

multiphase flow in polymer processing

[#multiphase flow in polymers](#) [#polymer processing optimization](#) [#rheology of polymer melts](#) [#extrusion flow analysis](#) [#composite material manufacturing](#)

Understanding multiphase flow in polymer processing is crucial for optimizing manufacturing efficiency and product quality. This phenomenon involves the interaction of multiple phases—such as polymer melts, gases, and solid fillers—within processing equipment, significantly influencing material properties and final product performance. Mastering these complex fluid dynamics is key to innovation in polymer engineering and advanced material development.

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Multiphase Flow in Polymer Processing

Multiphase Flow in Polymer Processing focuses on dispersed and stratified multiphase flow in polymer processing. This book explores the rheological behavior of multiphase (or multicomponent) polymeric systems as they are involved in various fabrication operations. It also outlines the importance of the morphological states of multiphase polymeric systems to explain the systems, rheological behavior in the fluid state, and mechanical behavior in the solid state. This monograph consists of eight chapters divided into two parts. After discussing dispersed and stratified multiphase flow in polymer processing, it introduces the reader to the fundamentals of rheology. The following chapters focus on the rheological behavior of particulate-filled polymeric systems and heterogeneous polymeric systems; the phenomenon of droplet breakup in dispersed flow; and gas-charged polymeric systems. The role of the discrete phase (that is, solid particles, liquid droplets, gas bubbles) in determining the bulk rheological properties of the multiphase system is highlighted, along with some representative polymer processing operations (namely, fiber spinning and injection molding) of the multiphase (or multicomponent) polymeric systems. Coextrusion in cylindrical, rectangular, and annular dies is also considered. The final chapter is devoted to the phenomenon of interfacial instability in coextrusion. This text will be a useful resource for chemists, chemical engineers, and those in the polymer processing industry.

Current Topics in Polymer Science: Rheology and polymer processing, multiphase systems

Experts in rheology and polymer processing present up-to-date, fundamental and applied information on the rheological properties of polymers, in particular those relevant to processing, contributing to the physical understanding and the mathematical modelling of polymer processing sequences. Basic concepts of non-Newtonian fluid mechanics, micro-rheological modelling and constitutive modelling are reviewed, and rheological measurements are described. Topics with practical relevance are debated, such as linear viscoelasticity, converging and diverging flows, and the rheology of multiphase systems.

Approximation methods are discussed for the computer modelling of polymer melt flow. Subsequently, polymer processing technologies are studied from both simulation and engineering perspectives. Mixing, crystallization and reactive processing aspects are also included. Audience: An integrated and complete view of polymer processing and rheology, important to institutions and individuals engaged in the characterisation, testing, compounding, modification and processing of polymeric materials. Can also support academic polymer processing engineering programs.

Rheological Fundamentals of Polymer Processing

This volume of the Advances in Engineering Fluid Mechanics Series covers topics in hydrodynamics related to polymerization of elastomers and plastics. Emphasis is given to advanced concepts in multiphase reactor systems often used in the manufacturing of products. This volume is comprised of 30 chapters that address key subject areas such as multiphase mixing concepts, multicomponent reactors and the hydrodynamics associated with their operations, and slurry flow behavior associated with non-Newtonian flows.

Advances in Engineering Fluid Mechanics: Multiphase Reactor and Polymerization System Hydr

FROM THE PREFACE Almost all polymeric systems are subjected to a flow field at least once along the route between preparation and application. . . . There is also an increased interest in predictive models on phase behavior and suitable techniques for characterizing the structure of these systems when subjected to flow. Multiphase polymeric systems are particularly susceptible to flow, which may cause orientation of species, morphological changes, and phase transitions. All these events may, in turn, affect the end product properties, such as permeability, electrical conductivity, [and] mechanical properties. In processing, escalating needs have evolved for optimization and development of novel and more uniform product properties and increased productivity. In order to arrive at an understanding of processing polymeric systems under elastic flow conditions, it is convenient to analyze the basic physical mechanisms under conditions that enable development of predictive models in conjunction with controlled experimentation. . . . In recent years, the science of rheo-physics has evolved and now involves both advanced theories and experimental techniques. Rheo-physics means the rheological, morphological, and thermodynamic behavior of structured polymer systems during flow. . . . In this monograph, the rheo-optical techniques are . . . emphasized. The book gives an introduction to rheo-physics, including fundamentals of theories, and a representative selection of applications of rheo-optical techniques for analyzing multiphase systems. The chapters contain both practical advice for the new experimenter . . . as well as review material for the experienced scientist.

Rheo-Physics of Multiphase Polymer Systems

Micro- and Nanostructured Multiphase Polymer Blend Systems: Phase Morphology and Interfaces focuses on the formation of phase morphology in polymer blends and copolymers and considers various types of blends including thermosets, thermoplastics, thermoplastic vulcanizates, and structured copolymers. The book carefully debates the processing

Micro- and Nanostructured Multiphase Polymer Blend Systems

Thoroughly revised edition of the classic text on polymer processing The Second Edition brings the classic text on polymer processing thoroughly up to date with the latest fundamental developments in polymer processing, while retaining the critically acclaimed approach of the First Edition. Readers are provided with the complete panorama of polymer processing, starting with fundamental concepts through the latest current industry practices and future directions. All the chapters have been revised and updated, and four new chapters have been added to introduce the latest developments. Readers familiar with the First Edition will discover a host of new material, including: * Blend and alloy microstructuring * Twin screw-based melting and chaotic mixing mechanisms * Reactive processing * Devolatilization--theory, mechanisms, and industrial practice * Compounding--theory and industrial practice * The increasingly important role of computational fluid mechanics * A systematic approach to machine configuration design The Second Edition expands on the unique approach that distinguishes it from comparative texts. Rather than focus on specific processing methods, the authors assert that polymers have a similar experience in any processing machine and that these experiences can be described by a set of elementary processing steps that prepare the polymer for any of the shaping methods. On the other hand, the authors do emphasize the unique features of particular polymer processing methods and machines, including the particular elementary step and shaping mechanisms

and geometrical solutions. Replete with problem sets and a solutions manual for instructors, this textbook is recommended for undergraduate and graduate students in chemical engineering and polymer and materials engineering and science. It will also prove invaluable for industry professionals as a fundamental polymer processing analysis and synthesis reference.

Principles of Polymer Processing

Today, fiber reinforced composites are in use • properties of different component (fiber, in a variety of structures, ranging from space matrix, filler) materials; craft and aircraft to buildings and bridges. • manufacturing techniques; This wide use of composites has been facilitated by the introduction of new materials, • analysis and design; aided by the introduction of new materials, • testing; improvements in manufacturing processes • mechanically fastened and bonded joints; and developments of new analytical and test • repair; ing methods. Unfortunately, information on • damage tolerance; these topics is scattered in journal articles, in • environmental effects; conference and symposium proceedings, in and disposal; • health, safety, reuse, workshop notes, and in government and com • applications in: many reports. This proliferation of the source - aircraft and spacecraft; material, coupled with the fact that some of - land transportation; the relevant publications are hard to find or - marine environments; are restricted, makes it difficult to identify and - biotechnology; obtain the up-to-date knowledge needed to - construction and infrastructure; utilize composites to their full advantage. - sporting goods. This book intends to overcome these difficulties. Each chapter, written by a recognized expert, contributes by presenting, in a single volume, is self-contained, and contains many of the many of the recent advances in the field of 'state-of-the-art' techniques required for practical composite materials. The main focus of this practical applications of composites.

Handbook of Composites

At the VIIth International Congress on Rheology, which was held in Goteborg in 1976, Proceedings were for the first time printed in advance and distributed to all participants at the time of the Congress. Although of course we Italians would be foolish to even try to emulate our Swedish friends as far as efficiency of organization is concerned, we decided at the very beginning that, as far as the Proceedings were concerned, the VIIIth International Congress on Rheology in Naples would follow the standards of time liness set by the Swedish Society of Rheology. This book is the result we have obtained. We wish to acknowledge the cooperation of Plenum Press in producing it within the very tight time schedule available. Every four years, the International Congress on Rheology represents the focal point where all rheologists meet, and the state of the art is brought up to date for everybody interested; the Proceedings represent the written record of these milestones of scientific progress in rheology. We have tried to make use of the traditions of having invited lectures, and of leaving to the organizing committee the freedom to choose the lecturers as they see fit, in order to collect a group of invited lectures which gives as broad as possible a landscape of the state of the art in every relevant area of rheology. The seventeen invited lectures are collected in the first volume of the proceedings.

Rheology

Multiphase polymeric systems include a wide range of materials such as composites, blends, alloys, gels, and interpenetrating polymer networks (IPNs). A one-stop reference on multiphase polymer systems, this book fully covers the preparation, properties, and applications of advanced multiphase systems from macro to nano scales. Edited by well-respected academics in the field of multiphase polymer systems, the book includes contributions from leading international experts. An essential resource for plastic and rubber technologists, filler specialists and researchers in fields studying thermal and electrical properties.

Handbook of Multiphase Polymer Systems

P. S. HOPE and M. J. FOLKES Mixing two or more polymers together to produce blends or alloys is a well-established strategy for achieving a specified portfolio of physical properties, without the need to synthesise specialised polymer systems. The subject is vast and has been the focus of much work, both theoretical and experimental. Much of the earlier work in this field was necessarily empirical and many of the blends produced were of academic rather than commercial interest. The manner in which two (or more) polymers are compounded together is of vital importance in controlling the properties of blends. Moreover, particularly through detailed rheological studies, it is becoming apparent that processing can provide a wide range of blend microstructures. In an extreme, this is exemplified by the in situ formation of fibres resulting from the imposition of predetermined flow fields on blends,

when in the solution or melt state. The microstructures produced in this case transform the blend into a true fibre composite; this parallels earlier work on the deformation of metal alloys. This type of processing-structure-property correlation opens up many new possibilities for innovative applications; for example, the production of stiff fibre composites and blends having anisotropic transport properties, such as novel membranes. This book serves a dual purpose.

Polymer Blends and Alloys

Discover the cutting-edge in multiphase flows used in the process industries In *Multiphase Flows for Process Industries: Fundamentals and Applications*, a team of accomplished chemical engineers delivers an insightful and complete treatment of the state-of-the-art in commonly encountered multiphase flows in the process industries. After discussing the theoretical background, experimental methods, and computational methods applicable to multiphase flows, the authors explore specific examples from the process industries. The book covers a wide range of multiphase flows, including gas-solid fluidized beds and flows with phase change. It also provides direction on how to use current advances in the field to realize efficient and optimized processes. Filling the gap between theory and practice, this unique reference also includes: A thorough introduction to multiphase flows and the process industry Practical discussions of flow regimes, lower order models and correlations, and the chronological development of mathematical models for multiphase flows Comprehensive explorations of experimental methods for characterizing multiphase flows, including flow imaging and visualization In-depth examinations of computational models for simulating multiphase flows Perfect for chemical and process engineers, *Multiphase Flows for Process Industries: Fundamentals and Applications* is required reading for graduate and doctoral students in the engineering sciences, as well as professionals in the chemical industry.

Polymer Rheology and Processing

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Multiphase Flows for Process Industries, 2 Volume Set

Polymer Processing Instabilities: Control and Understanding offers a practical understanding of the various flows that occur during the processing of polymer melts. The book pays particular attention to flow instabilities that affect the rate of production and the methods used to prevent and eliminate flow instabilities in order to increase production rates and enhance manufacturing efficiency. *Polymer Processing Instabilities: Control and Understanding* summarizes experimental observations of flow instabilities that occur in numerous processing operations such as extrusion, injection molding, fiber spinning, film casting, and film blowing for a wide range of materials, including most commodity polymers that are processed as melts at temperatures above their melting point or as concentrated solutions at lower temperatures. The book first presents the fundamental principles in rheology and flow instabilities. It relates the operating conditions with flow curves, the critical wall shear stress for the onset of the instabilities, and new visualization techniques with numerical modeling and molecular structure. It reviews one-dimensional phenomenological relaxation/oscillation models describing the experimental pressure and flow rate oscillations, analyzes the gross melt fracture (GMF) instability, and examines how traditional and non-traditional processing aids eliminate melt fracture and improve

polymer processability. It supplies a numerical approach for the investigation of the linear viscoelastic stability behavior of simplified injection molding flows and examines a newly discovered family of instabilities that occur in co-extrusion. *Polymer Processing Instabilities: Control and Understanding* is unique in that it fills a gap in the polymer processing literature where polymer flow instabilities are not treated in-depth in any book. It summarizes state-of-the-art developments in the field, particularly those of the last ten years, and contains significant data based on this research.

Multiphase Flows for Process Industries

Polymer science is fundamentally interdisciplinary, yet specialists in one aspect, such as chemistry or processing, frequently encounter difficulties in understanding the effects of other disciplines on their own. This book describes clearly how polymer chemistry and polymer processing interact to affect polymer properties. As such, specialists in both disciplines can gain a deeper understanding of how these subjects underpin each other. Coverage includes step-by-step introductions to polymer processing technologies; details of fluid flow and heat transfer behaviour; shaping methods and physical processes during cooking and curing, and analyses of moulding and extrusion processes.

Polymer Processing Instabilities

Fluid Dynamics is one of the most important topics of applied mathematics and physics. Together with complex flows and turbulence, multiphase flows remains one of the most challenging areas of computational mechanics, and even seemingly simple problems remain unsolved to date. Multiphase flows are found in all areas of technology, at all length scales and flow regimes. The fluids involved can be compressible or incompressible, linear or nonlinear. Because of the complexity of the problem, it is often essential to utilize advanced computational and experimental methods to solve the complex equations that describe them. Challenges in these simulations include nonlinear fluids, treating drop breakup and coalescence, characterizing phase structures, and many others. This volume brings together work presented at the Fourth International Conference on Computational and Experimental Methods in Multiphase and Complex Flows. Featured topics include: Suspensions; Bubble and Drop Dynamics; Flow in Porous Media; Interfaces; Turbulent Flow; Injectors and Nozzles; Particle Image Velocimetry; Macroscale Constitutive Models; Large Eddy Simulation; Finite Volumes; Interface Tracking Methods; Biological Flows; Environmental Multiphase Flow; Phase Changes and Stochastic Modelling.

Polymer Processing and Structure Development

Volume 1 presents first fundamental principles of the rheology of polymeric fluid including kinematics and stresses of a deformable body, the continuum theory for the viscoelasticity of flexible homogeneous polymeric liquids, the molecular theory for the viscoelasticity of flexible homogeneous polymeric liquids, and the experimental methods for the measurement of the rheological properties of polymeric liquids. The materials presented are intended to set a stage for the subsequent chapters by introducing the basic concepts and principles of rheology, from both phenomenological and molecular perspectives, of structurally simple flexible and homogeneous polymeric liquids. Next, this volume presents the rheological behavior of structurally complex polymeric materials including miscible polymer blends, block copolymers, liquid-crystalline polymers, thermoplastic polyurethanes, immiscible polymer blends, particulate-filled polymers, organoclay nanocomposites, molten polymers with dissolved gas, and thermosets.

Computational Methods in Multiphase Flow IV

This book presents the main results obtained by different laboratories involved in the research group Rheology for polymer melt processing which is associated with French universities, schools of engineering, and the CNRS (Centre National de la Recherche Scientifique - France). The group comprises some 15 research laboratories of varied disciplines (chemistry, physics, material sciences, mechanics, mathematics), but with a common challenge viz. to enhance the understanding of the relationships between macromolecular species, their rheology and their processing. Some crucial issues of polymer science have been addressed: correlation of viscoelastic macroscopic bulk property measurements and models, slip at the wall, extrusion defects, correlation between numerical flow simulations and experiments. Features of the book: • The book is unique in that it allows one to grasp the key issues in polymer rheology and processing at once through a series of detailed state-of-the-art contributions, which were previously scattered throughout the literature. • Each paper was reviewed by experts and the book editors and some coordination was established in order to achieve a readable and easy

access style. • Papers have been grouped in sections covering successively: Molecular dynamics, Constitutive equations and numerical modelling, Simple and complex flows. • Each paper can be read independently. Since the book is intended as an introduction to the main topics in polymer processing, it will be of interest to graduate students as well as to scientists in academic and industrial laboratories.

Rheology and Processing of Polymeric Materials

Processing techniques are critical to the performance of polymer products which are used in a wide range of industries. *Advances in polymer processing: From macro- to nano- scales* reviews the latest advances in polymer processing, techniques and materials. Part one reviews the fundamentals of polymer processing with chapters on rheology, materials and polymer extrusion. Part two then discusses advances in moulding technology with chapters on such topics as compression, rotational and blow moulding of polymers. Chapters in Part three review alternative processing technologies such as calendaring and coating, foam processing and radiation processing of polymers. Part four discusses micro and nano-technologies with coverage of themes such as processing of macro, micro and nanocomposites and processing of carbon nanotubes. The final section of the book addresses post-processing technologies with chapters on online monitoring and computer modelling as well as joining, machining, finishing and decorating of polymers. With its distinguished editors and team of international contributors, *Advances in polymer processing: From macro- to nano- scales* is an invaluable reference for engineers and academics concerned with polymer processing. Reviews the latest advances in polymer processing, techniques and materials analysing new challenges and opportunities. Discusses the fundamentals of polymer processing considering the compounding and mixing of polymers as well as extrusion. Assesses alternative processing technologies including calendaring and coating and thermoforming of polymers.

Rheology for Polymer Melt Processing

Specialist Periodical Reports provide systematic and detailed review coverage of progress in the major areas of chemical research. Written by experts in their specialist fields the series creates a unique service for the active research chemist, supplying regular critical in-depth accounts of progress in particular areas of chemistry. For over 80 years the Royal Society of Chemistry and its predecessor, the Chemical Society, have been publishing reports charting developments in chemistry, which originally took the form of Annual Reports. However, by 1967 the whole spectrum of chemistry could no longer be contained within one volume and the series Specialist Periodical Reports was born. The Annual Reports themselves still existed but were divided into two, and subsequently three, volumes covering Inorganic, Organic and Physical Chemistry. For more general coverage of the highlights in chemistry they remain a 'must'. Since that time the SPR series has altered according to the fluctuating degree of activity in various fields of chemistry. Some titles have remained unchanged, while others have altered their emphasis along with their titles; some have been combined under a new name whereas others have had to be discontinued. The current list of Specialist Periodical Reports can be seen on the inside flap of this volume.

Advances in Polymer Processing

Polymeric materials have been replacing other conventional materials like metals, glass and wood in a number of applications. The use of various types of fillers incorporated into the polymer has become quite common as a means of reducing cost and to impart certain desirable mechanical, thermal, electrical and magnetic properties to the polymers. Due to the energy crisis and high prices of petrochemicals, there has been a greater demand to use more and more fillers to cheapen the polymeric materials while maintaining and/or improving their properties. The advantages that filled polymer systems have to offer are normally offset to some extent by the increased complexity in the rheological behavior that is introduced by the inclusion of the fillers. Usually when the use of fillers is considered, a compromise has to be made between the improved mechanical properties in the solid state, the increased difficulty in melt processing, the problem of achieving uniform dispersion of the filler in the polymer matrix and the economics of the process due to the added step of compounding. It has been recognized that addition of filler to the polymer brings a change in processing behavior. The presence of the filler increases the melt viscosity leading to increases in the pressure drop across the die but gives rise to less die swell due to decreased melt elasticity.

Macromolecular Chemistry

Focusing on recent developments in techniques and materials, this volume examines the processing techniques critical to the quality performance of polymer products used in a wide range of industries. It discusses thermosets, thermoplastics, elastomers, foams, and nanocomposites. It also covers multiphase systems from macro to nano scales and reviews developments in established techniques. Leading experts in each area look at extrusion technologies, injection molding, and blow molding, in addition to recently developed processing technologies, such as those using supercritical fluids, micromolding, and reactive processing. The book also touches on post-processing techniques.

Rheology of Filled Polymer Systems

This second edition of *An Introduction to Plastics* is the answer to manifold requests for an updated version by the readership. Since publication of the first edition in 1993, the field of plastics has seen tremendous development. Their manufacture and properties are discussed and correlated to the molecular and supermolecular properties of polymers. The contents have been thoroughly revised, restructured and enlarged. Several topics such as polymer composites and mixtures, morphology, flow properties and processing have been given more space, and chapters on electrical conductivity and non-linear optical properties have been newly added. Reviews of the first edition: "This book presents a precise, yet non-mathematical introduction to plastics, their raw materials, syntheses, properties and applications." (B. Sillion, *Revue de l'Institut Francais du Pétrole*) "The volume is excellently written, with a simple, straightforward and comprehensive index. It provides an overview of all plastics, including raw materials: manufacture, structure, processing, properties and, of course, applications" (D.W. Taylor and J.F. Kennedy, *Polymer International*) "This book has all the earmarks of becoming a guide to or even a reference book for polymers in structural applications" (Willi Kreuder, *Acta Polymerica*)

Advances in Polymer Processing

This monograph presents theoretical and experimental studies of flows of elastic liquids. Falling into this category are particularly the melts and concentrated solutions of such flexible-chain polymers as polyethylene, polyisobutylene and polypropylene, all of which are widely used in polymer processing. These polydisperse polymers vary greatly, from batch to batch, in their mechanical properties and 20% variation in a property is believed to be good enough. I 7 All recent books - devoted to the rheology of polymers do not answer the question of which constitutive equations should be used for solving the fluid mechanic problems of polymer processing in the usual case of an appreciable nonlinear region of deformation where nonlinear effects of shear and extensional elasticity are very important. Viscoelastic constitutive equations cited commonly (see, e.g. Refs 5 and 6) do not describe simultaneously even the simplest cases of deformations, viz. simple shear and uniaxial extension. Moreover, some of them are internally inconsistent and sometimes display highly unstable behaviour in simple flows without any fundamental reasons. Even more respected molecular ap free from these defects.

An Introduction to Plastics

For several years, I have been responsible for organizing and teaching in the fall a short course on "Fundamentals of Adhesion: Theory, Practice, and Applications" at the State University of New York at New Paltz. Every spring I would try to assemble the most pertinent subjects and line up several capable lecturers for the course. However, there has always been one thing missing-an authoritative book that covers most aspects of adhesion and adhesive bonding. Such a book would be used by the participants as a main reference throughout the course and kept as a sourcebook after the course had been completed. On the other hand, this book could not be one of those "All you want to know about" volumes, simply because adhesion is an interdisciplinary and ever-growing field. For the same reason, it would be very difficult for a single individual, especially me, to undertake the task of writing such a book. Thus, I relied on the principle that one leaves the truly monumental jobs to experts, and I finally succeeded in asking several leading scientists in the field of adhesion to write separate chapters for this collection. Some chapters emphasize theoretical concepts and others experimental techniques. In the humble beginning, we planned to include only twelve chapters. However, we soon realized that such a plan would leave too much ground uncovered, and we resolved to increase the coverage. After the book had evolved into thirty chapters, we started to feel that perhaps our mission had been accomplished.

Nonlinear Phenomena in Flows of Viscoelastic Polymer Fluids

Multiphase flow technology, especially in the area of gas-droplet and gas-particle flows, is increasingly important in the energy and manufacturing industries. Pollution control, pneumatic transport, food

processing, combustion, and development of new materials as well as many other engineering applications will benefit from the fundamental engineering design applications and research in this field. Written for graduate students and professionals, *Multiphase Flows with Droplets and Particles* provides a clear, pedagogical approach to the fundamentals of gas-particle and gas-droplet flows.

Adhesive Bonding

Polymers are ubiquitous and pervasive in industry, science, and technology. These giant molecules have great significance not only in terms of products such as plastics, films, elastomers, fibers, adhesives, and coatings but also less obviously though none the less importantly in many leading industries (aerospace, electronics, automotive, biomedical, etc.). Well over half the chemists and chemical engineers who graduate in the United States will at some time work in the polymer industries. If the professionals working with polymers in the other industries are taken into account, the overall number swells to a much greater total. It is obvious that knowledge and understanding of polymers is essential for any engineer or scientist whose professional activities involve them with these macromolecules. Not too long ago, formal education relating to polymers was very limited, indeed, almost nonexistent. Speaking from a personal viewpoint, I can recall my first job after completing my Ph.D. The job with E.I. Du Pont de Nemours dealt with polymers, an area in which I had no university training. There were no courses in polymers offered at my alma mater. My experience, incidentally, was the rule and not the exception.

Multiphase Flows with Droplets and Particles

Multiphase Flows with Droplets and Particles provides an organized, pedagogical study of multiphase flows with particles and droplets. This revised edition presents new information on particle interactions, particle collisions, thermophoresis and Brownian movement, computational techniques and codes, and the treatment of irregularly shaped particles. An entire chapter is devoted to the flow of nanoparticles and applications of nanofluids. Features Discusses the modelling and analysis of nanoparticles. Covers all fundamental aspects of particle and droplet flows. Includes heat and mass transfer processes. Features new and updated sections throughout the text. Includes chapter exercises and a Solutions Manual for adopting instructors. Designed to complement a graduate course in multiphase flows, the book can also serve as a supplement in short courses for engineers or as a stand-alone reference for engineers and scientists who work in this area.

Polymer Process Engineering

Chemical Engineering and Chemical Process Technology is a theme component of Encyclopedia of Chemical Sciences, Engineering and Technology Resources in the global Encyclopedia of Life Support Systems (EOLSS), which is an integrated compendium of twenty Encyclopedias. Chemical engineering is a branch of engineering, dealing with processes in which materials undergo changes in their physical or chemical state. These changes may concern size, energy content, composition and/or other application properties. Chemical engineering deals with many processes belonging to chemical industry or related industries (petrochemical, metallurgical, food, pharmaceutical, fine chemicals, coatings and colors, renewable raw materials, biotechnological, etc.), and finds application in manufacturing of such products as acids, alkalis, salts, fuels, fertilizers, crop protection agents, ceramics, glass, paper, colors, dyestuffs, plastics, cosmetics, vitamins and many others. It also plays significant role in environmental protection, biotechnology, nanotechnology, energy production and sustainable economical development. The Theme on Chemical Engineering and Chemical Process Technology deals, in five volumes and covers several topics such as: Fundamentals of Chemical Engineering; Unit Operations – Fluids; Unit Operations – Solids; Chemical Reaction Engineering; Process Development, Modeling, Optimization and Control; Process Management; The Future of Chemical Engineering; Chemical Engineering Education; Main Products, which are then expanded into multiple subtopics, each as a chapter. These five volumes are aimed at the following five major target audiences: University and College students Educators, Professional practitioners, Research personnel and Policy analysts, managers, and decision makers and NGOs.

Multiphase Flows with Droplets and Particles, Third Edition

Chemical modification of polymers by reactive modifiers is no longer an academic curiosity but a commercial reality that has delivered a diverse range of speciality materials for niche markets: reactively grafted styrenic alloys, maleated polyolefins, super-tough nylons, silane modified and moisture-cured

polyolefins, and thermoplastic elastomers, are but few examples of commercial successes. Although the approach of reactive modification of polymers has been largely achieved either in solution or in the solid state (through in situ reactions in polymer melts), it is the latter route that has attracted most attention in the last two decades owing to its flexibility and cost-effectiveness. This route, referred to as reactive processing, focuses on the use of suitable reactive modifier(s) and the adoption of conventional polymer processing machinery, an extruder or a mixer, as a chemical reactor, to perform in situ targeted reactions for chemical modification of preformed polymers. This relatively simple, though scientifically highly challenging, approach to reactive modification offers unique opportunities in exploiting various reactive modifiers for the purpose of altering and transforming in a controlled manner the properties of preformed commercial polymers into new/speciality materials with tailor-made properties and custom-designed performance for target applications. Such an economically attractive route constitutes a radical diversion away from the traditional practices of manufacturing new polymers from monomers which involves massive investments in sophisticated technologies and chemical plants.

Chemical Engineering and Chemical Process Technology - Volume VII

This monograph contains manuscripts, poster abstracts and summary statements representing the contributions of a group of scientists who participated in the sixth annual Texas A&M Industry-University Cooperative Chemistry Program (IUCCP) at Texas A&M University in College Station, Texas, March 22-24, 1988. This symposium on "Functional Polymers" was organized by a university-industrial steering committee consisting of Dr. D. Keene, Hoechst Celanese; Dr. D. E. McLemore, Dow Chemical Company; Dr. B. Frushour, Monsanto Company; Dr. S. Corley, Shell Development; Dr. F. Hoffstadt, BP America; Dr. D. E. Bergbreiter, Texas A&M University; Dr. C. A. J. Hoeve, Texas A&M University; Dr. C. R. Martin, Texas A&M University; Dr. A. Clearfield, Texas A&M University; and Dr. A. E. Martell, Texas A&M University. The symposium itself was generously supported by the industrial companies participating in the IUCCP program. These sponsoring chemical companies include; Shell Development Company, Dow Chemical Company, BP America, Monsanto Company and Hoechst Celanese. The choice of "Functional Polymers" as the subject for this symposium reflects the rapid developments occurring in the broad field of polymer science and the potential for using polymeric derivatives in many new exciting and potentially profitable applications. The invited papers and submitted posters reflect the diversity of this field and include many different topics ranging from biomedical applications of polymers to conducting polymers to use of polymers as lithographic masks and recording media. General topics included in the symposium were: photoresponsive polymers, polymer blends, electronically conductive polymers, polymers catalysts, biomedical polymers and membrane transport and permeability.

Reactive Modifiers for Polymers

Multiphase Polylactide Blends: Toward a Sustainable and Green Environment guides the reader through fundamentals, science, preparation, and key areas of innovation in polylactide (PLA) blends. Bio-based polymers, and notably PLA, have not only gained increasing interest as a more sustainable alternative but also bring challenges in terms of mechanical, rheological, thermal and physical properties, processability, shapability, and foamability. The use of blends looks to address these, with the development of new types of economically viable and environmentally friendly systems. This is a valuable book for academic researchers, scientists, and graduate students across bio-based polymers, polymer science, chemistry, and materials science, as well as engineers, R&D professionals, and all those in industry with interest in PLA-based blends, biopolymers, and sustainable materials and products. More specifically, the first three chapters of this book overview the fundamentals of thermoplastic polymers, polymer blends, and structure and properties of PLA. These chapters could technically be used as a valuable textbook on the noted topics. The rest of the chapters inclusively study the fundamentals, investigations, and achievements in PLA-based blends with various types of polymers. These include miscible blends of poly L-lactide and poly D-lactide, binary immiscible/miscible blends of PLA with other thermoplastics and elastomers, PLA-based ternary blends and blend nanocomposites, as well as PLA-based blend foams. Overall, this book provides a thorough and critical overview of the state of the art in PLA-based blends, including significant past and recent advances, with the aim of supporting and shaping further research and industrial application of these materials for the development of a green and sustainable future. Overviews the fundamentals of thermoplastic polymers, polymer blends, and the structure and properties of PLA. Provides detailed coverage of the fundamentals and science of PLA blends, including phase miscibility, thermal and mechanical properties, interface and rheological properties, the use of compatibilizers, and phase morphological analysis. Offers a thorough critical

overview of the state of the art in processing and development of PLA-based blends, addressing key challenges and future perspectives. Covers the latest advances, including PLA-based ternary blends, blend nanocomposites, and PLA-based blend microcellular foams.

Functional Polymers

Biodegradable Polymer Blends and Composites from Renewable Resources provides a comprehensive, current overview of biopolymeric blends and composites and their applications in various industries. The book is organized according to the type of blend or composite. For each topic, the relationship between the structure of the blends/composites and their respective properties is explored, with particular focus on interface, compatibility, mechanical, and thermal properties. Real-life applications and potential markets are discussed. This is a premier reference for graduate students and researchers in polymer science, chemical and bio engineering, and materials science.

Mechanics of Polymer Processing

A comprehensive and highly practical survey of the materials, hardware, processes and applications of flexible plastic films. Aimed at a wide audience of engineers, technicians, managers, purchasing agents and users, Multilayer Flexible Packaging provides a thorough introduction to the manufacturing and applications of flexible plastic films, covering: Materials Hardware and Processes Multilayer film designs and applications The materials coverage includes detailed sections on polyethylene, polypropylene and additives. The dies used to produce multilayer films are explored in the hardware section, and the process engineering of film manufacture explained, with a particular focus on meeting specifications and targets. The section includes unique coverage of the problematic area of bending technology, providing a unique explanation of the issues involved in the blending of viscoelastic non-Newtonian polymeric materials. About the author John R. Wagner, Jr. is President of Crescent Associates, Inc., a consulting firm that specializes in plastic films and flexible packaging. He graduated from the University of Notre Dame with a BS and MS in Chemical Engineering.

Multiphase Polylactide Blends

In many cases rheological measurements are carried out in the simplest of geometries, but the interpretation involved in obtaining the rheological parameters of the test fluids from these measurements is surprisingly complex. The purpose of this book is to emphasise the points on which most workers in the field agree, and to let the authors deal with the contentious points according to their own beliefs and experience. This work represents a summary of the current thought on rheological measurement by experts in the various techniques. When making measurements and obtaining from them parameters that describe the flow behaviour of the test fluids, it is essential that the experimentalist understands the underlying theory and shortcomings of the measurement technique, that he is aware of the likely microstructure of the fluid, and that from this he can appreciate how the fluid and the measuring system will interact with each other. It is this interaction that gives both the required rheological parameters of the fluids and the artefacts that confuse the issue. This book covers the main rheological measurement techniques from capillary, slit and stretching flows to rotational and oscillatory rheometry in various geometries including sliding plate measurements. These topics are backed up by chapters on more practical aspects, such as commercial instruments, and on computer control and data acquisition. The chapters deal with the basic methods, how the measurements are taken, and what assumptions and interpretations are made to obtain valid data on the test fluids.

Biodegradable Polymer Blends and Composites from Renewable Resources

Liquid crystal polymers are sometimes called super polymers--with good reason. Their wide range of exceptional properties and ease of processing make them design candidates for many demanding applications. This new book provides a thorough review of LCP technology with the emphasis on the chemistry, synthesis and characterization of the material in its many variants. Additional chapters cover processing and applications. From the Editor's Preface The field of thermotropic liquid crystalline polymers has grown substantially in the last two decades, with fundamental research, publications, commercial products, and patents. In the 1980's, Dr. Ralph Miano led my colleagues and me at Hoechst Celanese in commercializing the first thermotropic liquid crystalline polymers, based on Dr. Gordon Calundann's composition patents. Today, more than seven companies have produced thermotropic liquid crystalline polymer materials, with at least 50 variants available. Hence, it is timely to compile a comprehensive review on the nature of this type of material and the ongoing progress in this field.... The

goals of this book are to summarize previous work, provide new insights into this class of polymers, and add to the understanding of the formation of liquid crystallinity. This book covers a wide range of topics and addresses different disciplines in the field. The chapters are arranged as a learning scheme for the professional, from basic science to applied engineering. The first few chapters summarize the syntheses of various polyester, polyester-amid, and polyimide liquid crystalline polymers. The science and origins of liquid crystal formation are revealed. Next, we introduce the characterizations of these materials by their different chemical and physical aspects. Because most commercially available thermotropic liquid crystalline polymers have been used in the form of composites, we have also incorporated a chapter on polymer blends, detailing blending mechanisms and resultant properties. Two chapters on thermosetting liquid crystalline polymers integrate them with other topics, because of their unique importance and their applications for microelectronics and packaging. The final chapter deals with the engineering and processing aspects of thermoplastic liquid crystalline polymers for a variety of applications.

Particulate and Multiphase Processes

Combining the science of foam with the engineering of extrusion processes, *Foam Extrusion: Principles and Practice* delivers a detailed discussion of the theory, design, processing, and application of degradable foam extraction. In one comprehensive volume, the editors present the collective expertise of leading academic, research, and industry spec

Multilayer Flexible Packaging

Rheological Measurement