

Catalysis  
by  
Metal  
Complexes

*Metalloporphyrins  
Catalyzed  
Oxidations*

*Edited by  
F. Montanari  
and  
L. Casella*

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# Metalloporphyrins Catalyzed Oxidations

**Jianbo Wang, Chi-Ming Che, Michael P.  
Doyle**



## **Metalloporphyrins Catalyzed Oxidations:**

**Metalloporphyrins Catalyzed Oxidations** F. Montanari, L. Casella, 2013-11-11 Oxidative catalysis by metalloporphyrin systems occupies a prominent role in the current research in the fields of chemical and biological catalysis. Our particular interest and approach has been to collect in the same volume papers dealing with both the chemical and biological aspects of the reactivity of heme systems because of the realization that a better understanding of the complementary discipline can be extremely useful for the researchers from either field. The current progress of the research on synthetic metalloporphyrin catalysts has led to the development of several systems that are able to reproduce the heme enzyme mediated oxygenation and oxidation reactions at least in terms of reaction types, mechanisms and often rates. These achievements have stimulated the of creating metalloporphyrin catalysts which are both ambitious project efficient and stable enough to become competitive for large scale industrial processes. Although this project is still far from being realized the efforts in this direction parallel those aimed at the application of heme enzymes to chemical technologies e.g. for the mild selective oxidation of organics or the detoxification of pollutants. Both the two approaches will be advantageous because while the enzyme systems can achieve selectivities which are probably unattainable by synthetic catalysts the latter can be active under experimental conditions that would readily inactivate the enzymes. Metalloporphyrins in Catalytic Oxidations Roger A. Sheldon, 1994-06-28 This volume provides an in depth overview of the chemistry of metalloporphyrins as oxidation catalysts in chemical and biological systems. It discusses practical techniques for the synthesis of metalloporphyrins and introduces useful methods of immobilization to improve their synthetic utility. Detailed discussions of underlying mechanistic features are provided. Biomimetic Oxidations Catalyzed By Transition Metal Complexes Bernard Meunier, Gary Brudvig, Jennifer L. McClain, Shun-ichi Murahashi, V. L. Pecoraro, D. Riley, Anne Robert, J. A. Rodriguez, R. A. Sheldon, J. S. Valentine, C. Young, James M. Mayer, Julian Limburg, Jinbo Lee, Diane Cabelli, R. H. Crabtree, Sergiu M. Gorun, John T. Groves, Zhengbo Hu, K. U. Ingold, Kenneth D. Karlin, Naruyoshi Komiyama, Marie-aude Kopf, Hans Jorg Krueger, H. Zhu, 2000-03-08 Since the classic work *Metal Catalyzed Oxidations of Organic Compounds* edited by R. A. Sheldon and J. K. Kochi 1991 no book has been devoted to advances in the field of biomimetic oxidations which was created nearly 18 years ago. This expanding research field is covered in this volume. All the different aspects of the modeling of oxidations catalyzed by metalloenzymes are dealt with. This invaluable book will be useful to postgraduates as well as researchers in academia and industry and will also benefit second year university students. *Metal-Oxo and Metal-Peroxo Species in Catalytic Oxidations* B. Meunier, 2003-09-04 The present volume is a description of the current knowledge on the different metal oxo and metal peroxo species which are involved in catalytic oxidations. These highly reactivity metal oxygen species are the key intermediates in heme or non heme oxygenases as well as in metal catalyzed oxidations. The accumulated knowledge on these reactive entities will facilitate a better understanding of the different intermediates involved in the catalytic cycles of enzymes like cytochromes P 450 non heme

oxygenases copper oxygenases in the oxidation of water by the manganese center of Photosystem II in the chemistry of dioxiranes and also in DNA cleavage performed by activated bleomycin The description of these metal oxo and metal peroxo species is based on physico chemical data reactivity results and also on theoretical calculations *The Porphyrin Handbook, Volume 4* Karl Kadish, Kevin M. Smith, Roger Guilard, 2000 How I Feel books help children ages 2-6 recognize and identify their emotions and give them a vocabulary to describe what they are feeling If children can name an emotion they are on their way to understanding it And when children can talk about what they are feeling their parents will be better able to help them Features 8 x 8 24 page hardcover or softcover full color picture book Each book includes an activity card and reusable stickers Question answer format stimulates conversation between parent and child *Enzyme Catalysis Today and the Chemistry of the 21st Century* Gertz I. Likhtenshtein, 2025-02-17 This book examines enzymatic reactions from the standpoint of physical chemistry An introductory chapter gives a brief overview of the role of enzymes in metabolism biotechnology and medicine while describing the framework for chemical mimicry of enzyme reactions Subsequent chapters of the book are devoted to a general overview of vital enzyme processes methods of enzyme kinetic reactions the theory of elementary mechanisms oriental dynamic and polar factors affecting enzyme catalysts as well as the current status and prospects of enzyme chemical modeling The book gives particular attention to chemical reactions highly important in modern research efforts such as the conversion of light energy into chemical energy with a high quantum yield photooxidation of water reduction of atmospheric nitrogen and utilization of carbon dioxide in ambient conditions The book is intended for scientists working on enzyme catalysis and the adjacent areas such as chemical modeling of biological processes homogeneous catalysis biomedical research biotechnology and bioengineering In addition it can serve as secondary instructional material for graduate and undergraduate students of chemistry medicine biochemistry biophysics biophysiology and bioengineering

**Catalytic Activation of Dioxygen by Metal Complexes** László I. Simándi, 2012-12-06 The activation of dioxygen by metal ions has both synthetic potential and biological relevance Dioxygen is the cleanest oxidant for use in emission free technologies to minimize pollution of the environment The book gives a survey of those catalyst systems based on metal complexes which have been discovered and studied in the last decade They activate molecular oxygen and effect the oxidation of various organic compounds under mild conditions Much of the recent progress is due to a search for biomimetic catalysts that would duplicate the action of metalloenzymes Mechanistic aspects are emphasized throughout the book An introductory chapter reviews the chemistry of transition metal dioxygen complexes which are usually the active intermediates in the catalytic reactions discussed Separate chapters are devoted to oxidation of saturated unsaturated and aromatic hydrocarbons phenols catechols oxo compounds phosphorus sulfur and nitrogen compounds **Third World Congress on Oxidation Catalysis** S.T. Oyama, A.M. Gaffney, J.E. Lyons, R.K. Grasselli, 1997-09-12 The overall theme of the 3rd World Congress is Atom Efficient Catalytic Oxidations for Global Technologies This theme was chosen to stimulate the

participants to report their findings with an emphasis on conserving valuable material in their catalytic transformations as well as conserving energy in an environmentally responsible manner Progress towards this stated goal is substantial as evidenced by the tremendous response of the community in their participation of quality publications compiled in these Proceedings of the Congress The subjects presented span a wide range of oxidation reactions and catalysts These include the currently important area of lower alkane oxidation to the corresponding olefins unsaturated aldehydes acids and nitriles The four featured lectures and seven plenary lectures constitute the general background and overview of the subject matter at hand The 104 contributed papers and 13 poster manuscripts summarized in this compendium probe new avenues to achieve catalytically efficient oxidation reactions for the future needs of mankind in a global environment *Biomimetics* Amitava Mukherjee, 2010-03-01 Nature's evolution has led to the introduction of highly efficient biological mechanisms Imitating these mechanisms offers an enormous potential for the improvement of our day to day life Ideally by bio inspiration we can get a better view of nature's capability while studying its models and adapting it for our benefit This book takes us into the interesting world of biomimetics and describes various arenas where the technology is applied The 25 chapters covered in this book disclose recent advances and new ideas in promoting the mechanism and applications of biomimetics *The Porphyrin Handbook* Roger Guilard, Karl Kadish, Kevin M. Smith, 2012-12-02 The Porphyrin Handbook Volume 11 Bioinorganic and Bioorganic Chemistry presents the fundamental aspects of the synthesis structure chemistry and spectroscopy of phthalocyanines This book discusses the biology and medical implications of porphyrin systems Organized into seven chapters this volume begins with an overview of the design synthesis and study of the structural and functional models of heme copper terminal oxidases This text then examines the proteins containing iron protoporphyrin IX heme which play key roles in photosynthesis and respiration Other chapters consider the syntheses of chiral porphyrin derivatives and summarize the uses of such compounds in enantioselective control This book discusses as well the reactivity and synthesis of synthetic carbene metalloporphyrins The final chapter deals with the B12 coenzymes which is the most complex and physiologically important organometallic enzymatic reactions that directly depend on the reactivity of metal coordinated organic ligands This book is a valuable resource for research scientists clinicians and engineers *Bioinorganic Chemistry* D.P. Kessissoglou, 2012-12-06 Bioinorganic chemistry is primarily concerned with the role of metal atoms in biology and is a very active research field However even though such important structures of metalloenzymes are known as the MoFeCo of nitrogenase Cu or Mn superoxide dismutase and plastocyanin the synthetic routes to the modelling of such centers remains a matter of acute scientific interest Other metalloenzymes such as the Mn center of the oxygen evolving complex of PSII are still the focus of in depth examination both spectroscopic and structural Another area of concern is the interaction between drugs and metals and metal ion antagonism Understanding the chemistry of metal ions in biological systems will bring benefits in terms of understanding such problems as biomineralization and the production of advanced materials by micro

organisms The 29 contributions to Bioinorganic Chemistry An Inorganic Perspective of Life give an excellent summary of the state of the art in this field covering areas from the NMR of paramagnetic molecules to the use of lanthanide porphyrins in artificial batteries

**New Developments in Selective Oxidation II** V. Cortés Corberán, S. Vic Bellón, 1994-06-21 This volume contains invited papers and communications presented at the Second World Congress and Fourth European Workshop Meeting on New Developments in Selective Oxidation The purpose of the meeting was to present new topics and recent advances as well as the discussion of new aspects of fundamental and applied aspects of partial selective oxidation in heterogeneous and homogeneous catalysis The following topics were discussed New processes for fine chemicals by catalytic oxidation Recent developments in surface chemistry of oxide catalysts Novel catalytic systems and preparation methods Heterogenized homogeneous oxidation catalysts Selective oxidation and oxidative dehydrogenation of alkanes New industrial developments based on catalytic oxidation reactions Bio photo and electro catalytic oxidation Oxidation by other agents than dioxygen Bifunctional metal on metal oxide catalysts for selective oxidation This book provides a valuable set of data on selective oxidation reactions which will be extremely useful to catalyst and related practitioners whether fundamentalists or highly applied and to process engineers who wish to evaluate current findings in this field

**New Developments in Selective Oxidation** G. Centi, F. Trifiró, 1990-04-26 Approx 890 pages

Advances in Catalytic Activation of Dioxygen by Metal Complexes László I. Simándi, 2006-04-11 The subject of dioxygen activation and homogeneous catalytic oxidation by metal complexes has been in the focus of attention over the last 20 years The widespread interest is illustrated by its recurring presence among the sessions and subject areas of important international conferences on various aspects of bioinorganic and coordination chemistry as well as catalysis The most prominent examples are ICCO ICBIC EUROBIC ISHC and of course the ADHOC series of meetings focusing on the subject itself Similarly the number of original and review papers devoted to various aspects of dioxygen activation are on the rise This trend is due obviously to the relevance of catalytic oxidation to biological processes such as dioxygen transport and the action of oxygenase and oxidase enzymes related to metabolism The structural and functional modeling of metalloenzymes particularly of those containing iron and copper by means of low molecular complexes of iron copper ruthenium cobalt manganese etc have provided a wealth of indirect information helping to understand how the active centers of metalloenzymes may operate The knowledge gained from the study of metalloenzyme models is also applicable in the design of transition metal complexes as catalysts for specific reactions This approach has come to be known as biomimetic or bioinspired catalysis and continues to be a fruitful and expanding area of research

*Transition Metal-Catalyzed Carbene Transformations* Jianbo Wang, Chi-Ming Che, Michael P. Doyle, 2021-12-20 Presents an up to date overview of the rapidly growing field of carbene transformations Carbene transformations have had an enormous impact on catalysis and organometallic chemistry With the growth of transition metal catalyzed carbene transformations in recent decades carbene transformations are today an important compound class in

organic synthesis as well as in the pharmaceutical and agrochemical industries Edited by leading experts in the field Transition Metal Catalyzed Carbene Transformations is a thorough summary of the most recent advances in the rapidly expanding research area This authoritative volume covers different reaction types such as ring forming reactions and rearrangement reactions details their conditions and properties and provides readers with accurate information on a wide range of carbene reactions Twelve in depth chapters address topics including carbene C H bond insertion in alkane functionalization the application of engineered enzymes in asymmetric carbene transfer progress in transition metal catalyzed cross coupling using carbene precursors and more Throughout the text the authors highlight novel catalytic systems transformations and applications of transition metal catalyzed carbene transfer Highlights the dynamic nature of the field of transition metal catalyzed carbene transformations Summarizes the catalytic radical approach for selective carbene cyclopropanation high enantioselectivity in X H insertions and bio inspired carbene transformations Introduces chiral N N dioxide and chiral guanidine based catalysts and different transformations with gold catalysis Discusses approaches in cycloaddition reactions with metal carbenes and polymerization with carbene transformations Outlines multicomponent reactions through gem difunctionalization and transition metal catalyzed cross coupling using carbene precursors Transition Metal Catalyzed Carbene Transformations is essential reading for all chemists involved in organometallics including organic and inorganic chemists catalytic chemists and chemists working in industry

*Advances in Organometallic Chemistry and Catalysis* Armando J. L. Pombeiro, 2013-10-11 A contemporary compilation of recent achievements in organometallic chemistry The prestigious International Conference on Organometallic Chemistry ICOMC was launched in 1963 providing a forum for researchers from around the world to share their findings and explore new paths to advance our knowledge and application of organometallic chemistry The 25th ICOMC held in Lisbon in 2012 gathered more than 1 200 participants from 54 countries This volume celebrates the 25th Silver Edition and the 50th Gold Year of the ICOMC Featuring contributions from invited 25th ICOMC speakers *Advances in Organometallic Chemistry and Catalysis* highlights recent achievements and new and emerging areas of research in the field Its seven sections cover Activation and Functionalization of Carbon Single Bonds and Small Molecules Organometallic Synthesis and Catalysis Organometallic Polymerization Catalysis Organometallic Polymers and Materials Organometallic Chemistry and Sustainable Energy Bioorganometallic Chemistry Organometallic Electrochemistry Chapters discuss fundamental underlying concepts offer illustrative examples and cases and explore future avenues for continued research Readers will discover basic principles and properties of organometallic compounds reaction mechanisms and detailed descriptions of current applications Collectively these chapters underscore the versatility richness and potential of modern organometallic chemistry including its interrelationships with other scientific disciplines All the contributions are extensively referenced providing a gateway to the most important original research papers and reviews in organometallic chemistry Presenting a contemporary understanding of organometallic chemistry and its many applications

Advances in Organometallic Chemistry and Catalysis is recommended for all researchers in the field from students to advanced investigators

*Enantioselective Epoxidation of Unfunctionalized Olefins Catalyzed by Threitol-strapped Metalloporphyrins* Virgil James Lee, 1992

Modern Oxidation Methods Jan-Erling Bäckvall, 2011-08-02 While rust is an unwanted oxidation reaction there are also many other useful oxidation reactions that are extremely important and number among the most commonly used reactions in the chemical industry This completely revised updated second edition now includes additional sections on industrial oxidation and biochemical oxidation Edited by one of the world leaders in the field high quality contributions cover every important aspect from classical to green chemistry methods Recent Developments in Metal catalyzed Dihydroxylation of Alkenes Transition Metal Catalyzed Epoxidation of Alkenes Organocatalytic Oxidation Ketone Catalyzed Asymmetric Epoxidation of Alkenes and Synthetic Applications Catalytic Oxidations with Hydrogen Peroxide in Fluorinated Alcohol Solvents Modern Oxidation of Alcohols using Environmentally Benign Oxidants Aerobic Oxidations and Related Reactions Catalyzed by N-Hydroxyphthalimide Ruthenium Catalyzed Oxidation for Organic Synthesis Selective Oxidation of Amines and Sulfides Liquid Phase Oxidation Reactions Catalyzed by Polyoxometalates Oxidation of Carbonyl Compounds Manganese Catalyzed Oxidation with Hydrogen Peroxide Biooxidation with Cytochrome P450 Monooxygenases By providing an overview of this vast topic the book represents an unparalleled aid for organic catalytic and biochemists working in the field

**Activation and Catalytic Reactions of Saturated Hydrocarbons in the Presence of Metal Complexes** A.E. Shilov, Georgiy B. Shul'pin, 2006-04-11 Chemistry is the science about breaking and forming of bonds between atoms One of the most important processes for organic chemistry is breaking bonds C-H as well as C-C in various compounds and primarily in hydrocarbons Among hydrocarbons saturated hydrocarbons alkanes methane ethane propane hexane etc are especially attractive as substrates for chemical transformations This is because on the one hand alkanes are the main constituents of oil and natural gas and consequently are the principal feedstocks for chemical industry On the other hand these substances are known to be the less reactive organic compounds Saturated hydrocarbons may be called the noble gases of organic chemistry and if so the first representative of their family methane may be compared with extremely inert helium As in all comparisons this parallel between noble gases and alkanes is not fully accurate Indeed the transformations of alkanes including methane have been known for a long time These reactions involve the interaction with molecular oxygen from air burning the main source of energy as well as some mutual interconversions of saturated and unsaturated hydrocarbons However all these transformations occur at elevated temperatures higher than 300-500 °C and are usually characterized by a lack of selectivity The conversion of alkanes into carbon dioxide and water during burning is an extremely valuable process but not from a chemist viewpoint

Redox-Active Therapeutics Ines Batinić-Haberle, Júlio S. Rebouças, Ivan Spasojević, 2016-10-13 This essential volume comprehensively discusses redox active therapeutics focusing particularly on their molecular design mechanistic pharmacological and medicinal aspects The first section of the book describes the basic



aspects of the chemistry and biology of redox active drugs and includes a brief overview of the redox based pathways involved in cancer and the medical aspects of redox active drugs assuming little in the way of prior knowledge Subsequent sections and chapters describe more specialized aspects of central nervous system injuries neurodegenerative diseases pain radiation injury and radioprotection such as of brain lungs head and neck and erectile function and neglected diseases e g leishmaniasis It encompasses several major classes of redox active experimental therapeutics which include porphyrins salens nitrones and most notably metal containing e g Mn Fe Cu Zn Sb drugs as either single compounds or formulations with nanomaterials and quantum dots Numerous illustrations tables and figures enhance and complement the text extensive references to relevant literature are also included Redox Active Therapeutics is an invaluable addition to Springer s Oxidative Stress in Applied Basic Research and Clinical Practice series It is essential reading for researchers clinicians and graduate students interested in understanding and exploring the Redoxome the organism redox network as an emerging frontier in drug design redox biology and medicine

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