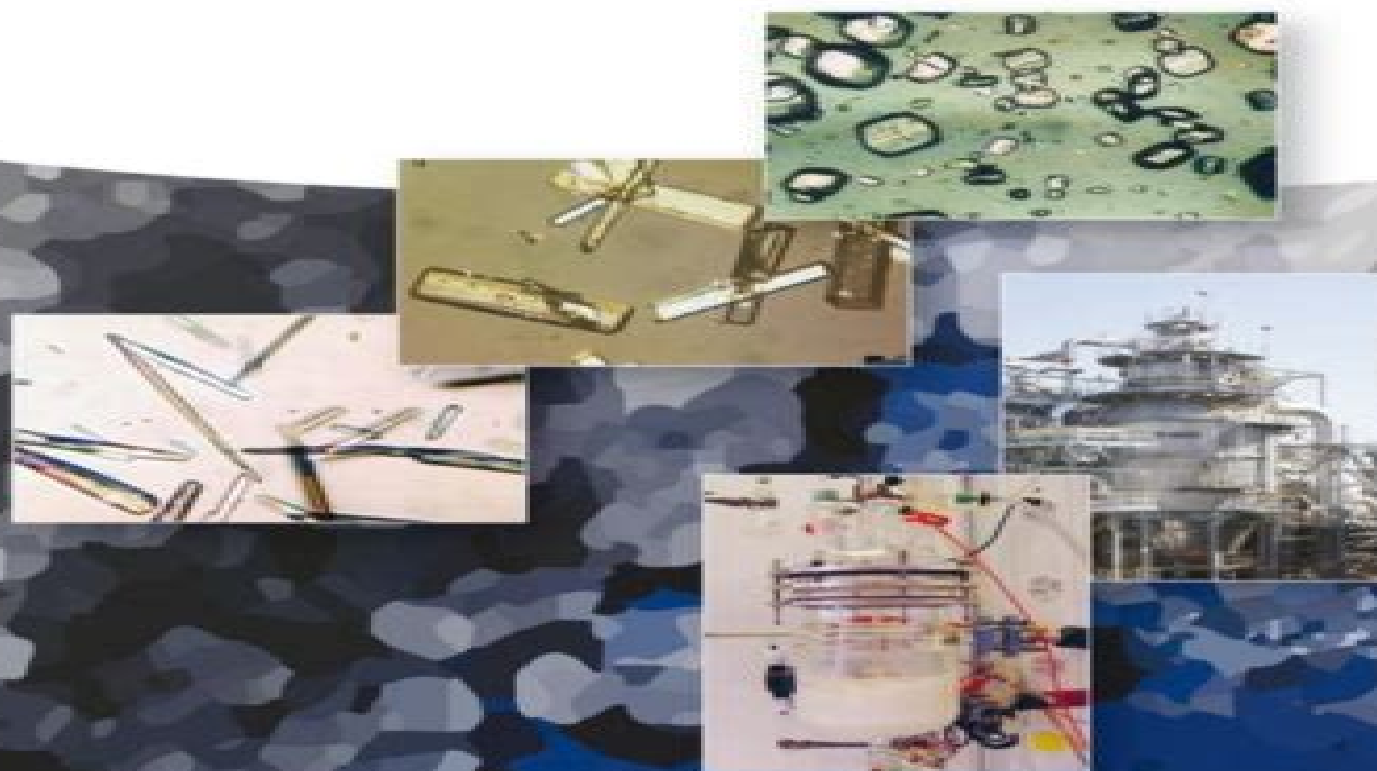


Edited by
Wolfgang Beckmann

Crystallization

Basic Concepts and Industrial Applications



Crystallization Basic Concepts And Industrial Applications

Heike Lorenz,Erik Temmel



Crystallization Basic Concepts And Industrial Applications:

Crystallization Wolfgang Beckmann, 2013-01-14 Crystallization is a natural occurring process but also a process abundantly used in the industry Crystallization can occur from a solution from the melt or via deposition of material from the gas phase desublimation Crystals distinguish themselves from liquids gases and amorphous substances by the long range order of its building blocks that entail the crystals to be formed of well defined faces and give rise to a large number of properties of the solid Crystallization is used at some stage in nearly all process industries as a method of production purification or recovery of solid materials Crystallization is practiced on all scales from the isolation of the first milligrams of a newly synthesized substance in the research laboratory to isolating products on the multi million tonne scale in industry The book describes the breadth of crystallization operations from isolation from a reaction broth to purification and finally to tailoring product properties In the first section of the book the basic mechanisms nucleation growth attrition and agglomeration are introduced It ensures an understanding of supersaturation the driving force of crystallization Furthermore the solubility of the substance and its dependences on process conditions and the various techniques of crystallization and their possibilities and limitations are discussed Last but not least the first part includes an intensive treatment of polymorphism The second part builds on the basics exploring how crystallization processes can be developed either batch wise or continuous from solution or from the melt A discussion of the purification during crystallization serves as a link between the two sections where practical aspects and an insight using theoretical concepts are combined Mixing and its influence on the crystallization as well as the mutual interference of downstream processes with the crystallization are also treated Finally techniques to characterize the crop are discussed The third part of the book is dedicated to accounts of actual developments and of carried out crystallizations Typical pitfalls and strategies to avoid these as well as the design of robust processes are presented

Industrial Crystallization Alison Lewis, Marcelo Seckler, Herman Kramer, Gerda van Rosmalen, 2015-07-02 Bridging the gap between theory and practice this text provides the reader with a comprehensive overview of industrial crystallization Newcomers will learn all of the most important topics in industrial crystallization from key concepts and basic theory to industrial practices Topics covered include the characterization of a crystalline product and the basic process design for crystallization as well as batch crystallization measurement techniques and details on precipitation melt crystallization and polymorphism Each chapter begins with an introduction explaining the importance of the topic and is supported by homework problems and worked examples Real world case studies are also provided as well as new industry relevant information making this is an ideal resource for industry practitioners students and researchers in the fields of industrial crystallization separation processes particle synthesis and particle technology

Conceptual Design of Crystallization Processes Christiano Wibowo, Ka Ming Ng, 2020-11-23 The book presents in a unified manner various crystallization design methods It discusses in detail the geometric framework for representing complex phase behavior

involving multiple solutes enantiomers hydrates compounds polymorphs and solid solutions through visualization of high dimensional phase diagrams It also describes how the impact of transport processes is accounted for using kinetically controlled process paths

Advances in Industrial Crystallization Heike Lorenz,Erik Temmel,2021-06-15 This Special Issue is result of a call for papers of the Section Industrial Crystallization of MDPI s scientific journal Crystals It addresses scientists and engineers active in research and process product development in life science industries e g pharmaceuticals fine chemicals and biotechnology products and bulk chemical applications e g desalination as well The contributions comprise several fundamental and application oriented facets of crystallization providing an overview of industrially relevant subjects in the field Main issues cover phase equilibria and solid state behavior of crystalline compounds crystal shape and size and related measurement techniques Melt and solution crystallization are considered specifically addressing contemporary aspects of continuous crystallization and process intensification

Food Processing Kshirod Kumar Dash,Sourav Chakraborty,2021-06-27 In food processing thermal operations are the most common and conventional methods for obtaining and treating different products This book covers basics and advances in thermal processing of food These include drying processes evaporation blanching deep fat frying crystallization extraction and ohmic heating in terms of food engineering and process design aspect It further describes theoretical aspects the basics of rate kinetics and their application for the analysis of food quality indices including practical oriented issues related to food technology Traditional and new extraction techniques are also covered Key features Presents engineering focus on thermal food processing technologies Discusses sub classification for recent trends and relevant industry information examples Different current research oriented results are included as a key parameter Covers advances in drying evaporation blanching crystallization and ohmic heating Includes mathematical modeling and numerical simulations Food Processing Advances in Thermal Technologies is aimed at graduate students and professionals in food engineering food technology and biological systems engineering

SME Mineral Processing and Extractive Metallurgy Handbook Courtney A. Young,2019-02-01 This landmark publication distills the body of knowledge that characterizes mineral processing and extractive metallurgy as disciplinary fields It will inspire and inform current and future generations of minerals and metallurgy professionals Mineral processing and extractive metallurgy are atypical disciplines requiring a combination of knowledge experience and art Investing in this trove of valuable information is a must for all those involved in the industry students engineers mill managers and operators More than 192 internationally recognized experts have contributed to the handbook s 128 thought provoking chapters that examine nearly every aspect of mineral processing and extractive metallurgy This inclusive reference addresses the magnitude of traditional industry topics and also addresses the new technologies and important cultural and social issues that are important today Contents Mineral Characterization and Analysis Management and Reporting Comminution Classification and Washing Transport and Storage Physical Separations Flotation Solid and Liquid

Separation Disposal Hydrometallurgy Pyrometallurgy Processing of Selected Metals Minerals and Materials Industrial Separation Processes André B. de Haan, H. Burak Eral, Boelo Schuur, 2020-07-06 Separation processes on an industrial scale account for well over half of the capital and operating costs in the chemical industry Knowledge of these processes is key for every student of chemical or process engineering This book is ideally suited to university teaching thanks to its wealth of exercises and solutions The second edition boasts an even greater number of applied examples and case studies as well as references for further reading *Solid-Liquid Separation Technologies* Olayinka I. Ogunsola, Isaac K. Gamwo, 2022-04-18 This book presents recent research and advances in various solid liquid separation technologies and some applications for treating produced water It covers fundamental principles and the importance of produced water in major industrial sectors and compares solid liquid separation technologies In addition this book Presents the results of research studies conducted to evaluate the performance of solid liquid separation technologies Discusses a wide range of technologies including membrane filtration crystallization desalination supercritical fluids coagulation and floatation Includes experimental theoretical modeling and process design studies With its comprehensive coverage this book is an essential reference for chemical researchers scientists and engineers in industry academia and professional laboratories It is also an important resource for graduate and advanced undergraduate students studying solid liquid separations Industrial Chemical Separation Timothy C. Frank, Bruce S. Holden, 2023-08-07 A fresh new treatment written by industry insiders this work gives readers a remarkably clear view into the world of chemical separation The authors review distillation extraction adsorption crystallization and the use of membranes providing historical perspective explaining key features and offering insights from personal experience The book is for engineers and chemists with current or future responsibility for chemical separation on a commercial scale in its design operation or improvement or for anyone wanting to learn more about chemical separation from an industrial point of view The result is a compelling survey of popular technologies and the profession one that brings the art and craft of chemical separation to life Ever wonder how popular separation technologies came about how a particular process functions or how mass transfer units differ from theoretical stages Or perhaps you want some pointers on how to begin solving a separation problem You will find clear explanations and valuable insights into these and other aspects of industrial practice in this refreshing new survey *Separation Process Engineering* Phillip C. Wankat, 2022-10-24 The Definitive Learner Friendly Guide to Chemical Engineering Separations Extensively Updated Including a New Chapter on Melt Crystallization Efficient separation processes are crucial to addressing many societal problems from developing new medicines to improving energy efficiency and reducing emissions Separation Process Engineering Fifth Edition is the most comprehensive accessible guide to modern separation processes and the fundamentals of mass transfer In this completely updated edition Phillip C Wankat teaches each key concept through detailed realistic examples using actual data with up to date simulation practice spreadsheet based exercises and references Wankat thoroughly covers each separation process

including flash column and batch distillation exact calculations and shortcut methods for multicomponent distillation staged and packed column design absorption stripping and more His extensive discussions of mass transfer and diffusion enable faculty to teach separations and mass transfer in a single course And detailed material on liquid liquid extraction adsorption chromatography and ion exchange prepares students for advanced work New and updated content includes melt crystallization steam distillation residue curve analysis batch washing the Shanks system for percolation leaching eutectic systems forward osmosis microfiltration and hybrid separations A full chapter discusses economics and energy conservation including updated equipment costs Over 300 new and updated homework problems are presented all extensively tested in undergraduate courses at Purdue University New chapter on melt crystallization solid liquid phase equilibrium suspension static and falling film layer approaches and 34 questions and problems New binary VLE equations and updated content on simultaneous solutions New coverage of safety and fire hazards New material on steam distillation simple multi component batch distillation and residue curve analysis Expanded discussion of tray efficiencies packed column design and energy reduction in distillation New coverage of two hybrid extraction with distillation and the Kremser equation in fractional extraction Added sections on deicing with eutectic systems eutectic freeze concentration and scale up New sections on forward osmosis and microfiltration Expanded advanced content on adsorption and ion exchange including updated instructions for eight detailed Aspen Chromatography labs Discussion of membrane separations including gas permeation reverse osmosis ultrafiltration pervaporation and applications Thirteen up to date Aspen Plus process simulation labs adaptable to any simulator This guide reflects an up to date understanding of how modern students learn designed organized and written to be exceptionally clear and easy to use It presents detailed examples in a clear standard format using real data to solve actual engineering problems preparing students for their future careers

Chemical Processes for a Sustainable Future Trevor Letcher, Janet Scott, Darrell Patterson, 2015-11-09 This comprehensive book approaches sustainability from two directions the reduction of pollution and the maintaining of existing resources both of which are addressed in a thorough examination of the main chemical processes and their impact Divided into five sections each introduced by a leading expert in the field the book takes the reader through the various types of chemical processes demonstrating how we must find ways to lower the environmental cost of both pollution and contributions to climate change of producing chemicals Each section consists of several chapters presenting the latest facts and opinion on the methodologies being adopted by the chemical industry to provide a more sustainable future A follow up to Materials for a Sustainable Future Royal Society of Chemistry 2012 this book will appeal to the same broad readership industrialists and investors policy makers in local and central governments students teachers scientists and engineers working in the field and finally editors journalists and the general public who need information on the increasingly popular concepts of sustainable living

Handbook of Continuous Crystallization Nima Yazdanpanah, Zoltan K Nagy, 2020-02-04 Continuous

crystallization is an area of intense research with particular respect to the pharmaceutical industry and fine chemicals. Improvements in continuous crystallization technologies offer chemical industries significant financial gains through reduced expenditure and operational costs and consistent product quality. Written by well known leaders in the field, *The Handbook of Continuous Crystallization* presents fundamental and applied knowledge with attention paid to application and scaling up and the burgeoning area of process intensification. Beginning with concepts around crystallization techniques and control strategies, the reader will learn about experimental methods and computational tools. Case studies spanning fine and bulk chemicals, the pharmaceutical industry and employing new mathematical tools put theory into context. **Continuous**

Manufacturing of Pharmaceuticals Peter Kleinebudde, Johannes Khinast, Jukka Rantanen, 2024-10-28. A comprehensive look at existing technologies and processes for continuous manufacturing of pharmaceuticals. As rising costs outpace new drug development, the pharmaceutical industry has come under intense pressure to improve the efficiency of its manufacturing processes. Continuous process manufacturing provides a proven solution. Among its many benefits are minimized waste, energy consumption and raw material use, the accelerated introduction of new drugs, the use of smaller production facilities with lower building and capital costs, the ability to monitor drug quality on a continuous basis and enhanced process reliability and flexibility. *Continuous Manufacturing of Pharmaceuticals* prepares professionals to take advantage of that exciting new approach to improving drug manufacturing efficiency. This book covers key aspects of the continuous manufacturing of pharmaceuticals. The first part provides an overview of key chemical engineering principles and the current regulatory environment. The second covers existing technologies for manufacturing both small molecule based products and protein peptide products. The following section is devoted to process analytical tools for continuously operating manufacturing environments. The final two sections treat the integration of several individual parts of processing into fully operating continuous process systems and summarize state of art approaches for innovative new manufacturing principles. Brings together the essential know how for anyone working in drug manufacturing as well as chemical food and pharmaceutical scientists working on continuous processing. Covers chemical engineering principles, regulatory aspects, primary and secondary manufacturing, process analytical technology and quality by design. Contains contributions from researchers in leading pharmaceutical companies, the FDA and academic institutions. Offers an extremely well informed look at the most promising future approaches to continuous manufacturing of innovative pharmaceutical products. Timely, comprehensive and authoritative. *Continuous Manufacturing of Pharmaceuticals* is an important professional resource for researchers in industry and academia working in the fields of pharmaceuticals development and manufacturing. Process Technology André B. de Haan, 2015-04-24. *Process Technology* provides a general overview about chemical and biochemical process technology. It focuses on the structure and development of production processes, main technological operations and the important aspects of process economics. The theoretical foundations in each chapter are supplemented by case studies.

and examples in a clear and instructive manner to illustrate the practical aspects The author highlights operating principles reasons for application and available industrial equipment of technological operations Aim is to facilitate those without a process technology background in multi disciplinary cooperation with bio chemical engineers by providing an overview of this exciting field The textbook is organized into seven distinct parts Structure of the chemical industry and bio chemical processes Bio Chemical reaction engineering Molecular separations distillation extraction absorption adsorption Mechanical separations filtration sedimentation membranes Particle and final product manufacturing Development scale up design and safety of processes Major industrial process descriptions **Purification of Laboratory Chemicals** W.L.F.

Armarego,2022-08-27 Purification of Laboratory Chemicals Part One Physical Techniques Chemical Techniques Organic Chemicals Ninth Edition describes contemporary methods for the purification of chemical compounds The work includes tabulated methods taken from literature for purifying thousands of individual commercially available chemical substances To help in applying this information the more common processes currently used for purification in chemical laboratories and new methods are discussed For dealing with substances not separately listed another chapter is included setting out the usual methods for purifying specific classes of compounds Laboratory workers whether carrying out research or routine work will invariably need to consult this book Apart from the procedures described the large amount of physical data about listed chemicals is essential This fully updated revised and expanded new edition includes the purification of many new substances that have been available commercially since 2017 along with previously available substances which have found new applications Features empirical formulae and formula weights for every entry References all important applications of each substance Includes updated CAS registry numbers Covers the latest commercial chemical products including pharmaceutical chemicals and safety hazard materials Provides expanded coverage of laboratory work practices and purification methods

Coulson and Richardson's Chemical Engineering Sohrab Rohani,2017-08-23 Coulson and Richardson s Chemical Engineering Volume 3B Process Control Fourth Edition covers reactor design flow modeling and gas liquid and gas solid reactions and reactors Converted from textbooks into fully revised reference material Content ranges from foundational through to technical Added emerging applications numerical methods and computational tools *Biomaterials and Biopolymers* Avi Domb,Boaz Mizrahi,Shady Farah,2023-09-22 This book is written to serve as textbook on biomaterials and biopolymers for faculty and students and thus contains a broad introduction and basic terms followed by major developments over the years with some emphasis on recent developments and future prospects It provide a comprehensive overview in biomaterials and biopolymers All relevant aspects of modern biomaterials including synthesis and characterization biocompatibility and host response the implementation of novel manufacturing processes and advanced medical and biotechnological applications Each chapter provides an overview of a specific field its importance the chemistry of biomaterials and the relations between chemical structure and the applications Each chapter ends with a future prospective

concepts and a friendly quiz multiple answer questions with answers that serves as a resource to provide guided additional practice **Process Engineering** Michael Kleiber,2020-04-20 This book provides a comprehensive introduction to chemical process engineering linking the fundamental theory and concepts to the industrial practice This 2nd Edition contains new chapters on biological wastewater treatment dynamic simulation and PID discussion It enables the reader to integrate fundamental knowledge of the basic disciplines to understand key chemical processes and to apply this knowledge to the practice in industry *Solid State Development and Processing of Pharmaceutical Molecules* Michael Gruss,2021-09-14

Solid State Development and Processing of Pharmaceutical Molecules A guide to the latest industry principles for optimizing the production of solid state active pharmaceutical ingredients *Solid State Development and Processing of Pharmaceutical Molecules* is an authoritative guide that covers the entire pharmaceutical value chain The authors noted experts on the topic examine the importance of the solid state form of chemical and biological drugs and review the development production quality control formulation and stability of medicines The book explores the most recent trends in the digitization and automation of the pharmaceutical production processes that reflect the need for consistent high quality It also includes information on relevant regulatory and intellectual property considerations This resource is aimed at professionals in the pharmaceutical industry and offers an in depth examination of the commercially relevant issues facing developers producers and distributors of drug substances This important book Provides a guide for the effective development of solid drug forms Compares different characterization methods for solid state APIs Offers a resource for understanding efficient production methods for solid state forms of chemical and biological drugs Includes information on automation process control and machine learning as an integral part of the development and production workflows Covers in detail the regulatory and quality control aspects of drug development Written for medicinal chemists pharmaceutical industry professionals pharma engineers solid state chemists chemical engineers *Solid State Development and Processing of Pharmaceutical Molecules* reviews information on the solid state of active pharmaceutical ingredients for their efficient development and production

Handbook of Crystal Growth Peter Rudolph,2014-11-04 Vol 2A Basic Technologies*Handbook of Crystal Growth* Second Edition Volume IIA Basic Technologies presents basic growth technologies and modern crystal cutting methods Particularly the methodical fundamentals and development of technology in the field of bulk crystallization on both industrial and research scales are explored After an introductory chapter on the formation of minerals ruling historically the basic crystal formation parameters advanced basic technologies from melt solution and vapour being applied for research and production of the today most important materials like silicon semiconductor compounds and oxides are presented in detail The interdisciplinary and general importance of crystal growth for human live are illustrated Vol 2B Growth Mechanisms and Dynamics*Handbook of Crystal Growth* Second Edition Volume IIB Growth Mechanisms and Dynamics deals with characteristic mechanisms and dynamics accompanying each bulk crystal growth method discussed in Volume IIA Before the

atoms or molecules pass over from a position in the fluid medium gas melt or solution to their place in the crystalline face they must be transported in the fluid over macroscopic distances by diffusion buoyancy driven convection surface tension driven convection and forced convection rotation acceleration vibration magnetic mixing Further the heat of fusion and the part carried by the species on their way to the crystal by conductive and convective transport must be dissipated in the solid phase by well organized thermal conduction and radiation to maintain a stable propagating interface Additionally segregation and capillary phenomena play a decisional role for chemical composition and crystal shaping respectively Today the increase of high quality crystal yield its size enlargement and reproducibility are imperative conditions to match the strong economy

Volume 2A Presents the status and future of Czochralski and float zone growth of dislocation free silicon Examines directional solidification of silicon ingots for photovoltaics vertical gradient freeze of GaAs CdTe for HF electronics and IR imaging as well as antiferromagnetic compounds and super alloys for turbine blades Focuses on growth of dielectric and conducting oxide crystals for lasers and non linear optics Topics on hydrothermal flux and vapour phase growth of III nitrides silicon carbide and diamond are explored

Volume 2B Explores capillarity control of the crystal shape at the growth from the melt Highlights modeling of heat and mass transport dynamics Discusses control of convective melt processes by magnetic fields and vibration measures Includes imperative information on the segregation phenomenon and validation of compositional homogeneity Examines crystal defect generation mechanisms and their controllability Illustrates proper automation modes for ensuring constant crystal growth process Exhibits fundamentals of solution growth gel growth of protein crystals growth of superconductor materials and mass crystallization for food and pharmaceutical industries

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