

Ion Exchange Membranes For Electro Membrane Processes

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Ion Exchange Membranes in Aqueous, Methanolic and Ethanolic Electrolyte Solutions Frank Sarfert 2005 Ion exchange membranes serve as the selective barrier in (electro-)dialytic separation processes. To date they are applied almost exclusively to aqueous electrolyte systems. In principal, however, ion exchange membranes also should be applicable to non aqueous solutions. In order to clarify how and why the membrane behavior in non aqueous electrolyte systems deviates from aqueous systems, equilibrium and transport properties of commercial monopolar and bipolar membranes are determined experimentally for aqueous, methanolic and ethanolic sodium perchlorate solutions in this study. Based on these results the dependence of the membrane performance on solution characteristics such as the relative permittivity, the solute concentration and the ionic mobility and on membrane specifics such as the type of functional groups and the membrane morphology is discussed. Thus, evidence is found for the importance of ion pair formation in the solution as well as in the membrane phase. Both effects lead to a more or less pronounced degradation of the membrane performance. Further insights into the stationary and dynamic behavior of ion exchange membranes is obtained from a detailed, physically meaningful and dynamic bipolar membrane model. It is characterized by the consideration of four ionic species as well as solvent and electric potential, the existence of a space charge region at the cation/anion exchange layer interface, the description of non-idealities by means of solution and membrane phase activity coefficients and the solvent dissociation according to the chemical reaction model. Thus, a model is developed which is able to reproduce all observed experimental trends for both aqueous and non aqueous solutions.

Proceedings of the Symposia on Fundamentals of Electrochemical Process Design 1995

Water Resources Research Catalog 1966

Membrane Technology and Applications Richard W. Baker 2004-05-31 Table of Contents Preface Acknowledgments for the first edition Acknowledgments for the second edition 1 Overview of Membrane Science and Technology 1 2 Membrane Transport Theory 15 3 Membranes and Modules 89 4 Concentration Polarization 161 5 Reverse Osmosis 191 6 Ultrafiltration 237 7 Microfiltration 275 8 Gas Separation 301 9 Pervaporation 355 10 Ion Exchange Membrane Processes - Electrodialysis 393 11 Carrier Facilitated Transport 425 12 Medical Applications of Membranes 465 13 Other Membrane Processes 491 Appendix 523 Index 535.

In-Depth on the Fouling and Antifouling of Ion-Exchange Membranes Las'aad Damak 2021-12-31 The use of ion-exchange membranes (IEMs) has accelerated over the past two decades in a wide variety of industrial processes (electrodialysis, electro-electrodialysis, electrolysis, dialysis, etc.) for applications related to chemical, pharmaceutical and food industries, energy production, water treatments, etc. Organic and mineral fouling (or scaling) phenomena are two major factors limiting the efficiencies of IEMs processes and performances (reduction of the IEMs selectivity and stability, increase of their electrical resistance, deduction of the energy efficiency of the process, etc.) leading to significant economic losses. The current washing, cleaning and sterilization processes (anti-fouling treatments) make it possible to recover some of the IEMs performances, but frequently induce degradation on the membrane material. Another essential point in the fouling studies is the choice of the best and appropriate analysis and diagnostic technique to evaluate this or that magnitude, or observe this or that object on the surface or in the mass of the membrane. This book is focused on recent advancements in techniques for diagnosing and characterizing the fouling effects on membranes, in mechanisms governing this complex phenomenon, and in the various innovative and economically viable solutions for reducing fouling.

Overcoming Limitations of Iontronic Delivery Devices Maria Seitanidou 2020-02-17 Organic electronic devices are considered as one of the best candidates to replace conventional inorganic electronic devices due to their electronic conductive functionality, low-cost production techniques, the ability to tune their optical and electronic properties using organic chemistry, and their mechanical flexibility. Moreover, these systems are ideal for bioelectronic applications due to their softness, biocompatibility, and most importantly, their electronic and ionic transport. Indeed, these materials are compatible with biological tissues and cells improving the signal transduction between electronic devices and electrically excitable cells. As ions serve as one of the primary signal carriers of cells, they can selectively tune a cell's activity; therefore, an improved interface between electronics and biological systems can offer several advantages in healthcare, e.g. the development of efficient drug delivery devices. The main focus of this thesis is the development of electronic delivery devices. Electrophoretic delivery devices called organic electronic ion pumps (OEIPs) are used to electronically control the delivery of small ions, neurotransmitters, and drugs with high spatiotemporal resolution. This work elucidates the ion transport processes and phenomena that happen in the ion exchange membranes during ion delivery and clarifies which parameters are crucial for the ion transport efficiency of the OEIPs. This thesis shows a systematic investigation of these parameters and indicates new methods and OEIP designs to overcome these challenges. Two novel OEIP designs are developed and introduced in this thesis to improve the local ion transport while limiting side effects. OEIPs based on palladium proton trap contacts can improve the membrane permselectivity and optimize the delivery of γ -aminobutyric acid (GABA) neurotransmitters at low pH while preventing any undesired pH changes from proton transport in the biological systems. And OEIPs based on glass capillary fibers are developed to overcome the limitations of devices on planar substrates, related to more complex and larger biologically relevant ion delivery with low mobility for implantable applications. This design can optimize the transport of ions and drugs such as salicylic acid (SA) at low concentrations and at relatively much higher rates, thereby addressing a wider range of biomedically relevant applications and needs.

Electromembrane Desalination Processes for Production of Low Conductivity Water Andrej Grabowski 2010 Water of very low mineral content, i.e. low ionic conductivity, is required in many industrial processes and laboratory applications. The demand for total output volume and purity of such water has been significantly increasing during the last decades. Electromembrane processes provide a more sustainable and cost effective water purification compared to alternative processes like distillation and ion-exchange deionization. In the first part of the publication a review of processes used for deionization of water is presented and main physicochemical phenomena occurring in electromembrane processes will be discussed. The subsequent parts are devoted to the experimental verification of novel improvements for two electromembrane processes: electrodialysis and continuous electrodeionization. Considering electrodialysis, an investigation on ion-exchange membranes with profiled surfaces will be presented. It includes a section of appropriate membrane manufacturing procedures and desalination tests with profiled membranes. It turns out that electrodialysis with profiled ion-exchange membranes is superior to conventional electrodialysis with flat membranes and spacers, in particular with respect to desalination degree and reduced energy consumption. Considering continuous electrodeionization, experimental studies concerning improvements of continuous electrodeionization with bipolar membranes will be presented and discussed. Influence of ion-exchange membrane permselectivity on the product water quality is demonstrated and proposed improvements are aimed to reduce this influence. Concepts with a so-called protection compartment will be discussed and compared experimentally with a concept where the concentrate compartments are filled with ion exchange resin beads. It will be shown that improved continuous electrodeionization with bipolar membranes is able to produce ultrapure water in a quality comparable to conventional mixed-bed ion-exchangers but in a more cost effective and sustainable way.

Sustainable Water for the Future Isabel C. Escobar 2009-10-05 This book is part of a series on sustainability. Specifically, it deals with the issue of sustainable water use. Fresh sources of potable water are being depleted across the world. Pure water is the goal of water utilities as well as several industries. Well past the experimental stage, membrane processes are now a proven and reliable method of providing high-quality, cost-effective water. Membrane technologies have immediate applications to treatment of fresh, brackish and sea waters, as well as wastewater reclamation. With innovative module design and engineering, micro- and ultra-filtrations have become effective and economical for drinking water production, particularly for removal of microorganisms. Membrane bioreactors are being developed for municipal and industrial water recycling. Various membrane processes are also used to remove contaminants from industrial wastewaters. This book covers the fundamental and practical concepts and issues regarding the application of membrane technologies for sustainable water treatment. It describes and compares the effectiveness of desalination versus water recycling for long-term sustainable water use. - Describes the global water situation with respect to sustainability - Emphasizes the role of membrane technologies - Compares the strategies of water recycling and desalination

Advancement in Polymer-Based Membranes for Water Remediation Sanjay K. Nayak 2022-02-23 *Advancements in Polymer-Based Membranes for Water Remediation* describes the advanced membrane science and engineering behind the separation processes within the domain of polymer-based

membrane systems in water remediation. Emphasis has been put on several aspects, ranging from fundamental concepts to the commercialization of pressure and potential driven membranes, updated with the latest technological progresses, and relevant polymer materials and application potential towards water treatment systems. Also included in this book are advances in polymers for membrane application in reverse osmosis, nanofiltration, ultrafiltration, microfiltration, forward osmosis, and polymeric ion-exchange membranes for electrodialysis and capacitive deionization. With its critical analyzes and opinions from experts around the world, this book will garner considerable interest among actual users, i.e., scientists, engineers, industrialists, entrepreneurs and students. Evaluates water remediation using pressure driven and potential driven membrane processes Reviews emerging polymer systems for membranes preparation Offers a comprehensive analysis in the development of polymer-based membranes and their applications in water remediation Analyzes membrane performance parameters to evaluate separation efficiency for various water pollutants Covers concept-to-commercialization aspects of polymer-based membranes in terms of water purification, pollutant removal, stability and scalability

Electrochemically Enabled Sustainability Kwong-Yu Chan 2014-06-13 Electrochemically Enabled Sustainability: Devices, Materials and Mechanisms for Energy Conversion covers topics related to current research in electrochemical power sources, highlighting some of the latest concepts in electrochemical conversion for sustainability. The book examines the most recent and innovative technologies employed in battery and fuel cell technology. It introduces the fundamental concepts applied to these electrochemical power sources and provides in-depth discussion on the materials, design, and performance of these devices. Written by internationally acclaimed experts, the chapters illustrate how key technologies for sustainability are enabled by electrochemical conversion. Topics include the reduction of carbon dioxide to resolve issues of carbon capture, energy storage, and generation of portable fuel; turning waste into energy using microbial fuel cells; the promise of vanadium redox flow batteries for massive energy storage; and improved performance of hybrid devices. The book addresses numerous aspects of lithium-type batteries for vehicle propulsion and energy storage, presenting a broad range of lithium batteries, and considering nano-structuring issues, layered-structure materials, and hierarchical structure. This book provides timely coverage of critical issues in emerging and conventional technologies, presenting a wide range of electrochemical devices, related materials, and operation mechanisms. It stimulates an appreciation for the novelty of these electrochemical power sources and offers a projection of future integration of these devices in practice.

Fundamental Modeling of Membrane Systems Patricia Luis 2018-06-29 Fundamental Modelling of Membrane Systems: Membrane and Process Performance summarizes the state-of-the-art modeling approaches for all significant membrane processes, from molecular transport, to process level, helping researchers and students who carry out experimental research save time and accurately interpret experimental data. The book provides an overview of the different membrane technologies, handling micro-, ultra-, and nanofiltration, reverse and forward osmosis, pervaporation, gas permeation, supported liquid membranes, membrane contactors, membrane bioreactors and ion-exchange membrane systems. Examples of hybrid membrane systems are also included. Presents an accessible reference on how to model membranes and membrane processes Provides a clear, mathematical description of mass transfer in membrane systems Written by well-known, prominent authors in the field of membrane science

Ion Exchange Membrane Electrodialysis Yoshinobu Tanaka 2010 Industrial application of ion exchange membranes started from saline water desalination. However, now it extends widely in many fields such as drinking water or wastewater treatment, demineralisation of amino acid, whey, sugar liquor, recovery of useful components, treatment of organic substances and contributes to the improvement of our standard of living. The application of ion exchange membranes must expand further if we pay attention to unique functions of the membranes for separating ionic species from non-ionic substances or other kinds of ionic species. This book discusses the performance of an electrodialyser from the stand point of fundamental and practical views.

Current Trends and Future Developments on (Bio-) Membranes Angelo Basile 2021-12-04 Current Trends and Future Developments on (Bio-) Membranes: Techniques of Computational Fluid Dynamic (CFD) for Development of Membrane Technology provides updates on new progress in membrane processes due to various challenges and how many industrial companies and academic centers are carrying out these processes. Chapters help readers understand techniques of computational fluid dynamic (CFD) for the development of membrane technology, including an introduction to the technologies, their applications, and the advantages/disadvantages of CFD modeling of various membrane processes. In addition, the book compares these modeling methods with other traditional separation systems and covers fouling and concentration polarization problems. The book is a key reference for R&D managers interested in the development of membrane technologies as well as academic researchers and postgraduate students working in the wider areas of strategic treatments, separation and purification processes. Includes developments of membrane technologies in different applications by using CFD tools Describes CFD methods for evaluation and optimization of membrane process performance Indicates CFD method advantages over other modeling strategies for the analysis of membrane/membrane reactor processes

Membrane Technology Enhancement for Environmental Protection and Sustainable Industrial Growth Zhien Zhang 2020-12-14 This book presents a detailed discussion of the fundamentals and practical applications of membrane technology enhancement in a range of industrial processes, energy recovery, and resource recycling. To date, most books on the applications of membrane technology have mainly focused on gas pollution removal or industrial wastewater treatment. In contrast, the enhancement of various membrane processes in the areas of energy and the environment has remained largely overlooked. This book highlights recent works and industrial products using membrane technology, while also discussing experiments and modeling studies on the membrane enhancement process.

Focus on Solid State Chemistry Arte M. Newman 2007 This book on solid state chemistry presents studies of chemical, structural, thermodynamic, electronic, magnetic, and optical properties and processes in solids. Research areas include: bonding in solids, crystal chemistry, crystal growth mechanisms, diffusion epitaxy, high-pressure processes, magnetic properties of materials, optical characterisation of materials, order-disorder, phase equilibria and transformation mechanisms, reactions at surfaces, statistical mechanics of defect interactions, structural studies and transport phenomena.

60 Years of the Loeb-Sourirajan Membrane Hui-Hsin Tseng 2022-04-02 60 Years of the Loeb-Sourirajan Membrane: Principles, New Materials, Modelling, Characterization and Applications bring forth theoretical advances, novel characterization techniques, materials development, advanced treatment processes, and emerging applications of membrane-based technologies. The trigger for writing this book is the 2020, 60th anniversary of the first asymmetric polymeric membrane invented by Dr. Sidney Loeb and Dr. Srinivasa Sourirajan (University of California, Los Angeles, USA) on the breakthrough discovery of the semipermeable membrane for seawater desalination. The book places emphasis on the advances of organic and inorganic membranes in different fields, covering not only the primary application of membranes for water and wastewater treatment but also other applications dealing with energy conversion and storage, organic solvent purification, gas separation, and biomedical processes. Provides a comprehensive overview on membrane technologies from the fundamental knowledge of fabrication principle and separation mechanisms to a wide range of applications, including new/emerging processes Covers the use of new/advanced materials (both organic and inorganic), novel membrane fabrication techniques, and cutting-edge characterization methods for the development of advanced membranes Includes advances in computational modeling and simulation of membrane processes

Ion Exchange Membranes Toshikatsu Sata 2007-10-31 Various separation membranes have been developed since their discovery over half a century ago, providing numerous benefits and fulfilling many applications in our everyday lives. They lend themselves to techniques ranging from microfiltration and gas separation, to what can be considered as the most advanced technique - ion exchange. This book, aimed at academic researchers, engineers and industrialists, contains a brief history of ion exchange and goes on to explain the preparation, characterization, modification and applications of these important membranes. Discussions include the use of ion exchange in analytical and medical techniques, as well as the development of future applications.

Ion and Molecule Transport in Membrane Systems Victor Nikonenko 2021-08-10 Membranes play an enormous role in our life. Biological cell membranes control the fluxes of substances in and out of cells. Artificial membranes are widely used in numerous applications including "green" separation processes in chemistry, agroindustry, biology, medicine; they are used as well in energy generation from renewable sources. They largely mimic the structure and functions of biological membranes. The similarity in the structure leads to the similarity in the properties and the approaches to study the laws governing the behavior of both biological and artificial membranes. In this book, some physico-chemical and chemico-physical aspects of the structure and behavior of biological and artificial membranes are investigated.

Ion Exchange Membranes Yoshinobu Tanaka 2015-01-20 Fundamental study and industrial application of ion exchange membranes started over half a century ago. Through ongoing research and development, ion exchange membrane technology is now applied to many fields and contributes to the improvement of our standard of living. Ion Exchange Membranes, 2nd edition states the ion exchange membrane technology from the standpoint of fundamentals and applications. It discusses not only various phenomena exhibited by membranes but also their applications in many fields with economical evaluations. This second edition is updated and revised, featuring ten expanded chapters. New to this edition is a computer simulation program of ion-exchange membrane electrodialysis for water desalination that provides a guideline for designing, manufacturing and operating a practical-scale electrodialyser. Meant to replace experiments, this program will be an important asset to those with time and monetary budgets. New edition features ten revised and expanded chapters, providing the latest developments in ion exchange membrane technology Computer simulation program, accessible through a companion website, provides a guideline for designing, manufacturing and operating practical-scale electrodialyzers Attractive visual presentation, including many figures and diagrams

Ion Exchange: Science and Technology A.E. Rodrigues 2012-12-06 Proceedings of the NATO Advanced Study Institute on Ion Exchange: Science and Technology, Troia, Portugal, July 14-26, 1985

Membrane Technologies for Water Treatment Alberto Figoli 2016-02-18 Focuses on the application of membrane technologies in removing toxic metals/metalloids from water. Particular attention is devoted to the removal of arsenic, uranium, and fluoride. These compounds are all existing in the earth's crust at levels between two and five thousands micrograms per kg (parts per million) on average and these compounds can be considered highly toxic to humans, who are exposed to them primarily from air, food and water. In order to comply with the new maximum contaminant level, numerous studies have been undertaken to improve established treatments or to develop novel treatment technologies for removing toxic metals from contaminated surface and groundwater. Among the technologies available, applicable for water treatment, membrane technology has been identified as a promising technology to remove such toxic metals from water. The book describes both pressure driven (traditional processes, such as Nanofiltration, Reverse Osmosis, Ultrafiltration, etc) and more advanced membrane processes (such as forward osmosis, membrane distillation, and membrane bio-reactors) employed in the application of interest. Key aspect of this book is to provide information on both the basics of membrane technologies and on the results depending on the type of technology employed.

Ion Exchange Technology I Inamuddin Dr. 2012-06-02 Ion-exchange Technology I: Theory and Materials describes the theoretical principles of ion-exchange processes. More specifically, this volume focuses on the synthesis, characterization, and modelling of ion-exchange materials and their associated kinetics and equilibria. This title is a highly valuable source not only to postgraduate students and researchers but also to industrial R&D specialists in chemistry, chemical, and biochemical technology as well as to engineers and industrialists.

Bibliography of Membrane Technology Pertaining to Saline Water Desalination James M. Shackelford 1965

Ion Exchange Membranes Yoshinobu Tanaka 2015-01-19 Fundamental study and industrial application of ion exchange membranes started over half a century ago. Through ongoing research and development, ion exchange membrane technology is now applied to many fields and contributes to the improvement of our standard of living. Ion Exchange Membranes, 2nd edition states the ion exchange membrane technology from the standpoint of fundamentals and applications. It discusses not only various phenomena exhibited by membranes but also their applications in many fields with economical evaluations. This second edition is updated and revised, featuring ten expanded chapters. New to this edition is a computer simulation program of ion-exchange membrane electrodialysis for water desalination that provides a guideline for designing, manufacturing and operating a practical-scale electrodialyzer. Meant to replace experiments, this program will be an important asset to those with time and monetary budgets. New edition features ten revised and expanded chapters, providing the latest developments in ion exchange membrane technology. Computer simulation program, accessible through a companion website, provides a guideline for designing, manufacturing and operating practical-scale electrodialyzers. Attractive visual presentation, including many figures and diagrams.

Electrocatalysis in Alkaline Media and Anion Exchange Membranes for Alkaline Fuel Cells Jimmy John 2013 The central theme of this thesis is the investigations of fundamental processes of relevance to the operation of fuel cells in alkaline media. In this respect, broadly speaking, aspects of electrocatalysis in alkaline media and phenomena active in hydroxide-conducting anion exchange membranes were explored. Specifically, the electrocatalytic oxidation of formate on platinum in alkaline media was examined in detail. Results from a suite of electrochemical measurements, complemented with *in situ* mass-spectrometric measurements in the form of differential electrochemical mass spectrometry (DEMS), revealed a highly adsorbate-mediated reaction mechanism of formate oxidation. In a comparative analysis of results, the relative inactivity of formate towards oxidation, *vis-à-vis* formic acid in acidic media, is inferred to be due to the slow kinetics associated with the rate-determining steps of the formation of an electro-active adsorbate from formate and its subsequent oxidation. This mechanistic study is detailed in Chapter 3. A prototypical quaternary-ammonium based anion exchange membrane material was the subject of electroanalytical investigations into the processes relevant to the application of anion exchange membranes in fuel cells. The uptake of carbonate ions, and any subsequent carbonate precipitation in the membrane, was studied using the electrochemical quartz crystal microbalance (EQCM) technique. The EQCM studies demonstrated reversible carbonate and formate (produced simultaneously with carbonate by the oxidation of methanol) exchange in the membrane. The studies, further, established that the membranes exhibit a finite capacity of carbonate/formate uptake which would preclude any precipitation. On an associated aspect, acoustic impedance measurements showed the membranes to undergo swelling on hydration. Further, during the EQCM measurements, the extent of swelling in the membrane changed *in situ* dynamically in response to the electrochemically driven anion exchange process in the membrane. The results from these studies are documented in Chapter 4. Physical and charge transport in the membrane were probed by employing redox active molecules which are neutral and negatively charged, respectively, and the applicable transport mechanisms inferred from the electrochemical studies. Preliminary results from *ex-situ* microscopic/spectroscopic studies targeting a more detailed physicochemical understanding of the membrane phenomena are also documented. These studies are intended to be a prelude to a comprehensive *in situ* characterization of the membrane in the future that will be needed to critically address the form-function relationships in these material systems. The transport and the *ex-situ* studies form the subject matter of Chapter 5. As for the methodologies employed in this work, the theoretical and the experimental aspects of the DEMS and the EQCM techniques are presented in Chapter 2. On a related note, the development of advanced *in situ* FTIR setups is described in Chapter 6. The preliminary testing of these setups is also reported. It is expected that, in the future, these advanced spectroscopic tools would be an invaluable aid in examining electrochemical interfaces. The final chapter deals with the rotating disc electrode voltammetric studies of the oxidation of hydrogen in the presence of carbon monoxide on platinum lead (PtPb) intermetallic in acidic media. This study was motivated by the promising electrocatalytic activity of the PtPb intermetallic for formic acid and methanol oxidation in acidic media. *iii*.

Ion-Exchange Membrane Separation Processes H Strathmann 2004-01-29 Today, membranes and membrane processes are used as efficient tools for the separation of liquid mixtures or gases in the chemical and biomedical industry, in water desalination and wastewater purification. Despite the fact that various membrane processes, like reverse osmosis, are described in great detail in a number of books, processes involving ion-exchange membranes are only described in a fragmented way in scientific journals and patents; even though large industrial applications, like electrodialysis, have been around for over half a century. Therefore, this book is emphasizing on the most relevant aspects of ion-exchange membranes. This book provides a comprehensive overview of ion-exchange membrane separation processes covering the fundamentals as well as recent developments of the different products and processes and their applications. The audience for this book is heterogeneous, as it includes plant managers and process engineers as well as research scientists and graduate students. The separate chapters are based on different topics. The first chapter describes the relevant Electromembrane processes in a general overview. The second chapter explains thermodynamic and physicochemical fundamentals. The third chapter gives information about ion-exchange membrane preparation techniques, while the fourth and fifth chapter discusses the processes as unit operations giving examples for the design of specific plants. First work on the principles and applications of electrodialysis and related separation processes. Presently no other comprehensive work that can serve as both reference work and text book is available. Book is suited for teaching students and as source for detailed information.

Membrane Technology Sundergopal Sridhar 2018-09-03 Contributed by multiple experts, the book covers the scientific and engineering aspects of membrane processes and systems. It aims to cover basic concepts of novel membrane processes including membrane bioreactors, microbial fuel cell, forward osmosis, electro-dialysis and membrane contactors. Maintains a pragmatic approach involving design, operation and cost analysis of pilot plants as well as scaled-up counterparts.

Electrodialysis Technology United States. Office of Water Research and Technology 1979

Ionic Transport Processes Kyösti Kontturi 2008-07-10 Modelling of heterogeneous processes, such as electrochemical reactions, extraction or ion-exchange, usually requires solving the transport problem associated to the process. Since the processes at the phase boundary are described by scalar quantities and transport quantities are vectors or tensors, coupling of them can take place only via conservation of mass, charge or momentum. In this book, transport of ionic species is addressed in a versatile manner, emphasizing the mutual coupling of fluxes in particular. Treatment is based on the formalism of irreversible thermodynamics, *i.e.* on linear (ionic) phenomenological equations, from which the most frequently used Nernst-Planck equation is derived. Limitations and assumptions made are thoroughly discussed. The Nernst-Planck equation is applied to selected problems at the electrodes and in membranes. Mathematical derivations are presented in detail so that the reader can learn the methodology of solving transport problems. Each chapter contains a large number of exercises, some of them more demanding than others.

Water Treatment Membrane Processes AWWARF 1996 Best water filtration strategies for the '90s. Get the engineering savvy you need to capitalize on membrane technology for effective water filtration. Water Treatment Membrane Processes, by the American Water Works Association Research Foundation, enables you to use membrane filtration methods for purifying drinking water--and utilize new research for wastewater treatment. This richly illustrated guide shows you how to apply membrane processes in numerous water treatment applications. . . model membrane performance. . . and take charge of field evaluation and piloting. You'll see how to implement nanofiltration, ultrafiltration, microfiltration, and electrodialysis techniques--and make the most of membrane reactors, bioreactors and ion exchange membrane reactors.

Membrane Processes in Separation and Purification J.G. Crespo 1994-06-30 The current vigour in separations research principally derives from the need for pioneering separations processes in an emerging technology (biotechnology), from new societal emphases (reduction of chemical emissions into the environment), as well as from opportunities for achieving dramatic improvements in the efficiency of a number of manufacturing technologies through the development of a new generation of membranes (novel membrane applications). Accordingly, the

contributions to this volume are grouped into 'Membranes in Biotechnology' (11 papers), 'Membranes in Environmental Technology' (6 papers), and 'New Concepts' (4 papers). This is followed by one contribution each on 'Energy Requirements' and 'Education', i.e. membrane processes within an academic curriculum. The book thus amounts to a state-of-the-art review of applied membrane processes. Even though other texts have appeared in recent years, a more documented, practical book is needed, with a strong interaction with the collateral disciplines of materials sciences, life sciences and environmental science. This book emphasizes the need for such an integrated approach to membrane processes.

Industrial Membrane Separation Technology K. Scott 2012-12-06 Membrane science and technology is an expanding field and has become a prominent part of many activities within the process industries. It is relatively easy to identify the success stories of membranes such as desalination and microfiltration and to refer to others as developing areas. This, however, does not do justice to the wide field of separations in which membranes are used. No other 'single' process offers the same potential and versatility as that of membranes. The word separation classically conjures up a model of removing one component or species from a second component, for example a mass transfer process such as distillation. In the field of synthetic membranes, the terminology 'separation' is used in a wider context. A range of separations of the chemical/mass transfer type have developed around the use of membranes including distillation, extraction, absorption, adsorption and stripping, as well as separations of the physical type such as filtration. Synthetic membranes are an integral part of devices for analysis, energy generation and reactors (cells) in the electrochemical industry.

Comprehensive Membrane Science and Engineering Enrico Drioli 2010-07-09 This multivolume work covers all aspects of membrane science and technology - from basic phenomena to the most advanced applications and future perspectives. Modern membrane engineering is critical to the development of process-intensification strategies and to the stimulation of industrial growth. The work presents researchers and industrial managers with an indispensable tool toward achieving these aims. Covers membrane science theory and economics, as well as applications ranging from chemical purification and natural gas enrichment to potable water. Includes contributions and case studies from internationally recognized experts and from up-and-coming researchers working in this multi-billion dollar field. Takes a unique, multidisciplinary approach that stimulates research in hybrid technologies for current (and future) life-saving applications (artificial organs, drug delivery).

Membrane Separations Technology R.D. Noble 1995-01-17 The field of membrane separation technology is presently in a state of rapid growth and innovation. Many different membrane separation processes have been developed during the past half century and new processes are constantly emerging from academic, industrial, and governmental laboratories. While new membrane separation processes are being conceived with remarkable frequency, existing processes are also being constantly improved in order to enhance their economic competitiveness. Significant improvements are currently being made in many aspects of membrane separation technology: in the development of new membrane materials with higher selectivity and/or permeability, in the fabrication methods for high-flux asymmetric or composite membranes, in membrane module construction and in process design. Membrane separation technology is presently being used in an impressive variety of applications and has generated businesses totalling over one billion U.S. dollars annually. The main objective of this book is to present the principles and applications of a variety of membrane separation processes from the unique perspectives of investigators who have made important contributions to their fields. Another objective is to provide the reader with an authoritative resource on various aspects of this rapidly growing technology. The text can be used by someone who wishes to learn about a general area of application as well as by the knowledgeable person seeking more detailed information.

Mass Transfer and Kinetics of Ion Exchange L. Liberti 2012-12-06 While ion-exchange processes were originally used for the treatment of very dilute solutions, many applications for the treatment of concentrated solutions have been developed in recent years. In these situations, the mass transfer bottlenecks are located in the solid phase, rather than the liquid phase. Therefore, the development of quantitative models for ion-exchange kinetics requires knowledge about the conductance characteristics of ions and solvent in the solid phase. A useful approach towards this aim is the study of transport characteristics of these species, and of their interactions in solid ion exchange membranes. Many different transport processes and related phenomena can be observed in membrane-solution systems, e.g., ion migration, electroosmosis, diffusion and self-diffusion, osmosis, hydraulic flow, hyperfiltration (reverse osmosis) or ultrafiltration, streaming potential and streaming current, and membrane potentials (also called "membrane concentration potentials"). It is important to correlate all these phenomena so as to avoid a very large number of unnecessary measurements. Such correlation is often possible [Meares, 1976] since all these phenomena are determined by the ease of migration of the different species across the membrane. Important correlations have been made and summarized even before high-capacity ion-exchange membranes became commercially available [Sollner, 1950, 1971].

Electromembrane Processes Luigi Gurreri 2021-09-08 Electromembrane processes offer a multitude of applications, allowing for the recovery of water, other products, and energy. This book is a collection of contributions on recent advancements in electromembrane processes attained via experiments and/or models. The first paper is a comprehensive review article on the applications of electro dialysis for wastewater treatment, highlighting current status, technical challenges, and key points for future perspectives. The second paper focuses on ZSM-5 zeolite/PVA mixed matrix CEMs with high monovalent permselectivity for recovering either acid or Li^+ . The third paper regards direct numerical simulations of electroconvection in an electro dialysis dilute channel with forced flow under potentiodynamic and galvanodynamic regimes. The fourth paper investigates the reasons for the formation and properties of soliton-like charge waves in overlimiting conditions. The fifth paper focuses on the characterization of AEMs functionalized by surface modification via poly(acrylic) acid yielding monovalent permselectivity for reverse electro dialysis. In the sixth paper, CFD simulations of reverse electro dialysis systems are performed. The seventh paper proposes an integrated membrane process, including electrochemical intercalation-deintercalation, for the preparation of Li_2CO_3 from brine with a high $\text{Mg}^{2+}/\text{Li}^+$ mass ratio. Finally, the eighth paper is a perspective article devoted to the acid-base flow battery with monopolar and bipolar membranes.

Electromembrane Processes Luboš Novák 2021-12-20 The book is a comprehensive view of all electromembrane processes, including electromembrane processes for energy conversion - a currently very significant problem. The necessary theory and basic information needed for understanding the technology are explained in Part I. Materials used for ion-selective membranes and separation processes are described in Part II, and the applications for synthesis and energy conversion in Part III.

Introduction to Membrane Science and Technology Heinrich Strathmann 2011-10-17 "The objective of this book is to provide a short but reasonably comprehensive introduction to membrane science and technology suitable for graduate students and persons with engineering or natural science background to gain a basic understanding of membranes, their function and application without studying a large number of different reference books."---P. xiii.

Principles of Desalination K Spiegler 2012-12-02 Principles of Desalination focuses on the principles of the developing technology of large-scale desalting. This book presents the principal desalting methods and explores the process of hyperfiltration or reverse osmosis. Comprised of 11 chapters, this book starts with an overview of the water use and the problem of a potential water shortage. This text then discusses the fundamentals of the major desalting methods in use and explores the basic scientific and design principles that underlie the methods. Other chapters consider the method of vapor reheat distillation, which incorporates the liquid-liquid heat exchange principle. This book discusses as well the various aspects of ion exchange and explores the mechanisms in dual-purpose plants producing both distilled water and steam-turbine raised power. The final chapter considers the cost of conventional water supplies. This book is a valuable resource for technologists and scientists. Students in the graduate courses of engineering will also find this book useful.

Nanotechnology in Membrane Processes Kailash Chandra Khulbe 2021-01-09 Nanotechnology has been established in membrane technology for decades. In this book, comprehensive coverage is given to nanotechnology applications in synthetic membrane processes, which are used in different fields such as water treatment, separation of gases, the food industry, military use, drug delivery, air filtration, and green chemistry. Nanomaterials such as carbon nanotubes, nanoparticles, and dendrimers are contributing to the development of more efficient and cost-effective water filtration processes. Gas separation and carbon capture can be significantly improved in flue gas applications. Nanoporous membrane systems engineered to mimic natural filtration systems are being actively developed for use in smart implantable drug delivery systems, bio artificial organs, and other novel nano-enabled medical devices. The microscopic structure of nanoporous ceramic membranes, mainly focusing on zeolite materials, as well as the energy-saving effect of membrane separation, contribute to various chemical synthesis processes. In the food industry, nanotechnology has the potential to create new tools for pathogen detection and packaging. For each application, nanotechnology is mostly used to make composite membranes, and the book provides a detailed look at the mechanisms by which the composite membrane works in each application area.