

Green Chemistry and Sustainable Technology

Bhalchandra M. Bhanage
Masahiko Arai *Editors*

Transformation and Utilization of Carbon Dioxide

 Springer

Transformation And Utilization Of Carbon Dioxide Green Chemistry And Sustainable Technology

**Abdel-Mohsen O. Mohamed, Maisa El
Gamal, Suhaib Hameedi**



Transformation And Utilization Of Carbon Dioxide Green Chemistry And Sustainable Technology:

Transformation and Utilization of Carbon Dioxide Bhalchandra M. Bhanage, Masahiko Arai, 2014-01-27 Transformation and Utilization of Carbon Dioxide shows the various organic polymeric and inorganic compounds which result from the transformation of carbon dioxide through chemical photocatalytic electrochemical inorganic and biological processes The book consists of twelve chapters demonstrating interesting examples of these reactions depending on the types of reaction and catalyst It also includes two chapters dealing with the utilization of carbon dioxide as a reaction promoter and presents a wide range of examples of chemistry and chemical engineering with carbon dioxide Transformation and Utilization of Carbon Dioxide is a collective work of reviews illustrative of recent advances in the transformation and utilization of carbon dioxide This book is interesting and useful to a wide readership in the various fields of chemical science and engineering

Bhalchandra Bhanage is a professor of industrial and engineering chemistry at Institute of Chemical Technology India

Masahiko Arai is a professor of chemical engineering at Hokkaido University Japan

Transformation and Utilization of Carbon Dioxide Bhalchandra M. Bhanage, Masahiko Arai, 2014-02-28 **Chemistry for Sustainable Technologies 2nd Edition** Neil Winterton, 2021-02-04

Following the success of the first edition this fully updated and revised book continues to provide an interdisciplinary introduction to sustainability issues in the context of chemistry and chemical technology Its prime objective is to equip young chemists and others to more fully to appreciate defend and promote the role that chemistry and its practitioners play in moving towards a society better able to control manage and ameliorate its impact on the ecosphere To do this it is necessary to set the ideas concepts achievements and challenges of chemistry and its application in the context of its environmental impact past present and future and of the changes needed to bring about a more sustainable yet equitable world Progress since 2010 is reflected by the inclusion of the latest research and thinking selected and discussed to put the advances concisely in a much wider setting historic scientific technological intellectual and societal The treatment also examines the complexities and additional challenges arising from public and media attitudes to science and technology and associated controversies and from the difficulties in reconciling environmental protection and global development While the book stresses the central importance of rigour in the collection and treatment of evidence and reason in decision making to ensure that it meets the needs of an extensive community of students it is broad in scope rather than deep It is therefore appropriate for a wide audience including all practising scientists and technologists Extracts from reviews of the first edition The book forms the basis for a superb training course on sustainability from a chemist's viewpoint and a wonderful introduction to the subject for undergraduates and postgraduates this unique book is highly recommended reading for all chemists Trevor Laird Org Process Res Dev 2013 17 7 991 I would even go so far as to recommend this to any serious graduate or undergraduate scientist as a must read David Harwood Reviews A Guide to Publications in the Physical Sciences 2011 12 1 9 **Transformation of Carbon Dioxide to Formic Acid and Methanol** Wan-Hui Wang, Xiujuan

Feng, Ming Bao, 2017-10-26 This brief explains the principles and fundamentals of carbon dioxide utilization and highlights the transformation to fuels and value added chemicals such as formic acid and methanol. It is divided into six chapters including an introduction to the basics of CO₂ utilization and transformation of CO₂ to formic acid and methanol with homogeneous and heterogeneous catalysts respectively. The brief will appeal to a wide readership of academic and industrial researchers focusing on homogeneous and heterogeneous catalysis, organometallic chemistry, green chemistry, energy conversion and storage.

Chemo-Biological Systems for CO₂ Utilization Ashok Kumar, Swati Sharma, 2020-09-20 Chemo Biological Systems for CO₂ Utilization describes the most recent advanced tools and techniques for carbon dioxide capture and its utilization. It discusses and compares the advantages of different systems and aids researchers and industrialists in understanding energy generation in the form of biofuels, bioelectricity or biogas using chemicals, nanomaterials and microbial enzymatic and chemo enzymatic integrated systems. It describes the importance and utilization of CO₂ in living systems and provides an overview of the various fundamental methods, policies and techniques involved in CO₂ conversion. Emphasis is placed on the production of value added products using CO₂ including biomethanol, industrial carbonates and liquid or gaseous fuels. Features: Explains the correlations between microbial, biological and chemical products and their roles in the conversion of CO₂ into usable energy and related products. Being suitable for a broad audience, it addresses fundamental treatment methods for reusing environmental waste materials. Aids in decision making and policy planning for environmental professionals. The information provided throughout this book will help researchers and professionals working in various industries to better understand the conversion of CO₂ into energy based products. Chemo Biological Systems for CO₂ Utilization also serves as a useful guide to seek alternative methods for clean energy and mitigating global climate change.

Hydrocarbon Chemistry, 2 Volume Set George A. Olah, Arpad Molnar, G. K. Surya Prakash, 2017-10-02 This book provides an unparalleled contemporary assessment of hydrocarbon chemistry, presenting basic concepts, current research and future applications. Comprehensive and updated review and discussion of the field of hydrocarbon chemistry. Includes literature coverage since the publication of the previous edition. Expands or adds coverage of carboxylation, sustainable hydrocarbons, extraterrestrial hydrocarbons. Addresses a topic of special relevance in contemporary science since hydrocarbons play a role as a possible replacement for coal, petroleum, oil and natural gas as well as their environmentally safe use. Reviews of prior edition literature coverage is comprehensive and ideal for quickly reviewing specific topics of most value to industrial chemists. Angewandte Chemie and useful for chemical engineers as well as engineers in the chemical and petrochemical industries. Petroleum Science and Technology.

Climate Change and Green Chemistry of CO₂ Sequestration Malti Goel, T. Satyanarayana, Maruthadu Sudhakar, D. P. Agrawal, 2021-05-10 The book comprises state of the art scientific reviews on carbon management strategies in response to climate change. It provides in depth information on topics relating to recent advances in carbon capture technology and its reuse in value added products. It

features contributions of leading scientists and technocrats on topics including climate change and carbon sequestration lowering carbon footprint CO₂ capture low carbon imperatives in oil industry CO₂ as refrigerant in cold chain application carbonic anhydrase mediated carbon sequestration and utilization chemical looping combustion with Indian coal CO₂ conversion to chemicals algae based biofuels and carbon capture patent landscaping analysis The contents of this book will be helpful for research scholars post graduate students industry agricultural scientists and policy makers planners

Sustainable Utilization of Carbon Dioxide Mohammad Jawaid, Anish Khan, 2023-07-08 This book covers the latest technology and experimental scientific advancements in converting carbon dioxide CO₂ from waste to useful commercial products This approach helps to mitigate climate change due to carbon emission greenhouse effect and also create a circular economy through CO₂ waste capture and utilization to produce CO₂ derived products This provides new direction for government organizations manufacturing industries fuel chemicals building materials and investment firms to work towards a zero carbon future This book caters to researchers policymakers industrial practitioners who are interested in more sustainable practices in carbon dioxide technology

Hydrogen Production and Energy Transition Marcel Van de Voorde, 2021-09-07 Carbon neutral hydrogen technologies play a key role in preventing climate change Maximizing production of hydrogen in a clean and efficient manner is critical to the hydrogen economy This book describes most of the potential hydrogen processing technologies and presents the state of the art and future developments of modern hydrogen technologies Attention has been given to the theoretical aspects thermodynamics process calculations and modeling approaches new technologies and reports of multiple successful new pilot systems The book should appeal to a broad readership and ideal for students of materials science chemistry physics for researchers chemical and mechanical engineering for industrialists policymakers economics safety agencies and governments

Advances in CO₂ Utilization Guoliang Zhang, Annemie Bogaerts, Jingyun Ye, Chang-jun Liu, 2024-03-27 This book presents the current status of CO₂ utilization from fundamental studies to industrial tests With the development of renewable energy carbon dioxide will become an important feedstock for the synthesis of fuels and chemicals and CO₂ utilization must be the final solution for the carbon dioxide issues This book discusses the effective techniques for activating inert carbon dioxide and various approaches for CO₂ conversion such as homogeneous catalytic conversion heterogeneous catalytic conversion photocatalytic conversion electrocatalytic conversion photo thermal catalytic conversion plasma chemical plasma catalytic conversion and bio catalytic conversion It also addresses the electronic and geometric structural effects of the supported catalyst on the activity and selectivity of the conversion of carbon dioxide The significant effects from single atom catalyst to nanoparticle are also discussed and process intensification in catalyst preparation and reaction is highlighted Furthermore this book contains chapters with theoretical studies including functional theory which has played an important role in the catalyst design the explanation of the reaction mechanism and in understanding the synergy of reaction and heat

and mass transfer Given its scope this book appeals to a wider readership especially for researchers in the field of CO₂ utilization

Sustainable Utilization of Carbon Dioxide in Waste Management Abdel-Mohsen O. Mohamed, Maisa El Gamal, Suhaib Hameedi, 2022-11-25 Sustainable Utilization of Carbon Dioxide in Waste Management addresses all aspects of sustainable use of carbon dioxide in waste management processes and provides best practices and process improvements for carbon sequestration in the management of a variety of waste types including carbide lime waste construction waste and reject brine effluents amongst others The book also provides underlying research on the environmental impacts of these wastes and the need for carbon capture to emphasize the importance and need for improvements of these processes Overall this information will be key to determining lifecycle benefits of CO₂ for each newly improved waste process This is an important source of information for environmental and sustainability scientists and engineers as well as academics and researchers in the field who should be trying to achieve increased carbon capture in any form of waste process to reduce environmental impact Introduces the basic principles of carbon sequestration by alkaline solid waste cement kiln dust steel slag fly ash and carbide lime wastes detailing the lack of current sustainability Provides a comprehensive resource on carbon sequestration in a variety of waste processes and practical guidance on applying them to these processes Details the need for carbon capture in these processes and the environmental impacts of not doing so Outlines the methods for determining lifecycle benefits of CO₂ for each newly developed product

Green Chemistry, Sustainable Processes, and Technologies Hirech, Kamal, El Massaoudi, Mohamed, 2025-04-22 As global environmental concerns like climate change rise green chemistry seeks to transform traditional chemical practices by incorporating renewable resources safer alternatives and cleaner technologies By reimagining how chemicals are produced and used green chemistry offers innovative solutions that not only reduce environmental impact but also enhance economic potential across industries From pharmaceuticals to energy the integration of sustainable processes paves the way for industrial growth aligned with environmental stewardship Further research will play a critical role in advancing a more sustainable and eco conscious global economy Green Chemistry Sustainable Processes and Technologies explores the innovative intersection of chemistry and sustainability focusing on the development of processes and technologies that minimize environmental impact while optimizing efficiency and safety It examines strategies for a more sustainable and eco friendly future supporting both the advancement of science and the global goals for sustainable development This book covers topics such as drug delivery environmental depollution and plant materials and is a useful resource for chemists environmental scientists biologists business owners academicians and researchers

Methanol Angelo Basile, Francesco Dalena, 2017-10-31 Methanol Science and Engineering provides a comprehensive review of the chemistry properties and current and potential uses and applications of methanol Divided into four parts the book begins with a detailed account of current production methods and their economics The second part deals with the applications of methanol providing useful insights into future applications Modeling of the various reactor systems is

covered in the next section with final discussions in the book focusing on the economic and environmental impact of this chemical Users will find this to be a must have resource for all researchers and engineers studying alternative energy sources Provides the latest developments on methanol research Reviews methanol production methods and their economics Outlines the use of methanol as an alternative green transportation fuel Includes new technologies and many new applications of methanol

Hydrogen Storage for Sustainability Marcel Van de Voorde,2021-09-07 Carbon neutral hydrogen technologies play a role in preventing climate change and the capacity to store and transport hydrogen will be critical in the growing hydrogen economy This book focuses on new developments of hydrogen storage technologies and deals with an overview of the materials and science necessary for storing hydrogen with great attention to the synthesis kinetics and thermodynamics of new advanced materials e a porous carbon and nanomaterials Ideal book for students of materials science chemistry physics for researchers chemical and mechanical engineers for industrialists policymakers safety agencies and governments

Capture and Utilization of Carbon Dioxide with Polyethylene Glycol Zhen-Zhen Yang,Qing-Wen Song,Liang-Nian He,2012-08-10 In this volume Professor He and his coworkers summarize polyethylene glycol PEG promoted CO₂ chemistry on the basis of understanding about phase behavior of PEG CO₂ system and reaction mechanism at molecular level As PEG could be utilized as a green replacement for organic solvents phase transfer catalyst surfactant support in various reaction systems significantly promoting catalytic activity and recovering expensive metal catalysts particularly regarded as a CO₂ philic material the authors focus on special applications of PEG in CO₂ capture and utilization including PEG functionalized catalysts for efficient transformation of CO₂ and PEG functionalized absorbents for efficient CO₂ capture Furthermore they describe carbon capture and utilization strategy as an alternative approach to address the energy penalty problem in carbon capture and storage Interestingly the authors also discuss PEG radical chemistry in dense CO₂ as rather creative and unusual use of PEG presumably serves as a reaction medium and a radical initiator for radical chemistry

CO₂-philic Polymers, Nanocomposites and Solvents Ashok Kumar Nadda,Swati Sharma,Susheel Kalia,2023-02-21 CO₂ philic Polymers Nanocomposites and Chemical Solvents Capture Conversion and Industrial Products is a multidisciplinary book that provides a compilation of concrete information on various polymers porous materials hydrogels membranes nanoparticles biochar metal organic frameworks bioinspired surfaces polysaccharides organic solvents chemicals eutectic solvents amine based chemical compounds porphyrins ionic liquids ceramics and cutting edge technologies for CO₂ sequestration and conversion Each chapter covers the latest developments and methods of synthesis and applications in the area The book discusses in detail valuable commercial products from CO₂ such as ethanol methanol formic acid and precursors of other fine chemicals The book covers the scientific technological and practical concepts concerning the research development and realization of CO₂ philic polymers nanocomposites and chemical solvents This makes it a valuable resource for academic researchers and graduate students in chemical engineering

materials science and chemical engineers engineers working in the industry Provides a comprehensive overview of candidates and techniques for CO₂ capture and conversion Written by worldwide experts from academia Contains numerous illustrations tables figures graphs bibliographies and extensive references Appeals to a broad academic audience with its interdisciplinary content From Glycerol to Value-Added Products Patrick Cognet, Mohamed Kheireddine Aroua, 2020-03-10 *Carbon Dioxide Utilization to Sustainable Energy and Fuels* Inamuddin, Rajender Boddula, Mohd Imran Ahamed, Anish Khan, 2021-11-30 This edited book provides an in depth overview of carbon dioxide CO₂ transformations to sustainable power technologies It also discusses the wide scope of issues in engineering avenues key designs device fabrication characterizations various types of conversions and related topics It includes studies focusing on the applications in catalysis energy conversion and conversion technologies etc This is a unique reference guide and one of the detailed works is on this technology The book is the result of commitments by leading researchers from various backgrounds and expertise The book is well structured and is an essential resource for scientists undergraduate postgraduate students faculty R D professionals energy chemists and industrial experts **Sustainable Green Catalytic Processes** Mousumi Sen, 2024-09-04 This groundbreaking book offers an in depth description of sustainable green catalytic processes that have emerged as the means to empower the existing protocols with greener sustainable and environmentally benign versions that hold enormous potential in industry and society Growing worldwide concerns about environmental pollution and global warming have directed the attention of scientists towards approaches for developing sustainable protocols and the need for employing greener and more sustainable catalytic approaches that are environmentally greener and more eco friendly than current ones Green and sustainable catalysts are the one class of catalysts that possess higher selectivity and activity efficient recovery from the reaction medium recyclability cost effectiveness and are prepared using environmentally benign preparation techniques The most potent instrument in organic synthesis and the cornerstone of green chemistry is catalysis which has broadened the possibilities for organic transformations in the direction of a sustainable future The catalyst has been playing a vital role from the improvement of reaction conditions to enhanced selectivity towards the intended product and a decrease in the creation of byproducts The purpose of this book is to highlight the developments made towards designing new catalysts homogeneous heterogeneous organocatalyst nanocatalyst photocatalyst nanophotocatalyst biocatalyst nanobiocatalyst metal catalyst etc and present the advancements in the field of chemical synthesis using greener catalytic routes with far reaching applications The other environmentally friendly method is the enzymatic synthesis of organic molecules which substitutes safe reagents for those that imitate the biosynthetic route to synthesize the desired organic molecules With its ability to produce transformations that occasionally enable the reduction of steps in a synthetic route biophotocatalysis has long been recognized as a green technology and key to creating environmentally friendly and sustainable chemistry The employment of sustainable green processes on the most crucial reaction steps of the synthetic

protocol satisfies contemporary needs for environmentally friendly operations during the creation of valuable chemicals Readers will find the book details new catalysts development designs homo and heterogeneous presents the advancement of organic synthesis using greener catalytic routes with far reaching applications elaborates on preparation techniques for green and sustainable catalysts that possess higher activity efficient recovery and cost effectiveness discusses how to epitomize a green approach towards the preparation of organic moieties via enzymatic synthesis analyzes nano catalysis with green based reagents and solvents that allow producers to follow the fundamental pillars of the green economy elucidates green chemistry s principles and metrics of the chemical s life cycle and design through disposal Audience The core audiences for this book include scientists and engineers working in green chemistry materials science photocatalysts biotechnology nanotechnology waste minimization and sustainability This book is an excellent resource for graduate students R D experts and researchers in academic and industrial fields of chemical synthesis

Facilitated Transport Membranes (FTMs) for CO₂ Capture: Overview and Future Trends Sarah Farrukh,Xianfeng Fan,Takeshi Matsuura,Syed Shujaat Karim,2023-02-13 This book highlights the importance of Facilitated Transport Membranes FTMs for the application of carbon capture covering its introduction gas transport phenomena and models reaction mechanisms industrial applications such as bio gas upgradation flue gas separation hydrogen gas and natural gas purification fabrication methods of both FTMs and their carrier mediums testing characterization techniques techno analysis with up to date trends and the future outlooks Climate change and environmental impacts are resulted due to greenhouse gases particularly CO₂ The industrial revolution is currently causing the augmented emission of greenhouse gases Therefore various technologies are being looked at to overcome these problems In which membrane technology is key among them and is envisaged for many industrial applications especially for gas separations and carbon capture Considering this FTMs are being actively investigated due to their remarkable gas separation performance This book describes the working principle of FTMs and includes case studies to explore their impact on different industrial applications Also the book highlights how FTMs are reshaping science to capture CO₂ for reducing climate and environmental impacts

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