Dynamics Of Polymeric Liquids Volume 1 Fluid Mechanics

This book is intended to provide a fundamental basis for the study of the interaction of polymers with living systems, biochemicals, and with aqueous solutions. The surface chemistry and physics of polymeric materials is a subject not normally covered to any significant extent in classical surface chemistry textbooks. Many of the assumptions of classical surface chemistry are invalid when applied to polymer surfaces. Surface properties of polymers are important in the development of medical devices and diagnostic products. Surface properties are also of vital importance in fields such as adhesion, paints and coatings, polymer-filler interactions, heterogeneous catalysis, composites, and polymers for energy generation. The book begins with a chapter considering the current sources of information on polymer surface chemistry and physics. It moves on to consider the question of the dynamics of polymer surfaces and the implica tions of polymer surface dynamics on all subsequent characterization and interfacial studies. Two chapters are directed toward the question of model polymers for preparing model surfaces and interfaces. Complete treatments of X-ray photoelectron spectroscopy and attenuated total reflection infrared spectroscopy are given. There is a detailed treatment of the contact angle with particular emphasis on contact angle

hysteresis in aqueous systems, followed by chapters on interfacial electrochemistry and interface acid-base charge-transfer properties. The very difficult problem of block and graft copolymer surfaces is also discussed. The problem of theoretical calculations of surface and interfacial tensions is presented. Raman spectroscopy is considered as an analytical technique for polymer surface characterization.

"Presents the fundamentals of momentum, heat, and mass transfer from both a microscopic and a macroscopic perspective. Features a large number of idealized and real-world examples that we worked out in detail."

The first four volumes of the series on 'Charged and Reactive Polymers' have been devoted to polymers in solution (Voh. I and II) or in gel and membrane forms (Vols. III and IV). In correlation with charges, other physical or chemical properties of macro molecules have been considered. Understanding of charge and hydrophobic effects is equally important for synthetic and biopolymers or their systems. Optically Active Polymers are related to problems of the same class, since optical activity is an inherent property of both natural macromolecules as well as a great variety of polymers synthesized in the Jast twenty years. Optical activity is a physical spectral property of chiral matter caused by asymmetrical configurations, conformations and structures which have no plane and no center of symmetry and consequently have two mirror image enantiomeric forms of inverse optical rotation. The racemic mixture of chiral enantiomers is optically inactive. The most common form of optical activity was first

measured at a constant wavelength by the angle of rotation of linearly polarized light. More recently the measurements have been extended to the entire range of visible and attainable ultraviolet regions where electronic transitions are observed, giving rise to the ORD technique (Optical Rotatory Dispersion). The Cotton effects appear in the region of optically active absorption bands; outside of these bands the plain curve spectrum is also dependent on all the electronic transitions of the chromophores.

The aim of the School on Rheology of Complex fluids is to bring together young researchers and teachers from educational and R&D institutions, and expose them to the basic concepts and research techniques used in the study of rheological behavior of complex fluids. The lectures will be delivered by well-recognized experts. The book contents will be based on the lecture notes of the school.

Models should be as simple as possible, but no simpler. For the physics of polymeric liquids, whose relevant lengths and time scales are out of reach for first principles calculations, this means that we have to choose a minimum set of sufficiently detailed descriptors such as architecture (linear, ring, branched), connectivity, semiflexibility, stretchability, excluded volume, and hydrodynamic interaction. These 'universal' fluids allow the prediction of material properties under external flow- or electrodynamic fields, the results being expressed in terms of reference units, specific for any particular chosen material. This book provides an introduction to the kinetic theory and computer simulation methods needed to handle these models and to interpret the results. Also

included are a number of sample applications and computer codes.
"With the appearance and fast evolution of high performance materials, mechanical, chemical and process engineers cannot perform effectively without fluid processing knowledge. The purpose of this book is to explore the systematic application of basic engineering principles to fluid flows that may occur in fluid processing and related activities. In Viscous Fluid Flow, the authors develop and rationalize the mathematics behind the study of fluid mechanics and examine the flows of Newtonian fluids. Although the material deals with Newtonian fluids, the concepts can be easily generalized to non-Newtonian fluid mechanics. The book contains many examples. Each chapter is accompanied by problems where the chapter theory can be applied to produce characteristic results. Fluid mechanics is a fundamental and essential element of advanced research, even for those working in different areas, because the principles, the equations, the analytical, computational and experimental means, and the purpose are common.
Controlling turbulence is an important issue for a number of technological applications. Several methods to modulate turbulence are currently being investigated. This book describes various aspects of turbulence structure and modulation, and explains and discusses the most promising techniques in detail.
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 poylmeric 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, ofstructurally 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, perticulare-filled polymers, organoclay nanocomposites, molten polymers with dissolved gas, and thermosts.

This text is a primer for liquid crystals, polymers, rubber and elasticity. It is directed at physicists, chemists, material scientists, engineers and applied mathematicians at the graduate student level and beyond.

Dynamics of Polymeric Liquids, Volume 1Fluid MechanicsWiley-Interscience
Polymeric Liquids and Networks: Structure and Properties is the first book of two by William W. Graessley that presents a unified view of flexible-chain polymer liquids and networks. The topics of both volumes range from equilibrium properties to dynamic response, finite deformation behavior and non-Newtonian flow. The second book will be titled Po

Providing a comprehensive review of the state-of-the-art advanced research in the field, Polymer Physics explores the interrelationships among polymer structure, morphology, and physical and mechanical behavior. Featuring contributions from renowned experts, the book covers the basics of important areas in polymer physics while projecting into the future, making it a valuable resource for students and chemists, chemical engineers, materials scientists, and polymer scientists as well as professionals in related industries.

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.
A groundbreaking textbook on twenty-first-century fluids and elastic solids and their
applications Kip Thorne and Roger Blandford's monumental Modern Classical Physics
is now available in five stand-alone volumes that make ideal textbooks for individual
graduate or advanced undergraduate courses on statistical physics; optics; elasticity
and fluid dynamics; plasma physics; and relativity and cosmology. Each volume
teaches the fundamental concepts, emphasizes modern, real-world applications, and
gives students a physical and intuitive understanding of the subject. Elasticity and Fluid
Dynamics provides an essential introduction to these subjects. Fluids and elastic solids
are everywhere—from Earth's crust and skyscrapers to ocean currents and airplanes.
They are central to modern physics, astrophysics, the Earth sciences, biophysics,
medicine, chemistry, engineering, and technology, and this centrality has intensified in
recent years—so much so that a basic understanding of the behavior of elastic solids
and fluids should be part of the repertoire of every physicist and engineer and almost
every other natural scientist. While both elasticity and fluid dynamics involve continuum
physics and use similar mathematical tools and modes of reasoning, each subject can
be readily understood without the other, and the book allows them to be taught
independently, with the first two chapters introducing and covering elasticity and the last
six doing the same for fluid dynamics. The book also can serve as supplementary
reading for many other courses, including in astrophysics, geophysics, and

aerodynamics. Includes many exercise problems Features color figures, suggestions for further reading, extensive cross-references, and a detailed index Optional "Track 2" sections make this an ideal book for a one-quarter or one-semester course in elasticity, fluid dynamics, or continuum physics An online illustration package is available to professors The five volumes, which are available individually as paperbacks and ebooks, are Statistical Physics; Optics; Elasticity and Fluid Dynamics; Plasma Physics; and Relativity and Cosmology.

Accompanying DVD-ROM contains ... "all chapters of the Springer Handbook."--Page 3 of cover.

The applications of ionic liquids can be enormously expanded by arranging the organic ions in the form a polymer architecture. Polymerized ionic liquids (PILs), also known as poly(ionic liquid)s or polymeric ionic liquids, provide almost all features of ionic polymers plus a rare versatility in design. Written by leading authors, the present book provides a comprehensive overview of this exciting area, discussing various aspects of PILs and their applications as smart materials. The book will appeal to a broad readership including students and researchers from materials science, polymer science, chemistry, and physics.

Non-Newtonian (non-linear) fluids are common in nature, for example, in mud and honey, but also in many chemical, biological, food, pharmaceutical, and personal care processing industries. This Special Issue of Fluids is dedicated to the recent advances in the mathematical and physical modeling of non-linear fluids with industrial applications, especially those concerned with CFD studies. These fluids include traditional non-Newtonian fluid models,

electro- or magneto-rheological fluids, granular materials, slurries, drilling fluids, polymers, blood and other biofluids, mixtures of fluids and particles, etc.

This book sets out to provide a guide, with examples, for those who wish to make predictions about the mechanical and thermal behaviour of non-Newtonian materials in engineering and processing technology. After an introductory survey of the field and a review of basic continuum mechanics, the radical differences between elongational and shear behaviour are shown. Two chapters, one based on a continuum approach and the other using microstructural approaches, lead to useful mathematical desriptions of materials for engineering applications. As examples of nearly-viscometric and nearly-elongational flows, there is a discussion of lubrication and related shearing flows, and fibre- spinning and film-blowing respectively. A long chapter is devoted to the important new field of computational rheology, and this is followed by chapters on stability and turbulence and the all-important temperature effects in flow. This new edition contains much new material not available in book form elsewhere-for example wall slip, suspension rheology, computational rheology and new results in stability theory.

Basic fluid dynamic theory and applications in a single, authoritative reference The growing capabilities of computational fluid dynamics and the development of laser velocimeters and other new instrumentation have made a thorough understanding of classic fluid theory and laws more critical today than ever before. Fundamentals of Fluid Mechanics is a vital repository of essential information on this crucial subject. It brings together the contributions of recognized experts from around the world to cover all of the concepts of classical fluid mechanics-from the basic properties of liquids through thermodynamics, flow theory, and gas dynamics. With answers for the practicing engineer and real-world insights for the student, it

includes applications from the mechanical, civil, aerospace, chemical, and other fields. Whether used as a refresher or for first-time learning, Fundamentals of Fluid Mechanics is an important new asset for engineers and students in many different disciplines.

These two volumes contain chapters written by experts in such areas as bio and food rheology, polymer rheology, flow of suspensions, flow in porous media, electrorheological fluids, etc. Computational as well as analytical mathematical descriptions, involving appropriate constitutive equations deal with complex flow situations of industrial importance. This work is unique in that it brings together state of the art reviews and recent advances in a variety of areas, involving viscoelastic materials, in a desirable and timely manner.

Dynamics of Polymeric Liquids, Second Edition Volume 2: Kinetic Theory R. Byron Bird, Charles F. Curtiss, Robert C. Armstrong and Ole Hassager Volume Two deals with the molecular aspects of polymer rheology and fluid dynamics. It is the only book currently available dealing with kinetic theory and its relation to nonlinear rheological properties. Considerable emphasis is given to the connection between kinetic theory results and experimental data. The second edition contains new material on the basis for molecular modeling, the application of phase-space theory to dilute solutions, kinetic theory of melts and melt mixtures, and network theories. 1987 (0 471-80244-1) 450 pp.

Constitutive Equations for Polymer Melts and Solutions presents a description of important constitutive equations for stress and birefringence in polymer melts, as well as in dilute and concentrated solutions of flexible and rigid polymers, and in liquid crystalline materials. The book serves as an introduction and guide to constitutive

equations, and to molecular and phenomenological theories of polymer motion and flow. The chapters in the text discuss topics on the flow phenomena commonly associated with viscoelasticity; fundamental elementary models for understanding the rheology of melts, solutions of flexible polymers, and advanced constitutive equations; melts and concentrated solutions of flexible polymer; and the rheological properties of real liquid crystal polymers. Chemical engineers and physicists will find the text very useful.

One common feature of new emerging technologies is the fusion of the very small (nano) scale and the large scale engineering. The classical environment provided by single scale theories, as for instance by the classical hydrodynamics, is not anymore satisfactory. The main challenge is to keep the important details while still be able to keep the overall picture and simplicity. It is the thermodynamics that addresses this challenge. Our main reason for writing this book is to explain such general viewpoint of thermodynamics and to illustrate it on a very wide range of examples. Contents Levels of description Hamiltonian mechanics Irreversible evolution Reversible and irreversible evolution Multicomponent systems Contact geometry Appendix: Mathematical aspects Polymers are used in everything from nylon stockings to commercial aircraft to artificial heart valves, and they have a key role in addressing international competitiveness and other national issues. Polymer Science and Engineering explores the universe of polymers, describing their properties and wide-ranging potential, and presents the state

of the science, with a hard look at downward trends in research support. Leading experts offer findings, recommendations, and research directions. Lively vignettes provide snapshots of polymers in everyday applications. The volume includes an overview of the use of polymers in such fields as medicine and biotechnology, information and communication, housing and construction, energy and transportation, national defense, and environmental protection. The committee looks at the various classes of polymers--plastics, fibers, composites, and other materials, as well as polymers used as membranes and coatings--and how their composition and specific methods of processing result in unparalleled usefulness. The reader can also learn the science behind the technology, including efforts to model polymer synthesis after nature's methods, and breakthroughs in characterizing polymer properties needed for twenty-first-century applications. This informative volume will be important to chemists, engineers, materials scientists, researchers, industrialists, and policymakers interested in the role of polymers, as well as to science and engineering educators and students. Rheology--the study of the deformation and flow of matter--deals primarily with the stresses generated during the flow of complex materials including polymers, colloids, foams, and gels. A rapidly growing and industrially important field, it plays a significant role in polymer processing, food processing, coating and printing, and many other manufacturing processes. Designed as a main text for advanced undergraduate- or graduate-level courses in rheology or polymer rheology, Understanding Rheology is

also an ideal self-teaching guide for practicing engineers and scientists who find rheological principles applicable to their work. Covering the most important aspects of elementary modern rheology, this detailed and accessible text opens with an introduction to the field and then provides extensive background chapters on vector and tensor operations and Newtonian fluid mechanics. It continues with coverage of such topics as: * Standard Flows for Rheology * Material Functions * Experimental Observations * Generalized Newtonian Fluids * Generalized Linear-Viscoelastic Fluids * Nonlinear Constitutive Equations * Rheometry, including rheo-optics Understanding Rheology incorporates helpful pedagogical aids including numerous problems for each chapter, many worked examples, and an extensive glossary. It also contains useful appendices on nomenclature, mathematical tools, predictions of constitutive equations, and birefringence.

The first reference of its kind in the rapidly emerging field of computational approachs to materials research, this is a compendium of perspective-providing and topical articles written to inform students and non-specialists of the current status and capabilities of modelling and simulation. From the standpoint of methodology, the development follows a multiscale approach with emphasis on electronic-structure, atomistic, and mesoscale methods, as well as mathematical analysis and rate processes. Basic models are treated across traditional disciplines, not only in the discussion of methods but also in chapters on crystal defects, microstructure, fluids, polymers and soft matter.

Written by authors who are actively participating in the current development, this collection of 150 articles has the breadth and depth to be a major contributor toward defining the field of computational materials. In addition, there are 40 commentaries by highly respected researchers, presenting various views that should interest the future generations of the community. Subject Editors: Martin Bazant, MIT; Bruce Boghosian, Tufts University; Richard Catlow, Royal Institution; Long-Qing Chen, Pennsylvania State University; William Curtin, Brown University; Tomas Diaz de la Rubia, Lawrence Livermore National Laboratory; Nicolas Hadjiconstantinou, MIT; Mark F. Horstemeyer, Mississippi State University; Efthimios Kaxiras, Harvard University; L. Mahadevan, Harvard University; Dimitrios Maroudas, University of Massachusetts; Nicola Marzari, MIT; Horia Metiu, University of California Santa Barbara; Gregory C. Rutledge, MIT; David J. Srolovitz, Princeton University; Bernhardt L. Trout, MIT; Dieter Wolf, Argonne National Laboratory.

The Structure and Rheology of Complex Fluids describes the microstructures of polymeric, colloidal, amphiphilic, and liquid crystalline liquids, and the relationship between microstructure and mechanical and flow properties. It provides illustrations, practical examples, and worked problems. This book can serve as both a textbook for a graduate course and a research monograph.

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.

Presenting a completely new approach to examining how polymers move in non-dilute solution, this book focuses on experimental facts, not theoretical speculations, and concentrates on polymer solutions, not dilute solutions or polymer melts. From centrifugation and solvent dynamics to viscosity and diffusion, experimental measurements and their quantitative representations are the core of the discussion. The book reveals several experiments never before recognized as revealing polymer solution properties. A novel approach to relaxation phenomena accurately describes viscoelasticity and dielectric relaxation and how they depend on polymer size and concentration. Ideal for graduate students and researchers interested in the properties of polymer solutions, the book covers real measurements on practical systems, including the very latest results. Every significant experimental method is presented in considerable detail, giving unprecedented coverage of polymers in solution. This two-volume work is detailed enough to serve as a text and comprehensive enough to stand as a reference. Volume 1, Fluid Mechanics, summarizes the key experiments that show how polymeric fluids differ from structurally simple fluids, then presents, in rough historical order, various methods for solving polymer fluid

dynamics problems. Volume 2, Kinetic Theory, uses molecular models and the methods of statistical mechanics to obtain relations between bulk flow behavior and polymer structure. Includes end-of-chapter problems and extensive appendixes.

Introductory Transport Phenomena by R. Byron Bird, Warren E. Stewart, Edwin N. Lightfoot, and Daniel Klingenberg is a new introductory textbook based on the classic Bird, Stewart, Lightfoot text, Transport Phenomena. The authors' goal in writing this book reflects topics covered in an undergraduate course. Some of the rigorous topics suitable for the advanced students have been retained. The text covers topics such as: the transport of momentum; the transport of energy and the transport of chemical species. The organization of the material is similar to Bird/Stewart/Lightfoot, but presentation has been thoughtfully revised specifically for undergraduate students encountering these concepts for the first time. Devoting more space to mathematical derivations and providing fuller explanations of mathematical developments—including a section of the appendix devoted to mathematical topics—allows students to comprehend transport phenomena concepts at an undergraduate level.

This book consists of two strongly interweaved parts: the mathematical theory of stochastic processes and its applications to molecular theories of polymeric

fluids. The comprehensive mathematical background provided in the first section will be equally useful in many other branches of engineering and the natural sciences. The second part provides readers with a more direct understanding of polymer dynamics, allowing them to identify exactly solvable models more easily, and to develop efficient computer simulation algorithms in a straightforward manner. In view of the examples and applications to problems taken from the front line of science, this volume may be used both as a basic textbook or as a reference book. Program examples written in FORTRAN are available via ftp from ftp.springer.de/pub/chemistry/polysim/.

This is an introduction to the dynamics of fluids at small scales, the physical and mathematical underpinnings of Brownian motion, and the application of these subjects to the dynamics and flow of complex fluids such as colloidal suspensions and polymer solutions. It brings together continuum mechanics, statistical mechanics, polymer and colloid science, and various branches of applied mathematics, in a self-contained and integrated treatment that provides a foundation for understanding complex fluids, with a strong emphasis on fluid dynamics. Students and researchers will find that this book is extensively cross-referenced to illustrate connections between different aspects of the field. Its focus on fundamental principles and theoretical approaches provides the

necessary groundwork for research in the dynamics of flowing complex fluids.

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