPhase EquilibriaPhase Equilibria, Phase Diagrams and Phase TransformationsHigh Temperature Phase Equilibria and Phase DiagramsIntroduction to Phase Equilibria in Ceramic SystemsEquilibrium Between Phases of MatterPhase Diagrams and Heterogeneous EquilibriaPhase EquilibriaIntroduction to Phase Equilibria in CeramicsClassical Thermodynamics of Nonelectrolyte SolutionsPrinciples 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 CalculationsAlloy Phase EquilibriaPhase Equilibria for Complex Fluid MixturesPhase Equilibria DiagramsPhase Equilibrium EngineeringPrinciples of phase equilibriaMolecular Thermodynamics of Fluid-phase EquilibriaPhase EquilibriaPhase Equilibrium in Mixtures Stanley M. Walas Arnold Reisman Mats Hillert Chu-Kun Kuo Hummel H.A.J. Oonk Bruno Predel Andreas L. Muhlbauer Clifton G. Bergeron Hendrick C. Van Ness F. E. W. Wetmore J. David Raal Alan Prince American Ceramic Society Esteban Alberto Brignole F.E.W. Wetmore J. M. Prausnitz Arnold Reisman M. B. King

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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

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

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

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

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 are the basic elements of the system formulation

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

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

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 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

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

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

97774 4 the classic guide to mixtures completely updated with new models theories examples and data efficient separation operations and many other chemical processes depend upon a thorough understanding of the properties of gaseous and liquid mixtures molecular thermodynamics of fluid phase equilibria third edition is a systematic practical guide to interpreting correlating and predicting thermodynamic properties used in mixture related phase equilibrium calculations completely updated this edition reflects the growing maturity of techniques grounded in applied statistical thermodynamics and molecular simulation while relying on classical thermodynamics molecular physics and physical chemistry wherever these fields offer superior solutions detailed new coverage includes techniques for improving separation processes and making them more environmentally friendly theoretical concepts enabling the description and interpretation of solution properties new models notably the lattice fluid and statistical associated fluid theories polymer solutions including gas polymer equilibria polymer blends membranes and gels electrolyte solutions including semi empirical models for solutions containing salts or volatile electrolytes coverage also includes

fundamentals of classical thermodynamics of phase equilibria thermodynamic properties from volumetric data intermolecular forces fugacities in gas and liquid mixtures solubilities of gases and solids in liquids high pressure phase equilibria virial coefficients for quantum gases and much more throughout molecular thermodynamics offluid phase equilibria strikes a perfect balance between empirical techniques and theory and is replete with useful examples and experimental data more than ever it is the essential resource for engineers chemists and oth

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

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