Polymer Processing

This unified approach to polymer materials science is divided in three major sections:

Principles of Polymer Processing

The Fifth Edition of Principles of Polymer Systems has been completely revised and updated. The chemical engineering perspective has been retained and strengthened, and the broad applications of polymers in chemistry and materials science have been addressed. The theoretical basis for various topics has been deepened and strengthened and several new topics are addressed. These changes reflect the rapidly growing recognition by all scientists and engineers of the role polymers play in industry. Electronics and medicine are representative areas that require more than a passing knowledge of macromolecular principles. Both areas receive attention in this edition. The end-of-chapter problems in the book have been completely replaced with the new problems. A solutions manual will be available to qualified instructors.

Principles of Polymer Systems

Engineering of polymers is not an easy exercise with evolving technology, it often involves complex concepts and processes. This book is intended to provide the theoretical essentials: understanding of processes, a basis for the use of design software, and much more. The necessary physical concepts such as continuum mechanics, rheological behavior and measurement methods, and thermal science with its application to heating-cooling problems and implications for flow behavior are analyzed in detail. This knowledge is then applied to key processing methods, including single-screw extrusion and extrusion die flow, twin-screw extrusion and its applications, injection molding, calendaring, and processes involving stretching. With many exercises with solutions offered throughout the book to reinforce the concepts presented, and extensive illustrations, this is an essential guide for mastering the art of plastics processing. Practical and didactic, Polymer Processing: Principles and Modeling is intended for engineers and technicians of the profession, as well as for advanced students in Polymer Science and Plastics Engineering.

Principles of Polymerization

Provides the basic background needed by engineers to determine experimentally and interpret the rheological behavior of polymer melts—including not only traditional pure melts but also solutions and compounds containing anisotropic (fiber or disc) or colloidal particles—and apply it to analyze flow in processing operations. Experimental foundations of modern rheology and rheo-optics and the interpretation of experimental data are covered, which also develops the fundamentals of continuum mechanics and shows how it may be applied to devise methods for measurement of rheological properties, formulation of three-dimensional stress-deformation relationships, and analysis of flow in processing operations. Also discussed is the structure of polymers and considers rheological behavior in terms of structure. Constitutive equations relating stress to deformation history in non-Newtonian fluids and their applications are discussed. Each chapter presents an overview of the subject matter and then develops the material in a pedagogical manner.

Materials Science of Polymers for Engineers

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.

Principles of Polymer Engineering Rheology

Covering a broad range of polymer science topics, Handbook of Polymer Synthesis, Characterization, and Processing provides polymer industry professionals and researchers in polymer science and technology with a single, comprehensive handbook summarizing all aspects involved in the polymer production chain. The handbook focuses on industrially important polymers, analytical techniques, and formulation methods, with chapters covering step-growth, radical, and co-polymerization, crosslinking and grafting, reaction engineering, advanced technology applications, including conjugated, dendritic, and nanomaterial polymers and emulsions, and characterization methods, including spectroscopy, light scattering, and microscopy.

Polymer Chemistry

Joining of Polymer-Metal Hybrid Structures

Principles of Polymer Science and Technology in Cosmetics and Personal Care

Principles of Polymer Engineering

This introductory text is intended as the basis for a two or three semester course in synthetic macromolecules. It can also serve as a self-instruction guide for engineers and scientists without formal training in the subject who find themselves working with polymers. For this reason, the material covered begins with basic concepts and proceeds to current practice, where appropriate. Serves as both a textbook and an introduction for scientists in the field. Problems accompany each chapter.

High-Performance Polymers for Engineering-Based Composites

Exploring the chemistry of synthesis, mechanisms of polymerization, reaction engineering of step-growth and chain-growth polymerization, polymer characterization, thermodynamics and structural, mechanical, thermal and transport behavior of polymers as melts, solutions and solids, Fundamentals of Polymer Engineering, Third Edition covers essential concepts and breakthroughs in reactor design and polymer production and processing. It contains modern theories and real-world examples for a clear understanding of polymer function and development. This fully updated edition addresses new materials, applications, processing techniques, and interpretations of data in the field of polymer science. It discusses the conversion of biomass and coal to plastics and fuels, the use of porous polymers and membranes for water purification, and the use of polymeric membranes in fuel cells. Recent developments are brought to light in detail, and there are new sections on the improvement of barrier properties of polymers, constitutive equations for polymer melts, additive manufacturing and polymer recycling. This textbook is aimed at senior undergraduate students and first year graduate students in polymer engineering and science courses, as well as professional engineers, scientists, and chemists. Examples and problems are included at the end of each chapter for concept reinforcement.

Principles of Polymer Systems 5th Edition

Polymer Engineering Principles

High-Performance Polymers for Engineering-Based Composites presents a selection of investigations and innovative research in polymer chemistry and advanced materials. The book includes case studies in the field of nanocomposites. The volume provides coverage of new research in polymer science and engineering with applications in chemical engineering, materials science, and chemistry. In addition to synthetic polymer chemistry, it also looks at the properties of polymers in various states (solution, melt, solid). The chapters provide a survey of the important categories of polymers including commodity thermoplastics and fibers.
elastomers and thermosets, and engineering and specialty polymers. Basic polymer processing principles are explained as well as in-depth descriptions of the latest polymer applications in different industrial sectors. This new book reviews the field’s current state and emerging advances. With contributions from experts from both the industry and academia, this book presents the latest developments in polymer products and chemical processes.

**Principles of Polymer Engineering**

How can a scientist or engineer synthesize and utilize polymers to solve our daily problems? This introductory text, aimed at the advanced undergraduate or graduate student, provides future scientists and engineers with the fundamental knowledge of polymer design and synthesis to achieve specific properties required in everyday applications. In the first five chapters, this book discusses the properties and characterization of polymers, since designing a polymer initially requires us to understand the effects of chemical structure on physical and chemical characteristics. Six further chapters discuss the principles of polymerization reactions including step, radical chain, ionic chain, chain copolymerization, coordination and ring opening. Finally, material is also included on how commonly known polymers are synthesized in a laboratory and a factory. This book is suitable for a one-semester course in polymer chemistry and does not demand prior knowledge of polymer science.

**Fundamentals of Polymer Engineering, Third Edition**

This book has been written in a concise manner to include all fundamental aspects of polymer science including recent inventions in polymerization’s and polymers. It covers atom transfer radical polymerisation (ATRP), reversible addition-fragmentation chain transfer (RAFT), nitroxide mediated polymerisation (NMP), click chemistry as well as stereopolymerisation, ring opening metathesis polymerisation (ROMP), group transfer polymerisation (GTP), plasma polymerisation etc. in addition to the usual polymerisation mechanisms such as radical, ionic and step polymerisations. This book also includes new developments in polymer science which are considered as hot topics of functional polymers like smart or intelligent polymers, light emitting polymers, conducting polymers, magnetic polymers, optically active and/or chiral polymers, liquid crystalline polymers, self-healing polymers, polymers for biomedical applications, dendrimers and/or dendritic polymers and polymer nanocomposites etc.

**PEDOT**

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 Chemistry**

The unparalleled large-scale commercial application of poly(3,4-ethylenedioxythiophene), otherwise known as PEDOT, continues to fuel a need for literature about it that is concise, easily available, but sufficiently comprehensive. Designed to meet the requirements of readers from different areas of expertise and experience with the substance, PEDOT: Principles and Applications of an Intrinsically Conductive Polymer provides a comprehensive overview of chemical, physical, and technical information about this preeminent and most forwardly developed electrically conductive polymer. An indispensable resource for researchers, developers, and users of PEDOT—written by the researchers who succeeded in commercializing it—A necessary response to the massive interest—as well as patents and papers—spawned by PEDOT, this handbook provides basic knowledge and explores technical applications, based on information generated by universities and academic research, as well as by industrial scientists. Available in various formulations and conductivities, this versatile PEDOT can be adapted for the needs and specific industrial applications of its different users. Although valuable information exists in handbooks on polythiophene chemistry and physics, under which
This text introduces the design engineer to the basic elements and properties of polymers. These characteristics are related to solid and fluid behavior, processing, and performance of polymers.
Fundamentals of Polymer Engineering, Revised and Expanded

The new edition of a classic text and reference. The large chains of molecules known as polymers are currently used in everyday things as wash and wear clothing to rubber tires to protective enamels and paints. Yet the practical applications of polymers are only increasing. Innovations in polymer chemistry constantly bring both improved and entirely new uses for polymers onto the technological playing field. Principles of Polymerization, Fourth Edition presents the text on polymer synthesis, fully updated to reflect today's state of the art. New and expanded coverage in the Fourth Edition includes: * Metallocene and post-metallocene polymerization catalysts * Living polymerizations (radical, cationic, anionic) * Dendrimer, hyperbranched, brush, and other polymer architectures and assemblies * Graft and block copolymers * High-temperature polymers * Inorganic and organometallic polymers * Conducting polymers * Ring-opening polymerization * In vivo and in vitro polymerization. Appropriate for both novice and advanced students as well as professionals, this comprehensive yet accessible resource enables the reader to achieve an advanced, up-to-date understanding of polymer synthesis. Different methods of polymerization, reaction parameters for synthesis, molecular weight, branching and crosslinking, and the chemical and physical structure of polymers all receive ample coverage. A thorough discussion at the elementary level precedes each topic, with a more advanced treatment following. Yet the language throughout remains straightforward and geared towards the student. Extensively updated, Principles of Polymerization, Fourth Edition provides an excellent textbook for today's students of polymer chemistry, chemical engineering, and materials science, as well as a current reference for the researcher or other practitioner working in these areas.

Experimental Methods in Polymer Science

A comprehensive introduction to the concepts of joining technologies for hybrid structures. This book introduces the concepts of joining technology for polymer-metal hybrid structures by addressing current and new joining methods. This is achieved by using a balanced approach focusing on the scientific features (structural, physical, chemical, and metallurgical/polymer science phenomena) and engineering properties (mechanical performance, design, applications, etc.) of the currently available and new joining processes. It covers such topics as mechanical fastening, adhesive bonding, advanced joining methods, and statistical analysis in joining technology. Joining of Polymer-Metal Hybrid Structures: Principles and Applications is structured by joining principles, in adhesion-based, mechanical fastened, and direct-assembly methods. The book discusses such recent technologies as friction riveting, friction spot joining and ultrasonic joining. This is used for applications where the original base material characteristics must remain unchanged. Additional sections cover the main principles of statistical analysis in joining technology (illustrated with examples from the field of polymer-metal joining). Joining methods discussed include mechanical fastening (bolting, screwing, riveting, hinges, and fits of polymers and composites), adhesive bonding, and other advanced joining methods (friction staking, laser welding, induction welding, etc.). Provides a combined engineering and scientific approach used to describe principles, properties, and applications of polymer-metal hybrid joints. Describes the current developments in design of experiments and statistical analysis in joining technology with emphasis on joining of polymer-metal hybrid structures. Covers recent innovations in joining technology of polymer-metal hybrid joints including friction riveting, friction spot joining, friction staking, and ultrasonic joining. Principles illustrated by pictures, 3D-schemes, charts, and drawings using examples from the field of polymer-metal joining. Joining of Polymer-Metal Hybrid Structures: Principles and Applications will appeal to chemical, polymer, materials, metallurgical, composites, mechanical, process, product, and welding engineers, scientists and students, technicians, and joining process professionals.

Solutions Manual to Accompany Principles of Polymer Engineering

Given the infinite number of applications of polymeric materials in everyday life, especially applications where a failure in service may lead to economic loss, injury or death, the ability to determine the cause of failure using forensic engineering techniques is essential. Forensic polymer engineering. Why polymer products fail in service? Reviews the latest forensic engineering techniques used in the investigation of failed polymer materials. It presents a series of case studies which illustrate the different types of failure and the forensic engineering techniques used in their investigation. The first chapters give an introduction to forensic polymer engineering and an overview of the examination and analysis of failed polymer components. Further chapters give detailed case studies of failure and forensic investigation of polymeric medical devices, polymer storage tanks, small polymeric containers, polymer pipes and fittings, polymeric seals, polymeric tools and ladders, polymer components in transport applications and polymer consumer products. A final concluding chapter provides information on causes of product failure and discusses poor manufacturing methods, poor design, poor choice of materials and failure due to insufficient account being taken of environmental factors. With its distinguished authors, Forensic polymer engineering. Why polymer products fail in service is a standard reference for forensic experts practicing in all engineering fields that involve polymeric materials, as well as design and construction professionals, product manufacturers and insurance professionals. Reviews the latest forensic engineering techniques used in the investigation of failed polymer components. Detailed case studies illustrate different types of failure in polymer components, fittings and medical devices. Examines the role of manufacturing in product failure with an overview of faults recognised in methods, design and material selection.

Principles of Polymer Design and Synthesis

These bright home learning books are designed to appeal to both children and parents alike, with exercises extensively researched by educational specialists and fun stickers to reward progress. Attractively designed with full-colour insides and up-to-date content.
Successful characterization of polymer systems is one of the most important objectives of today’s experimental research of polymers. Considering the tremendous scientific, technological, and economic importance of polymeric materials, not only for today’s applications but for the industry of the 21st century, it is impossible to overestimate the usefulness of experimental techniques in this field. Since the chemical, pharmaceutical, medical, and agricultural industries, as well as many others, depend on this progress to an enormous degree, it is critical to be as efficient, precise, and cost-effective in our empirical understanding of the performance of polymer systems as possible. This presupposes our proficiency with, and understanding of, the most widely used experimental methods and techniques. This book is designed to fulfill the requirements of scientists and engineers who wish to be able to carry out experimental research in polymers using modern methods. Each chapter describes the principle of the respective method, as well as the detailed procedures of experiments with examples of actual applications. Thus, readers will be able to apply the concepts as described in the book to their own experiments. The book addresses the most important practical techniques for experimental research in the growing field of polymer science. The first well-documented presentation of the experimental methods in one consolidated source covers principles, practical techniques, and actual examples. Can be used as a handbook or lab manual for both students and researchers. Present ideas and methods from an international perspective. Techniques addressed in this volume include: Light Scattering, Neutron Scattering and X-Ray Scattering, Fluorescence Spectroscopy, NMR on Polymers, Rheology, Gel Experiments.

Principles of Polymers

"Describes new modification methods and applications for natural, synthetic, thermoplastic, and thermoset polymers that result from economic forces, commercial processes, and the latest research and development. Features chemical and physical technologies such as sulfonation, alkylation, acid/base hydrolysis, hydrogenation, stress orienting, annealing, crystallization, and more."

The Elements of Polymer Science and Engineering

Exploring the characterization, thermodynamics and structural, mechanical, thermal and transport behavior of polymers as melts, solutions and solids, this text covers essential concepts and breakthroughs in reactor design and polymer production and processing. It contains modern theories, end-of-chapter problems and real-world examples for a clear understanding of polymer function and development. Fundamentals of Polymer Engineering, Second Edition provides a thorough grounding in the fundamentals of polymer science for more advanced study in the field of polymers. Topics include reaction engineering of step-growth polymerization, emulsion polymerization, and polymer diffusion.

Principles of Polymer Engineering

The first textbook to cover both properties and processing of reinforced and unreinforced plastics to this level. It assumes no prior knowledge of plastics and emphasizes the practical aspects of the subject. In this second edition over half the book has been rewritten and the remainder has been updated and reorganized. Early chapters give an introduction to the types of plastics which are currently available and describe how a designer goes about selection of a plastic for a particular application. Later chapters lead the reader into more advanced aspects of mechanical design and analysis of polymer melt flow. All techniques developed are illustrated by numerous worked examples, and several problems are given at the end of each chapter - the solutions to which form an Appendix.

Fundamentals of Polymer Engineering

A well-rounded and articulate examination of polymer properties at the molecular level, Polymer Chemistry focuses on fundamental principles based on underlying chemical structures, polymer synthesis, characterization, and properties. It emphasizes the logical progression of concepts and provide mathematical tools as needed as well as fully derived problems for advanced calculations. The much-anticipated Third Edition expands and reorganizes material to better develop polymer chemistry concepts and update the remaining chapters. New examples and problems are also featured throughout. This revised edition: Integrates concepts from physics, biology, materials science, chemical engineering, and statistics as needed. Contains mathematical tools and step-by-step derivations for example problems. Incorporates new theories and experiments using the latest tools and instrumentation and topics that appear prominently in current polymer science journals. Polymer Chemistry, Third Edition offers a logical presentation of topics that can be scaled to meet the needs of introductory as well as more advanced courses in chemistry, materials science, polymer science, and chemical engineering.

Polymer Process Engineering
Principles of Polymer Engineering

Organized to present the subject clearly to a person with no prior knowledge of polymer systems. Serves also as a broadening tool for scientists and engineers with partial experience in the field. New edition has added more than 300 general references and over 35 original problems. Annotation copyrighted by Book News, Inc., Portland, OR

Polymer Science and Engineering

Maintaining a balance between depth and breadth, the Sixth Edition of Principles of Polymer Systems continues to present an integrated approach to polymer science and engineering. A classic text in the field, the new edition offers a comprehensive exploration of polymers at a level geared toward upper-level undergraduates and beginning graduate students. Revisions to the sixth edition include: A more detailed discussion of crystallization kinetics, strain-induced crystallization, block copolymers, liquid crystal polymers, and gels. New, powerful radical polymerization methods. Additional polymerization process flow sheets and discussion of the polymerization of poly styrene and poly(vinyl chloride). New discussions on the elongational viscosity of polymers and coarse-grained bead-spring molecular and tube models. Updated information on models and experimental results of rubber elasticity. Expanded sections on fracture of glassy and semicrystalline polymers. New sections on fracture of elastomers, diffusion in polymers, and membrane formation. New coverage of polymers from renewable resources. New section on X-ray methods and dielectric relaxation. All chapters have been updated and out-of-date material removed. The text contains more theoretical background for some of the fundamental concepts pertaining to polymer structure and behavior, while also providing an up-to-date discussion of the latest developments in polymerization systems. Example problems in the text help students through step-by-step solutions and nearly 300 end-of-chapter problems, many new to this edition, reinforce the concepts presented.

Essentials of Polymer Science and Engineering

Principles of Polymer Engineering 2nd edition (OUP, 1997) is a text for students in their third year. It is an integrated, complete, and stimulating introduction to polymer engineering suitable for a core course in mechanical or production engineering. It is also useful to polymer scientists wanting to know more about materials applications. This is a manual of complete solutions to all the problems in the text, written by the authors of the main text. It will be an invaluable aid to lecturers and as a tool for self-teaching.

Principles of Polymer Science

"Principles of Polymer Science introduces several basic and advanced aspects of polymers for the undergraduate and graduate students in chemistry, chemical engineering and materials science. The second and thoroughly revised edition includes the technical aspects of synthesis, characterization, behaviour and technology in a straightforward and lucid manner. Separate chapters on natural, inorganic and specialty polymers would attract readers from interdisciplinary courses."--BOOK JACKET.

Ionizing Radiation and Polymers

Radiation processing is widely employed in plastics engineering to enhance the physical properties of polymers, such as chemical resistance, surface properties, mechanical and thermal properties, particle size reduction, melt properties, material compatibility, fire retardation, etc. Drobny introduces readers to the science of ionizing radiation and its effects on polymers, and explores the technologies available and their current and emerging applications. The resulting book is a valuable guide for a wide range of plastics engineers employing ionizing radiation for polymer treatment in a range of sectors including packaging, aerospace, defense, medical devices and energy applications. Radiation resistant polymers are also explored. Unlock the potential of ionizing radiation in applications such as electron-beam curing and laser joining. Gain an understanding of the selection and safe use of radiation treatment equipment. The only detailed guide to ionizing radiation written for the plastics engineering community.

Handbook of Polymer Synthesis, Characterization, and Processing

This book is at once an introduction to polymers and an imaginative invitation to the field of polymer science and engineering as a whole, including plastics and plastics processing. Created by two of the best-known scientists in America, the text explains and helps students as well as professionals appreciate all major topics in polymer chemistry and engineering: polymerization synthesis and kinetics, applications of probability theory, structure and morphology, thermal and solution properties, mechanical properties, biological properties and plastics processing methods. Essentials of Polymer Science and Engineering, designed to supersede many standard texts (including the authors'), is unique in a number of ways. Special attention has been paid to explaining fundamentals and providing high-level visuals. In addition, the text is replete with engaging profiles of polymer chemists and their discoveries. The book explains the science of polymer engineering, and at the same time, tells the story of the field from its beginnings to the present, indicating when and how polymer discoveries have played a role in history and society. The book comes well equipped with study questions and problems and is suitable for a one- or two-semester course for chemistry students at the
undergraduate and graduate levels.

**Principles of Polymer Science and Technology in Cosmetics and Personal Care**

Your search for the perfect polymers textbook ends here - with Polymer Science and Technology. By incorporating an innovative approach and consolidating in one volume the fundamentals currently covered piecemeal in several books, this efficient text simplifies the learning of polymer science. The book is divided into three main sections: polymer fundamentals; polymer formation and conversion into useful articles; and polymer properties and applications. Polymer Science and Technology emphasizes the basic, qualitative understanding of the concepts rather than rote memorization or detailed mathematical analysis. Since the book focuses on the ultimate property of the finished product, it minimizes laborious descriptions of experimental procedures used for the characterization of polymers. Instead, the author highlights how the various stages involved in the production of the finished product influence its properties. Well-organized, clear-cut, and user-friendly, Polymer Science and Technology is an outstanding textbook for teaching junior and senior level undergraduates and first year graduate students in an introductory course covering the challenging subject of polymers.

**Forensic Polymer Engineering**

The second edition of Principles of Polymer Engineering brings up-to-date coverage for undergraduates studying materials and polymer science. The opening chapters show why plastics and rubbers have such distinctive properties and how they are affected by temperature, strain rate, and other factors. The rest of the book concentrates on how these properties can be exploited to produce functional components within the constraints placed on them. The main changes for the second edition are a new chapter on environmental issues and substantially rewritten sections on yield and fracture and forming. To request a copy of the Solutions Manual, visit: http://global.oup.com/uk/academic/physics/admin/solutions

**Principles of Polymer Systems, Sixth Edition**

The book provides a systematic and profound account of scientific challenges in fuel cell research. The introductory chapters bring readers up to date on the urgency and implications of the global energy challenge, the prospects of electrochemical energy conversion technologies, and the thermodynamic and electrochemical principles underlying the operation of polymer electrolyte fuel cells. The book then presents the scientific challenges in fuel cell research as a systematic account of distinct components, length scales, physicochemical processes, and scientific disciplines. The main part of the book focuses on theory and modeling. Theoretical tools and approaches, applied to fuel cell research, are presented in a self-contained manner. Chapters are arranged by different fuel cell materials and components, and sections advance through the hierarchy of scales, starting from molecular-level processes in proton-conducting media or electrocatalytic systems and ending with performance issues at the device level, including electrochemical performance, water management, durability, and analysis of failure mechanisms. Throughout, the book gives numerous examples of formidable scientific challenges as well as of tools to facilitate materials design and development of diagnostic methods. It reveals reserves for performance improvements and uncovers misapprehensions in scientific understanding that have misled or may continue to mislead technological development. An indispensable resource for scientifically minded and practically oriented researchers, this book helps industry leaders to appreciate the contributions of fundamental research, and leaders of fundamental research to appreciate the needs of industry.