

# Co2 Removal From Natural Gas Membranes

**H Ohya, V V Kudryavsev, S I Semenova**

*Membrane Engineering* Enrico Drioli, Lidietta Giorno, Francesca Macedonio, 2018-12-17 Modern membrane science and technology aids engineers in developing and designing more efficient and environmentally-friendly processes. The optimal material and membrane selection as well as applications in the many involved industries are provided. This work is the ideal introduction for engineers working in membrane science and applications (wastewater, desalination, adsorption, and catalysis), process engineers in separation science, biologists and biochemists, environmental scientists, and most of all students. Its multidisciplinary approach also stimulates thinking of hybrid technologies for current and future life-saving applications (artificial organs, drug delivery).

Advanced CO2 Capture Technologies Shin-ichi Nakao, Katsunori Yogo, Kazuya Goto, Teruhiko Kai, Hidetaka Yamada, 2019-05-07 This book summarises the advanced CO2 capture technologies that can be used to reduce greenhouse gas emissions, especially those from large-scale sources, such as power-generation and steel-making plants. Focusing on the fundamental chemistry and chemical processes, as well as advanced technologies, including absorption and adsorption, it also discusses other aspects of the major CO2 capture methods: membrane separation; the basic chemistry and process for CO2 capture; the development of materials and processes; and practical applications, based on the authors' R&D experience. This book serves as a valuable reference resource for researchers, teachers and students interested in CO2 problems, providing essential information on how to capture CO2 from various types of gases efficiently. It is also of interest to practitioners and academics, as it discusses the performance of the latest technologies applied in large-scale emission sources.

Gas Separation Membranes Ahmad Fauzi Ismail, Kailash Chandra Khulbe, Takeshi Matsuura, 2015-04-28 This book describes the tremendous progress that has been made in the development of gas separation membranes based both on inorganic and polymeric materials. Materials discussed include polymer inclusion membranes (PIMs), metal organic frameworks (MOFs), carbon based materials, zeolites, as well as other materials, and mixed matrix membranes (MMMs) in which the above novel materials are incorporated. This broad survey of gas membranes covers material, theory, modeling, preparation, characterization (for example, by AFM, IR, XRD, ESR, Positron annihilation spectroscopy), tailoring of membranes, membrane module and system design, and applications. The book is concluded with some perspectives about the

future direction of the field.

Membrane Technology for CO<sub>2</sub> Sequestration Zeinab Abbas Jawad,2019-03-26 This book addresses the fundamentals of CO<sub>2</sub> storage for long-term sequestration in a subsurface geologic formation. In general, membrane gas separation can find a large room of application in flue gas. To achieve the development of this technology on a larger scale than which is possible in the lab we have to use membrane engineering. Consequently, greater emphasis is placed on novel materials for gas separation. Possible design strategies and role of novel materials are discussed. Additionally, the latest progress in design and preparation of asymmetric membranes for natural gas purification are highlighted. In fact, further development should focus on module and process design in order to bring gas separation membrane technology into commercial application. Therefore, the key issues to propel current research towards industrial application are examined. Besides, the feasibility of implementing polyimide membrane for CO<sub>2</sub> removal under real industrial conditions and its economic viability are highlighted. In order to exhibit excellent film-forming properties, zeolite membrane and cellulose acetate butyrate membrane are addressed. Interestingly, it was found that the most accurate theoretical three-phase model is arguably revised Pal model with average percentage error of 0.74%.

Process Systems and Materials for CO<sub>2</sub> Capture Athanasios I. Papadopoulos, Panos Seferlis,2017-05-01 This comprehensive volume brings together an extensive collection of systematic computer-aided tools and methods developed in recent years for CO<sub>2</sub> capture applications, and presents a structured and organized account of works from internationally acknowledged scientists and engineers, through: Modeling of materials and processes based on chemical and physical principles Design of materials and processes based on systematic optimization methods Utilization of advanced control and integration methods in process and plant-wide operations The tools and methods described are illustrated through case studies on materials such as solvents, adsorbents, and membranes, and on processes such as absorption / desorption, pressure and vacuum swing adsorption, membranes, oxycombustion, solid looping, etc. Process Systems and Materials for CO<sub>2</sub> Capture: Modelling, Design, Control and Integration should become the essential introductory resource for researchers and industrial practitioners in the field of CO<sub>2</sub> capture technology who wish to explore developments in computer-aided tools and methods. In addition, it aims to introduce CO<sub>2</sub> capture technologies to process systems engineers working in the development of general computational tools and methods by highlighting opportunities for new developments to address the needs and challenges in CO<sub>2</sub> capture technologies.

**Basic Principles of Membrane Technology** Marcel Mulder,2012-12-06 III . 2 Preparation of synthetic membranes 72 III . 3 Phase inversion membranes 75 III. 3. 1 Preparation by evaporation 76 III . 3. 2 Precipitation. from the vapour phase 76 III . 3. 3 Precipitation by controlled evaporation 76 Thermal precipitation 76 III . 3. 4 III . 3. 5 Immersion precipitation 77 Preparation techniques for immersion precipitation 77 III . 4 Flat membranes 77 III . 4. 1 78 III . 4. 2 Tubular membranes 81

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**Membrane Contactors: Fundamentals, Applications and Potentialities** Enrico Drioli,A. Criscuoli,E. Curcio,2011-08-30 Membrane Contactors: Fundamentals, Applications and Potentialities, Volume 11 covers new operations that could be efficiently used to improve the performance of a variety of industrial production cycles in applications ranging from biotechnology to agrofood. This book focuses on the basic principles of work: required membrane materials and properties; major operating parameters; the importance of module configuration and design and; the performance of membrane contactors in specific processes. The authors' dynamic approach to this subject makes Membrane Contactors: Fundamentals, Applications and Potentialities, Volume 11 the most comprehensive book currently available on all aspects related to the 'membrane contactor world.\* Describes new unit operations in process engineering\* Covers a wide variety of industrial applications, from biotechnology to agrofood\* Applicable to process intensification and sustainable growth strategies

**Membrane Contactor Technology** Mohammad Younas,Mashallah Rezakazemi,2022-04-18 An eye-opening exploration of membrane contactors from a group of industry leaders In Membrane Contactor Technology: Water Treatment, Food Processing, Gas Separation, and Carbon Capture, an expert team of researchers delivers an up-to-date and insightful explanation of membrane contactor technology, including transport phenomena, design aspects, and diverse process applications. The book also includes explorations of membrane synthesis, process, and module design, as well as rarely discussed process modeling and simulation techniques. The authors discuss the technical and economic aspects of this increasingly important technology and examine the geometry, flow, energy and mass transport, and design aspects of membrane contactor modules. They also cover a wide range of application opportunities for this technology, from the materials sciences to process engineering. Membrane Contactor Technology also includes: A thorough introduction to the membrane contactor extraction process, including dispersion-free membrane extraction processes and supported liquid membrane processes Comprehensive explorations of membrane transport theory, including discussions of diffusional mass and heat transfer modeling, as well as numerical modeling In-depth examinations of module configuration and geometry,

including design and flow configuration Practical discussions of modes or operation, including membrane distillation, osmotic evaporation, and forward osmosis Perfect for process engineers, biotechnologists, water chemists, and membrane scientists, Membrane Contactor Technology also belongs in the libraries of chemical engineers, polymer chemists, and chemists working in the environmental industry.

**Membrane Engineering for the Treatment of Gases** Enrico Drioli, Giuseppe Barbieri, 2011-07-06 Membranes already have important applications in artificial organs, the processing of biotechnological products, food manufacture, waste water treatment, and seawater desalination. Their uses in gaseous mixture separations are, however, far from achieving their full potential. Separation of air components, natural gas dehumidification and sweetening, separation and recovery of CO<sub>2</sub> from biogas, and H<sub>2</sub> from refinery gases are all examples of current industrial applications. The use of membranes for reducing the greenhouse effect and improving energy efficiency has also been suggested. New process intensification strategies in the petrochemical industry have opened up another growth area for gas separation membrane systems and membrane reactors. This two volume set presents the state-of-the-art in membrane engineering for the separation of gases. It addresses future developments in carbon capture and utilization, H<sub>2</sub> production and purification, and O<sub>2</sub>/N<sub>2</sub> separation. Topics covered include the: applications of membrane gas separation in the petrochemical industry; implementation of membrane processes for post-combustion capture; commercial applications of membranes in gas separations; simulation of membrane systems for CO<sub>2</sub> capture; design and development of membrane reactors for industrial applications; Pd-based membranes in hydrogen production; modelling and simulation of membrane reactors for hydrogen production and purification; novel hybrid membrane/pressure swing adsorption process for gas separation; molecular dynamics as a new tool for membrane design, and physical aging of membranes for gas separations. Volume 1 focuses predominantly on problems relating to membranes.

**Materials for Carbon Capture** De-en Jiang, Shannon M. Mahurin, Sheng Dai, 2020-02-25 Covers a wide range of advanced materials and technologies for CO<sub>2</sub> capture As a frontier research area, carbon capture has been a major driving force behind many materials technologies. This book highlights the current state-of-the-art in materials for carbon capture, providing a comprehensive understanding of separations ranging from solid sorbents to liquid sorbents and membranes. Filled with diverse and unconventional topics throughout, it seeks to inspire students, as well as experts, to go beyond the novel materials highlighted and develop new materials with enhanced separations properties. Edited by leading authorities in the field, Materials for Carbon Capture offers in-depth chapters covering: CO<sub>2</sub> Capture and Separation of Metal-Organic Frameworks; Porous Carbon Materials: Designed Synthesis and CO<sub>2</sub> Capture; Porous Aromatic Frameworks for Carbon Dioxide Capture; and Virtual Screening of Materials for Carbon Capture. Other chapters look at Ultrathin Membranes for Gas Separation; Polymeric Membranes; Carbon Membranes for CO<sub>2</sub> Separation; and Composite Materials for Carbon Captures. The book finishes with sections on Poly(amidoamine) Dendrimers for Carbon Capture and Ionic Liquids for Chemisorption of

CO<sub>2</sub> and Ionic Liquid-Based Membranes. A comprehensive overview and survey of the present status of materials and technologies for carbon capture Covers materials synthesis, gas separations, membrane fabrication, and CO<sub>2</sub> removal to highlight recent progress in the materials and chemistry aspects of carbon capture Allows the reader to better understand the challenges and opportunities in carbon capture Edited by leading experts working on materials and membranes for carbon separation and capture Materials for Carbon Capture is an excellent book for advanced students of chemistry, materials science, chemical and energy engineering, and early career scientists who are interested in carbon capture. It will also be of great benefit to researchers in academia, national labs, research institutes, and industry working in the field of gas separations and carbon capture.

**Mixed Matrix Membranes** Clara Casado-Coterillo, 2019-12-16 Mixed matrix membranes (MMMs) have attracted a large amount of interest in research laboratories worldwide in recent decades, motivated by the gap between a growing interest in developing novel mixed matrix membranes by various research groups and the lack of large-scale implementation. This Special Issue contains six publications dealing with the current opportunities and challenges of mixed matrix membranes development and applications to solve environmental and health challenges of the society of 21st century.

*Fundamentals of Natural Gas Processing* Arthur J. Kidnay, William R. Parrish, 2006-06-21 Fundamentals of Natural Gas Processing explores the natural gas industry from the wellhead to the marketplace. It compiles information from the open literature, meeting proceedings, and experts to accurately depict the state of gas processing technology today and highlight technologies that could become important in the future. This book cov

**Carbon Dioxide Removal from Coal-Fired Power Plants** C. Hendriks, 2012-12-06

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**Hollow Fiber Membrane Contactors** Anil K. Pabby, S. Ranil Wickramasinghe, Kamallesh K. Sirkar, Ana-Maria Sastre, 2020-11-23 This book on hollow fiber contactors presents an up-to-date compilation of the latest developments and milestones in this membrane technology. Hollow Fiber Membrane Contactors: Module Fabrication, Design and Operation, and Potential Applications provides a comprehensive discussion of hollow fiber membrane applications (including a few case studies) in biotechnology, chemical, food, and nuclear engineering. The chapters in this book have been classified using the following, based on different ways of contacting fluids with each other: Gas-liquid contacting; Liquid-liquid contacting; Supported liquid membrane; Supported gas membrane; Fluid-fluid contacting. Other features include: Discusses using non-dispersive solvent extraction, hollow fiber strip dispersion, hollow fiber supported liquid membranes and role of process intensification in integrated use of these processes Provides technical and economic perspectives with several case studies related to specific scenarios Demonstrates module fabrication, design, operation and maintenance of hollow fiber contactors for different applications and performance Presents discussion on newer concepts like membrane emulsification, membrane nanoprecipitation, membrane crystallization and membrane condenser Special focus on emerging areas such as the use of hollow fiber contactor in back end of nuclear fuel cycle, membrane distillation, dehumidification of air and gas absorption and stripping Discusses theoretical analysis including computational modeling of different hollow fiber membrane processes, and presents emphasis on newly developed area of hollow fiber membrane based analytical techniques Presents discussion on upcoming area dealing with hollow fiber contactors-based technology in fermentation and enzymatic transformation and in chiral separations This book is equally suited for newcomers to the field, as well as for engineers and scientists that have basic knowledge in this field but are interested in obtaining more information about specific future applications.

**Energy Efficient Solvents for CO2 Capture by Gas-Liquid Absorption** Wojciech M. Budzianowski, 2016-12-01 This book reviews and characterises promising single-compound solvents, solvent blends and advanced solvent systems suitable for CO2 capture applications using gas-liquid absorption. Focusing on energy efficient solvents with minimal adverse environmental impact, the contributions included analyse the major technological advantages, as well as research and development challenges of promising solvents and solvent systems in various sustainable CO2 capture applications. It provides a valuable source of information for undergraduate and postgraduate students, as well as for chemical engineers and energy specialists.

Power Generation from Solid Fuels Hartmut Spliethoff, 2010-03-18 Power Generation from Solid Fuels introduces the different technologies to produce heat and power from solid fossil (hard coal, brown coal) and renewable (biomass, waste) fuels, such as combustion and gasification, steam power plants and combined cycles etc. The book discusses technologies

with regard to their efficiency, emissions, operational behavior, residues and costs. Besides proven state of the art processes, the focus is on the potential of new technologies currently under development or demonstration. The main motivation of the book is to explain the technical possibilities for reducing CO<sub>2</sub> emissions from solid fuels. The strategies which are treated are: more efficient power and heat generation technologies, processes for the utilisation of renewable solid fuels, such as biomass and waste, and technologies for carbon capture and storage. Power Generation from Solid Fuels provides, both to academia and industry, a concise treatment of industrial combustion of all types of solid, hopefully inspiring the next generation of engineers and scientists.

**Modeling in Membranes and Membrane-Based Processes** Anirban Roy, Siddhartha Moulik, Reddi Kamesh, Aditi Mullick, 2020-04-07 The book *Modeling in Membranes and Membrane-Based Processes* is based on the idea of developing a reference which will cover most relevant and “state-of-the-art” approaches in membrane modeling. This book explores almost every major aspect of modeling and the techniques applied in membrane separation studies and applications. This includes first principle-based models, thermodynamics models, computational fluid dynamics simulations, molecular dynamics simulations, and artificial intelligence-based modeling for membrane separation processes. These models have been discussed in light of various applications ranging from desalination to gas separation. In addition, this breakthrough new volume covers the fundamentals of polymer membrane pore formation mechanisms, covering not only a wide range of modeling techniques, but also has various facets of membrane-based applications. Thus, this book can be an excellent source for a holistic perspective on membranes in general, as well as a comprehensive and valuable reference work. Whether a veteran engineer in the field or lab or a student in chemical or process engineering, this latest volume in the “Advances in Membrane Processes” is a must-have, along with the first book in the series, *Membrane Processes*, also available from Wiley-Scrivener.

**Polyimide Membranes** H Ohya, V V Kudryavsev, S I Semenova, 1997-01-30 This is a first attempt to provide a general analysis of developments in polyimide membrane synthesis and applications. It will serve as a valuable reference for those with an interest in synthesis of polyimides, the chemistry and physical chemistry of polyimide compounds, the separation properties of membranes and in their preparation and application. It is intended as a summary of the current status of polyimide membrane research for the specialist as well as a teaching aid for graduate studies in polymer chemistry. The authors collaboration demonstrates the high level of scientific research in Russia and the active development of applied research in Japan.

*Advances in Sustainable Polymers* Vimal Katiyar, Raghvendra Gupta, Tabli Ghosh, 2019-11-05 This book provides a systematic overview of the processing and applications of sustainable polymers. The volume covers recent advances in biomedical, food packaging, fuel cell, membrane, and other emerging applications. The book begins by addressing different

sections of biomedical application including use of carbohydrate-based therapeutics, nanohybrids, nanohydrogels, bioresorbable polymers and their composites, polymer-grafted nanobiomaterials for biomedical devices and implants, nanofibres, and others. The second part of this book discusses various processing and packaging materials for food packaging applications. The last section discusses other emerging applications, including using microbial fuel cells for waste water treatment, microfluidic fuel cells for low power applications, among others. This volume will be relevant to researchers working to improve the properties of bio-based materials for their advanced application and wide commercialization.

Membrane Gas Separation Benny Freeman, Yuri Yampolskii, 2011-06-20 Gas separation membranes offer a number of benefits over other separation technologies, and they play an increasingly important role in reducing the environmental impacts and costs of many industrial processes. This book describes recent and emerging results in membrane gas separation, including highlights of nanoscience and technology, novel polymeric and inorganic membrane materials, new membrane approaches to solve environmental problems e.g. greenhouse gases, aspects of membrane engineering, and recent achievements in industrial gas separation. It includes: Hyperbranched polyimides, amorphous glassy polymers and perfluorinated copolymers Nanocomposite (mixed matrix) membranes Polymeric magnetic membranes Sequestration of CO<sub>2</sub> to reduce global warming Industrial applications of gas separation Developed from sessions of the most recent International Congress on Membranes and Membrane Processes, Membrane Gas Separation gives a snapshot of the current situation, and presents both fundamental results and applied achievements.

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