

Ethylene Glycol Production From Syngas A New Route

This text describes water's use in the production of raw fuels, as an energy carrier (e.g., hot water and steam), and as a reactant, reaction medium, and catalyst for the conversion of raw fuels to synthetic fuels. It explains how supercritical water is used to convert fossil- and bio-based feedstock to synthetic fuels in the presence and absence of a catalyst. It also explores water as a direct source of energy and fuel, such as hydrogen from water dissociation, methane from water-based clathrate molecules, and more.

Catalysts are now widely used in both laboratory and industrial-scale chemistry. Indeed, it is hard to find any complex synthesis or industrial process that does not, at some stage, utilize a catalytic reaction. The development of homogeneous transition metal catalysts on the laboratory scale has demonstrated that these systems can be far superior to the equivalent heterogeneous systems, at least in terms of selectivity. is an increasing interest in this field of research from both an Thus, there academic and industrial point of view. In connection with the rapid developments in this area, four universities from the E.E.C (Aachen, FRG; Liege, Belgium; Milan, Italy; and Lille, France) have collaborated to organise a series of seminars for high-level students and researchers. These meetings have been sponsored by the Commission of the E.E.C and state organizations. The most recent of these meetings was held in Lille in September 1985 and this book contains updated and expanded presentations of most of the lectures given there. These lectures are concerned with the field of homogeneous transition metal catalysis and its application to the synthesis of organic intermediates and fine chemicals from an academic and industrial viewpoint. The continuing petroleum crisis which began in the early 1970s has given rise to the need to develop new feedstocks for the chemical industry.

This report presents a cost analysis of Monoethylene Glycol (MEG) production from synthesis gas (syngas) In this process, syngas is carbonylated to dimethyl oxalate intermediate, which is then hydrogenated to MEG. This report was developed based essentially on the following reference(s): (1) US Patent 4453026, issued to Ube Industries Ltd. in 1984 (2) CN Patent 102380382, issued to Shenyang University of Chemical Technology in 2012 Keywords: 1,2-Ethanediol, Carbonylation, Hydrogenation, Nitric Oxide, Ube, Fujian Research Institute on the Structure of Matter, FJIRSM, Union Carbide, ARCO, Gasification

The contributions in this book present an overview of cutting edge research on natural gas which is a vital component of world's supply of energy. Natural gas is a combustible mixture of hydrocarbon gases, primarily methane but also heavier gaseous hydrocarbons such as ethane, propane and butane. Unlike other fossil fuels, natural gas is clean burning and emits lower levels of potentially harmful by-products into the air. Therefore, it is considered as one of the cleanest, safest,

and most useful of all energy sources applied in variety of residential, commercial and industrial fields. The book is organized in 25 chapters that cover various aspects of natural gas research: technology, applications, forecasting, numerical simulations, transport and risk assessment.

This book summarizes recent advances in the processing of waste biomass resources to produce biofuels and biochemicals. Worldwide interest in clean energy sources, environmental protection, and mitigating global warming is rapidly gaining momentum and spurring on the search for alternative energy sources, especially for the transportation and industrial sectors. This book reviews the opportunities presented by low-cost organic waste materials, discussing their suitability for alternative fuel and fine chemical production, physicochemical characterization, conversion technologies, feedstock and fuel chemistry, refining technologies, fuel upgrading, residue management, and the circular economy. In addition, it explores applied aspects of biomass conversion by highlighting several significant thermochemical, hydrothermal and biological technologies. In summary, the book offers comprehensive and representative descriptions of key fuel processing technologies, energy conversion and management, waste valorization, eco-friendly waste remediation, biomass supply chain, lifecycle assessment, techno-economic analysis and the circular bioeconomy.

Advances in Organometallic Chemistry

The 5th International Symposium on Microbial Growth on C Compounds was held at the Biological 1 Center of the University of Groningen, Haren, The Netherlands, 11-16 August 1986. The meeting attracted well over 200 participants from 15 countries. This volume contains the formal presentations made at that time, which, because of the breadth of topics covered, were divided into seven sections of related papers. This meeting, under the chairmanship of Wim Harder, was both scientifically and socially very successful. This success cannot only be credited to the main presentations, but also to the well cared for 121 poster presentations, whereof the abstracts have been published separately. The series of Symposia will be continued in 1989, in the Federal Republic of Germany. We wish to acknowledge the invaluable help of Joke Daniels, Roberta Stroer-Schneider, Karin Uylert, Hansje Bartelson and Josine van Verseveld-Stroer, who retyped the manuscripts resulting in a uniform presentation of these proceedings.

A comprehensive survey of industrial organic chemicals, their useful properties, and the economic rationale for the dominant synthetic pathways. This practical guide explains where these organic building blocks of the chemical industry come from, how to make them on a commercial scale, how to price them, and how to analyze trends in demand and production of any given material. Coverage ranges from how and why different processes originated to the latest developments in high-value-added specialty chemicals.

The demand for coal use (for electricity generation) and coal products, particularly liquid fuels and chemical feedstocks, is increasing throughout the world. Traditional markets such as North America and Europe are experiencing a steady increase in demand whereas

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emerging Asian markets, such as India and China, are witnessing a rapid surge in demand for clean liquid fuels. A detailed and comprehensive overview of the chemistry and technology of coal in the twenty-first century, *The Chemistry and Technology of Coal, Third Edition* also covers the relationship of coal industry processes with environmental regulations as well as the effects of combustion products on the atmosphere. Maintaining and enhancing the clarity of presentation that made the previous editions so popular, this book: Examines the effects of combustion products on the atmosphere Details practical elements of coal evaluation procedures Clarifies misconceptions concerning the organic structure of coal Discusses the physical, thermal, electrical, and mechanical properties of coal Analyzes the development and current status of combustion and gasification techniques In addition to two new chapters, *Coal Use and the Environment* and *Coal and Energy Security*, much of the material in this edition been rewritten to incorporate the latest developments in the coal industry. Citations from review articles, patents, other books, and technical articles with substantial introductory material are incorporated into the text for further reference. *The Chemistry and Technology of Coal, Third Edition* maintains its initial premise: to introduce the science of coal, beginning with its formation in the ground to the production of a wide variety of products and petrochemical intermediates in the twenty-first century. The book will prove useful for scientists and engineers already engaged in the coal and/or catalyst manufacturing industry looking for a general overview or update on the clean coal technology as well as professional researchers and students in chemistry and engineering. In addition to enabling a clean and energy efficient future, alternative fuel sources are fast becoming a necessity for meeting today's growing demands for low-cost and convenient energy. *The Handbook of Alternative Fuel Technologies* offers a thorough guide to the science and available technologies for developing alternatives to petroleum fuel sour

This is an easily-accessible two-volume encyclopedia summarizing all the articles in the main volumes *Kirk-Othmer Encyclopedia of Chemical Technology, Fifth Edition* organized alphabetically. Written by prominent scholars from industry, academia, and research institutions, the *Encyclopedia* presents a wide scope of articles on chemical substances, properties, manufacturing, and uses; on industrial processes, unit operations in chemical engineering; and on fundamentals and scientific subjects related to the field.

Written to help the student chemist clarify the career areas and technical problems which are to be considered when chemical reactions are carried out on a large scale. Covers the research and development of consumer products based on chemical processes. Topics covered include the chemical industry and large-scale chemical manufacturing, inorganic and fermentation processes, the conversion of petroleum into purified chemical substances, and the environmental impact of these and other processes.

The importance of reconciling the continuing needs of humankind with the protection of the environment and the earth's ability to provide for those needs is now better recognised. Chemistry and chemical technology play an important role in this, though not on their own. Interdisciplinarity and multidisciplinary are, therefore, critically important concepts. This book, the first of its kind, provides an interdisciplinary introduction to sustainability issues in the context of chemistry and chemical technology. The prime objective of this book is to equip young chemists (and others) to better 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 the changes needed to bring about a more sustainable yet equitable world. Covering aspects assumed, barely addressed or neglected in previous publications - it puts Green Chemistry in a much wider (historic, scientific, technological, intellectual and societal) context and addresses complexities and challenges associated with attitudes to science and technology, media treatment of scientific and technological

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controversies and 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 a wide community of students, it is broad in scope, rather than deep. It is, therefore, appropriate to a wide audience including practising scientists and technologists.

One of the largest industrial applications of homogeneous catalysis, hydroformylation is the process whereby alkenes react with carbon monoxide and hydrogen at high temperatures in the presence of a transition metal catalyst to yield aldehydes. The resulting products are valuable intermediates in the synthesis of alcohols, esters, amines, and olefins, used in pharmaceutical chemistry and the manufacture of fragrances. This reaction was discovered around 70 years ago, and nowadays some ten million metric tons of aldehydes are produced each year. This up-to-date reference is unique in its comprehensive coverage from fundamentals to applications, summarizing the latest advances and developments in hydroformylation reactions. The two authors are at the forefront of catalysis research, and unite their expertise in synthetic and applied catalysis, as well as theoretical and analytical chemistry. As such, they provide a detailed account of the catalytic systems employed, catalyst stability and recovery, mechanistic investigations, substrate scope, and technical implementation. Chapters on multiphase hydroformylation procedures, tandem hydroformylations and other industrially applied reactions using syngas and carbon monoxide are also included. A must-have reference not only for synthetic chemists working in academic and industrial research, but also for theoreticians and analytical chemists.

The most comprehensive and up-to-date survey of five industrially important areas of catalysis, *Catalysis and Surface Science* focuses on chemicals from methanol ... hydrotreating of hydrocarbons ... catalyst preparation ... monomers and polymers ... and photocatalysis and photovoltaics. In each of these significant topics, this useful collection of articles traces state-of-the-art developments in fundamental science ... in current exploratory and applied research ... and in current technology. It outlines future trends in catalytic research and technology, and gathers together and synthesizes -- into one, single, handy reference -- the information contained in voluminous, widely scattered articles, books, and patents. As added reference features, this authoritative source provides a wealth of illustrations, including photographs, charts, tables, and line drawings ... plus useful, detailed bibliographies for further research. Written by 32 leading authorities on all aspects of catalysis, *Catalysis and Surface Science* is essential reading for chemical, industrial process, petrochemical, and electronic engineers, as well as industrial, polymer, and materials chemists. It is also a useful text for graduate students in chemistry and chemical engineering. Book jacket.

Exploring the solvent life cycle, this book provides a critical assessment on emerging solvents for academics and industrialists working with solvents, as well as policy-makers.

Born and initially developed in various industrial laboratories, mainly in U.S.A. and Germany, homogeneous phase catalytic carbon monoxide hydrogenation and alcohols and their derivatives carbonylation and homologation, have generally been considered and reviewed separately in the course of their 40 years history without concern for common

aspects in the chemical transformations and in catalysis. Thanks to researchers of Japanese companies participating in the National C 1 Chemistry Project (1980-1987) the scientific and technical approaches in this field have been unified and applied in parallel, in the light of some common aspects of the chemical reactions and mechanisms. Now, at a moment when research seems becalmed, a general presentation and discussion of the most recent topics might be an useful basis for further development of this chemistry. To delimit and simplify the discussion of the chemical aspects and the nature of the catalysts involved, the present review is limited to reactions employing homogeneous metal complexes for the direct conversion of syngas to oxygenates and to the hydrocarbonylation of these last to homologous derivatives. Since the previous practically contemporary reviews by Dombek [in Adv. Organomet. Chem. (1983)] on CO hydrogenation and by the present authors [in Asp.Homog.Catal.(Reidel Pu.1984)] on alcohol homologation fully cover the literature up to 1982, here we mainly refer to work done after 1982, and consider the cited reviews as covering the historical development of research in the 1940- 1980 period.

Hydrogen has been an important feedstock for various industries, and its global market is already valued at hundreds of billions of dollars per year. It is also playing additional roles as a clean alternative energy carrier for power generation and as a crucial feedstock in the bioeconomy. This Special Issue "Hydrogen Production Technologies" highlights different thermochemical, electrochemical, and biological technologies such as high- and low-temperature electrolyzers, microchannel reactors, sorption-enhanced reactors, multi-tubular solar reactors, and anaerobic digestors. It also covers other aspects ranging from reactor design, hydrogen storage, and process analysis of different alternatives.

Ethylene Glycol Production from Syngas - Cost Analysis - MEG E41A Intratec

This manual contains necessary and useful information and data in an easily accessible format relating to the use of membranes. Membranes are among the most important engineering components in use today, and each year more and more effective uses for membrane technologies are found - for example: water purification, industrial effluent treatment, solvent dehydration by per-vaporation, recovery of volatile organic compounds, protein recovery, bioseparations and many others. The pace of change in the membrane industry has been accelerating rapidly in recent years, occasioned in part by the demand of end-users, but also as a result of the investment in R&D by manufacturers. To reflect these changes the author has obtained the latest information from some of the leading suppliers in the business. In one complete volume this unique handbook gives practical guidance to using selected membrane processes in individual industries while also providing a useful guide to equipment selection and usage.

Environmentally acceptable alternative fuels are in demand. This book discusses the energy resources that are directly tied to the alleviation of petroleum dependence, and the science and technology in the area of alternative fuels. Various

process treatments leading to cleaner and better use of existing fuel resources are discussed. This comprehensive reference book is consistent and is helpful for students and researchers.

While strides are being made in the research and development of environmentally acceptable and more sustainable alternative fuels—including efforts to reduce emissions of air pollutants associated with combustion processes from electric power generation and vehicular transportation—fossil fuel resources are limited and may soon be on the verge of depletion in the near future. Measuring the correlation between quality of life, energy consumption, and the efficient utilization of energy, the *Handbook of Alternative Fuel Technologies, Second Edition* thoroughly examines the science and technology of alternative fuels and their processing technologies. It focuses specifically on environmental, technoeconomic, and socioeconomic issues associated with the use of alternative energy sources, such as sustainability, applicable technologies, modes of utilization, and impacts on society. Written with research and development scientists and engineers in mind, the material in this handbook provides a detailed description and an assessment of available and feasible technologies, environmental health and safety issues, governmental regulations, and issues and agendas for R&D. It also includes alternative energy networks for production, distribution, and consumption. **What's New in This Edition:** Contains several new chapters of emerging interest and updates various chapters throughout Includes coverage of coal gasification and liquefaction, hydrogen technology and safety, shale fuel by hydraulic fracturing, ethanol from lignocellulosics, biodiesel, algae fuels, and energy from waste products Covers statistics, current concerns, and future trends A single-volume complete reference, the *Handbook of Alternative Fuel Technologies, Second Edition* contains relevant information on chemistry, technology, and novel approaches, as well as scientific foundations for further enhancements and breakthroughs. In addition to its purposes as a handbook for practicing scientists and engineers, it can also be used as a textbook or as a reference book on fuel science and engineering, energy and environment, chemical process design, and energy and environmental policy.

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The *Handbook of Clean Energy Systems* brings together an international team of experts to present a comprehensive overview of the latest research, developments and practical applications throughout all areas of clean energy systems. Consolidating information which is currently scattered across a wide variety of literature sources, the handbook covers a broad range of topics in this interdisciplinary research field including both fossil and renewable energy systems. The development of intelligent energy systems for efficient energy processes and mitigation technologies for the reduction of environmental pollutants is explored in depth, and environmental, social and economic impacts are also addressed. Topics covered include: Volume 1 - Renewable Energy: Biomass resources and biofuel production; Bioenergy Utilization; Solar Energy; Wind Energy; Geothermal Energy; Tidal Energy. Volume 2 - Clean Energy Conversion Technologies: Steam/Vapor Power Generation; Gas Turbines Power Generation; Reciprocating Engines; Fuel Cells; Cogeneration and Polygeneration. Volume 3 - Mitigation Technologies: Carbon Capture; Negative Emissions System; Carbon Transportation; Carbon Storage; Emission Mitigation Technologies; Efficiency Improvements and Waste Management; Waste to Energy. Volume 4 - Intelligent Energy Systems: Future Electricity Markets;

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Diagnostic and Control of Energy Systems; New Electric Transmission Systems; Smart Grid and Modern Electrical Systems; Energy Efficiency of Municipal Energy Systems; Energy Efficiency of Industrial Energy Systems; Consumer Behaviors; Load Control and Management; Electric Car and Hybrid Car; Energy Efficiency Improvement. Volume 5 - Energy Storage: Thermal Energy Storage; Chemical Storage; Mechanical Storage; Electrochemical Storage; Integrated Storage Systems. Volume 6 - Sustainability of Energy Systems: Sustainability Indicators, Evaluation Criteria, and Reporting; Regulation and Policy; Finance and Investment; Emission Trading; Modeling and Analysis of Energy Systems; Energy vs. Development; Low Carbon Economy; Energy Efficiencies and Emission Reduction. Key features: Comprising over 3,500 pages in 6 volumes, HCES presents a comprehensive overview of the latest research, developments and practical applications throughout all areas of clean energy systems, consolidating a wealth of information which is currently scattered across a wide variety of literature sources. In addition to renewable energy systems, HCES also covers processes for the efficient and clean conversion of traditional fuels such as coal, oil and gas, energy storage systems, mitigation technologies for the reduction of environmental pollutants, and the development of intelligent energy systems. Environmental, social and economic impacts of energy systems are also addressed in depth. Published in full colour throughout. Fully indexed with cross referencing within and between all six volumes. Edited by leading researchers from academia and industry who are internationally renowned and active in their respective fields. Published in print and online. The online version is a single publication (i.e. no updates), available for one-time purchase or through annual subscription.

"Written by engineers for engineers (with over 150 International Editorial Advisory Board members), this highly lauded resource provides up-to-the-minute information on the chemical processes, methods, practices, products, and standards in the chemical, and related, industries. "

The origins of the petrochemical industry can be traced back to the 1920s when simple organic chemicals such as ethanol and isopropanol were first prepared on an industrial scale from by-products (ethylene and propylene) of oil refining. This oil-based petrochemical industry, with lower olefins and aromatics as the key building blocks, rapidly developed into the enormous industry it is today. A multitude of products that are indispensable to modern day society, from plastics to pharmaceuticals, are derived from oil and natural gas-based hydrocarbons. The industry had its heyday in the '50s and '60s when predictions of future growth rates tended to be exponential curves. However, two developments that took place in the early '70s disturbed this simplistic and optimistic view of the future. Firstly, the publication of the report for the Club of Rome on the 'Limits to Growth' emphasized the finite nature of non-renewable fossil fuel resources. Secondly, the Oil Crisis of 1973 emphasized the vulnerability of an energy and chemicals industry that is based largely on a single raw material.

A thoroughly up-to-date overview of carbonylation reactions in the presence of carbon monoxide In *Carbon Monoxide in Organic Synthesis: Carbonylation Chemistry*, expert researcher and chemist Bartolo Gabriele delivers a robust summary of the most central advances in the field of carbonylation reactions in the presence of carbon monoxide. Beginning with a brief introduction on the importance of carbon monoxide as a building block in modern organic synthesis, the author goes on to describe metal-catalyzed carbonylations utilizing iron, cobalt, nickel, copper, and manganese. Descriptions of palladium, ruthenium, and rhodium-catalyzed reactions follow, as do discussions of metal-free carbonylation processes. The book is organized by metal to make the book useful as a guide for researchers from both academia and industry whose work touches on the direct synthesis of carbonyl compounds, carboxylic acid derivatives, and heterocycles. It aims to stimulate further discoveries in this rapidly developing field. Readers will also enjoy: A thorough introduction to carbonylations promoted by first row transition metal catalysts, including cobalt-catalyzed and nickel-catalyzed carbonylations An exploration of carbonylations promoted by second row transition metal catalysts, including ruthenium-, rhodium-, palladium(0)-, and palladium(II)-catalyzed carbonylations Practical

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discussions of miscellaneous carbonylation reactions, including carbonylations promoted by third row transition metal catalysts and metal-free carbonylation processes Perfect for catalytic and organic chemists, Carbon Monoxide in Organic Synthesis: Carbonylation Chemistry is also an indispensable resource for chemists working with organometallics and industrial chemists seeking a summary of important processes used to synthesize value-added products.

The aim of this volume is to provide scientists with a comprehensive summary of new research areas in the activation of carbon monoxide, as one of the most reactive molecules, and in its applications. In order to understand the variety of the reactivity of CO, a quantum-chemical approach helps the reader to understand the binding state of CO to the solid surface (Chapter 1). The structure of the adsorbed CO can be better understood by examining its reactivity towards single crystals in the absence and in the presence of promoters (Chapter 2). The first approach in the reactivity study is that of studying catalytic activity of single crystals and structure sensitivity which are summarized in Chapter 3. One of the most prominent effects in the CO activation process is ascribed to the presence of additives, promoters which, in a real catalyst system, are far more complicated than on single crystal surfaces (Chapter 4). The original Fischer-Tropsch process applied fused iron or cobalt catalysts which were suitable for producing mainly straight chain hydrocarbons. The two most important processes involving CO activation, the new FT process and alcohol formation are discussed in Chapters 5 and 7. An important type of catalyst, the bimetallic catalysts, is discussed in Chapter 6. The role of hydrogen as one of the most frequently used partners in CO activation is discussed in Chapter 8. The field of production of specialty chemicals is an excellent example of the homogeneous catalytic activation of CO (Chapter 9). In Chapter 10 an overview is given of the industrial applications of CO chemistry and these are illustrated by working processes. The final chapter gives the reader some hints about future progress in the field.

to the Third Edition Following the success of the first two editions of this book in which the core subject matter has been retained, we have taken the opportunity to add substantial new material, including an additional chapter on that most important activity of the chemical industry, research and development. Topical items such as quality, safety and environmental issues also receive enhanced coverage. The team of authors for this edition comprises both those revising and updating their chapters and some new ones. The latter's different approach to the subject matter is reflected in the new titles: Organisational Structures - A Story of Evolution (chapter 5) and Environmental Impact of the Chemical Industry (chapter 9). The chapter on Energy retains its original title but different approach of the new authors is evident. We have updated statistics and tables wherever possible and expanded the index. We hope readers find the brief 'pen pictures' of authors to be interesting. It is worth stressing again that this book is designed to be used with its companion volume - The Chemical Industry, 2nd Edition, ed. Alan Heaton (referred to as Volume 2) - for a complete introduction to the chemical industry. Thanks are due to all contributors and to my wife Joy for typing my contributions.

Plant biomass is attracting increasing attention as a sustainable resource for large-scale production of renewable fuels and chemicals. However, in order to successfully compete with petroleum, it is vital that biomass conversion processes are designed to minimize costs and maximize yields. Advances in pretreatment technology are critical in order to develop high-yielding, cost-competitive routes to renewable fuels and chemicals. Aqueous Pretreatment of Plant Biomass for Biological and Chemical Conversion to Fuels and Chemicals presents a comprehensive overview of the currently available aqueous pretreatment technologies for cellulosic biomass, highlighting the fundamental chemistry and biology of each method, key attributes and limitations, and opportunities for future advances. Topics covered include:

- The importance of biomass conversion to fuels
- The role of pretreatment in biological and chemical conversion of biomass
- Composition and

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structure of biomass, and recalcitrance to conversion • Fundamentals of biomass pretreatment at low, neutral and high pH • Ionic liquid and organosolv pretreatments to fractionate biomass • Comparative data for application of leading pretreatments and effect of enzyme formulations • Physical and chemical features of pretreated biomass • Economics of pretreatment for biological processing • Methods of analysis and enzymatic conversion of biomass streams • Experimental pretreatment systems from multiwell plates to pilot plant operations This comprehensive reference book provides an authoritative source of information on the pretreatment of cellulosic biomass to aid those experienced in the field to access the most current information on the topic. It will also be invaluable to those entering the growing field of biomass conversion.

This book provides state-of-the-art reviews, current research, prospects and challenges of the production of biofuels and chemicals such as furanic biofuels, biodiesel, carboxylic acids, polyols and others from lignocellulosic biomass, furfurals, syngas and γ -valerolactone with bifunctional catalysts, including catalytic, and combined biological and chemical catalysis processes. The bifunctionality of catalytic materials is a concept of not only using multifunctional solid materials as activators, but also design of materials in such a way that the catalytic materials have synergistic characteristics that promote a cascade of transformations with performance beyond that of mixed mono-functional catalysts. This book is a reference designed for researchers, academicians and industrialists in the area of catalysis, energy, chemical engineering and biomass conversion. Readers will find the wealth of information contained in chapters both useful and essential, for assessing the production and application of various biofuels and chemicals by chemical catalysis and biological techniques.

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