

DEVELOPMENTS IN FULLERENE SCIENCE

# Radical Reactions of Fullerenes and their Derivatives

by  
Boris Tumanskii and Oleg Kalina

Kluwer Academic Publishers

# Radical Reactions Of Fullerenes And Their Derivatives

**Jean-Luc Montchamp**



## Radical Reactions Of Fullerenes And Their Derivatives:

**Radical Reactions of Fullerenes and their Derivatives** B.L. Tumanskii, O. Kalina, 2006-04-11 The discovery of fullerenes species belonging to the electron deficient polyalkenes with weakly conjugated double bonds has opened novel opportunities for the radical chemistry Pioneering study in this field was performed by P J Krusic E Wasserman P N Keizer J R Morton and K F Preston Science 1991 254 1184 The fullereryl radical adducts formed via addition of atoms or free radicals to fullerenes have no analogs in organic chemistry In fact radicals in which the unpaired electrons are delocalized over the surface of a sphere or ellipsoid have never been studied before The unusual character of the fullereryl radicals is also due to the fact that they occupy a sort of intermediate position between the planar and tetrahedral radicals Thus the elucidation of the characteristic features of fullereryl radicals and their reactivity by EPR spectroscopy and the comparison of the results with those of quantum chemical studies are of fundamental importance Isolation of the products from homolytic reactions of fullerenes in bulk amounts opens the door to large scale preparation of new organic and organoelement derivatives of including biologically active ones Radical reactions of fullerenes find wide application in the synthesis of fullerene containing polymers with valuable photophysical characteristics Ferromagnetism of the complex of with tetra dimethylamino ethylene found lends impetus to a search of novel methods for preparation of biradicals one unpaired electron of those is located on the fullerene cage while the other retained by the addend

*Radical Reactions of Fullerenes and Their Derivatives* B L Tumanskii, O Kalina, 2014-01-15 The discovery of fullerenes has opened novel opportunities for radical chemistry The fullereryl radical adducts formed via addition of atoms or free radicals to fullerenes have no analogs in organic chemistry Thus the elucidation of the characteristic features of fullereryl radicals and their reactivity by EPR spectroscopy is of fundamental importance Isolation of the products from homolytic reactions of fullerenes in bulk amounts opens the door to large scale preparation of new organic and organoelement derivatives of C<sub>60</sub> including biologically active ones Radical reactions of fullerenes find wide application in the synthesis of fullerene containing polymers with valuable photophysical characteristics Ferromagnetism of the complex of C<sub>60</sub> with tetra dimethylamino ethylene lends impetus to a search for novel methods for preparation of biradicals with one unpaired electron located on the fullerene cage and the other retained by the addend This book covers the results of studies on homolytic reactions of fullerenes the structures and reactivities of fullereryl radicals performed by EPR quantum chemical and other methods Examples of the application of radical reactions of fullerenes in the synthesis and typical methods for their investigation are given This book is intended for researchers working in chemistry of homolytic reactions as well as for fullerene scientists

*Fullerene Research Advances* Carl N. Kramer, 2007 Until 1985 the chemical element Carbon was only known to exist in two forms diamond and graphite This changed when Kroto and co workers discovered an entirely new form of carbon which became known as C<sub>60</sub> or the fullerene molecule This discovery later led to their award of the 1996 Nobel Prize in Chemistry The original discovery of C<sub>60</sub> was in

the soot produced from the laser ablation of graphite Since then other methods of production have been developed It is also thought that isolated C<sub>60</sub> molecules may be found in stars and interstellar media It was soon discovered that C<sub>60</sub> is not the only ball like carbon molecule possible although it is the most stable and the most dominant The rugby ball shaped C<sub>70</sub> molecule is another possibility In nanotechnology the potential applications of carbon nanotubes formed by combining hexagonal rings of carbon atoms only rather than hexagons and pentagons as in C<sub>60</sub> for very small electronic devices are currently the subject of much activity This book presents the latest research in this dynamic field CRC Handbook of Organic Photochemistry and Photobiology, Volumes 1 & 2 William M. Horspool, Francesco Lenci, 2003-09-29 The second edition of this best selling handbook is bigger more comprehensive and now completely current In addition to thorough updates to the discussions featured in the first edition this edition includes 66 new chapters that reflect recent developments new applications and emerging areas of interest Within the handbook s 145 critically r

**Lecture Notes On Fullerene Chemistry: A Handbook For Chemists** Roger Taylor, 1999-02-25 The fullerenes hailed as one of the discoveries of the century have created whole new fields of organic organometallic chemistry and of physics Together with the related nanotubes they hold the promise of providing new materials with novel chemical and solid state properties The cost of the basic fullerenes is now such that research into them is feasible for very many chemists This book describes the fundamental aspects of fullerene chemistry Following brief background on the discovery basic fullerene nomenclature and relevant properties including those of endohedral fullerenes and nanotubes there are chapters describing the rules governing the addition patterns and each of the reaction types with representative examples Leading references are given to key papers describing individual reactions and phenomena

**Endofullerenes** T. Akasaka, Sh. Nagase, 2002-10-31 To the eyes of a chemist carbon is certainly one of the most fascinating elements of the periodic table Basically the electronic structure and atomic size of carbon enables this element to form a variety of bonds with other elements and most importantly with other carbon atoms as well These unique features lead to the amazingly complicated molecular structures we encounter e g in life sciences and organic chemistry Of course the technical importance of carbon is enormous but I don t want to carry too many coals to Newcastle From the viewpoint of an astrophysicist or chemist the significance of carbon lies in the fact that it is the most abundant condensable element in space Born in the interior of stars and from there expelled into the interstellar medium it initiates the formation of simple and complex molecules and of nanoscopic grains These in turn form huge clouds in space the birthplace of new stars and planetary systems The decisive role of carbon in interstellar chemistry is widely accepted and the search for more and more families of interstellar carbon bearing molecules is a topic of ongoing research The interdisciplinary aspect of carbon also concerns its various solid forms in which C and the other closed cage fullerenes are certainly some of the most popular 60 newcomers

**Fullerenes** Karl M. Kadish, Rodney S. Ruoff, 2000-07-06 Fullerenes a guide to the current state of knowledge in the field The last decade has seen an explosion of research into the chemical and

physical properties of a promising new class of carbon based materials known as fullerenes Karl Kadish and Rodney Ruoff two highly recognized leaders in the fullerene and nanotube research community edit a comprehensive and much needed survey of this important and rapidly evolving field Contributions by experts in diverse areas of chemistry physics pharmacology materials science and chemical engineering provide an excellent introduction to fullerenes and highlight their considerable potential in such cutting edge applications as semiconductor materials new pharmaceutical compounds and polymers From the electrochemistry of fullerenes to molecular and solid C<sub>36</sub> this book offers a remarkably fresh and authoritative look at some of the hottest research topics today including Organic functionalization of fullerenes Photophysical properties of different types of fullerenes Polyfunctional polymer derivatives of fullerenes The theory and production of endohedral metallofullerenes Fullerene surface interactions Superconductivity in fullerenes Synthesis of materials incorporated within carbon nanotubes

**Periodic Nanostructures** Mircea V. Diudea, Csaba L. Nagy, 2007-08-23 These tiny structures could offer architectural designs for the cities of the future The authors explore the foam like carbon structures which relate to schwarzites and which are infinite periodic minimal surfaces of negative curvature They show that the periodicity of close repeat units of such structures is evident not only in these formations but also in all of the carbon allotropes The text provides literature and data on the field of nanostructure periodicity and the authors own results on nanostructure building and energy calculations

*Handbook of Fullerene Science and Technology* Xing Lu, Takeshi Akasaka, Zdeněk Slanina, 2022-09-24 Nanocarbon chemistry and physics is a fast developing broad research area the Nobel prizes in 1996 and 2010 awarded to two key discoveries in the field and several other nanocarbon achievements of comparable importance Owing to this rapid growth the nanocarbon landscape fundamentally changes every few years creating a need to survey the field on a regular basis to update the books that have become incomplete or even obsolete As such this book focuses on fullerenes and metallofullerenes and also on the related areas of nanotubes and graphenes All the covered research topics provide important fundamental knowledge for the natural sciences but also for applications in molecular electronics superconductivity catalysis photovoltaics and medical diagnostics The current nanocarbon research activities have particularly high application potential in the conversion of solar energy future molecular memories non conventional materials for optoelectronics and new treatments for civilization diseases Offering a truly up to date critical survey of nanocarbon science its concepts and highlights it follows the concept of a handbook it addresses key topics systematically from historical background methodological aspects current important issues and application potential all supplied with extensive referencing With individual chapters written by leading experts with extensive research experience it is a comprehensive reference resource for graduate students and active researchers alike

Electronic Structure Calculations on Fullerenes and Their Derivatives Jerzy Cioslowski, 1995 This book provides a comprehensive overview of the latest approaches to electronic structure calculations of fullerenes Topics include C<sub>60</sub> and C<sub>70</sub> molecules the medium size

fullerenes large carbon clusters hypothetical allotropic forms of carbon small fullerenes endohedral complexes heterofullerenes fullerene derivatives and solid state fullerenes A summary of recent research breakthroughs and a discussion of potential future directions round out the book Far reaching and well written the book will be welcomed by students and researchers in chemistry and quantum physics

#### **Nanomedicine for Neurodegenerative Disorders**

Rishabha Malviya,Kamla Pathak,Swati Verma,2025-05-07 With the population getting older and with a corresponding increase in neurodegenerative diseases NDs worldwide developing drug delivery systems that can overcome conventional barriers in treating these diseases is the need of the hour Drug delivery by nanotechnology has great promise for detecting and treating a wide range of neurodegenerative conditions This new book provides an informative overview of the cutting edge applications of various nanocarriers that encapsulate active compounds to effectively treat NDs

*Carbon Based Nanomaterials for Drug Delivery* Sarat Kumar Swain,2025-01-27 This book comprehensively reviews the incorporation of different types of carbon based nanomaterials for application in targeted and controlled drug delivery systems Carbon based nanomaterials play a vital role as vectors and scaffolds during drug delivery owing to their ultra small size non toxicity and high water solubility The chapters in this book present the use of different carbon based nanomaterials such as graphene carbon quantum dots carbon nanotubes fullerenes and carbon nanofibers into polymeric and polysaccharide based matrices for the designing of effective drug delivery vehicles which demonstrate superior performance compared to traditional drug delivery systems In particular it demonstrates the incorporation of carbon based nanomaterials into supramolecular drug delivery systems leading to improved drug delivery properties This book aims to be a reference for researchers and scientists interested in new nanomaterials for drug delivery applications

#### **Carbon-Based Nanomaterials for Sustainable and**

**Technological Applications** Loutfy H. Madkour,2024-10-29 Carbon Based Nanomaterials for Sustainable and Technological Applications covers the fundamentals of carbon based nanomaterials CNMs and their potential for technological and industrial applications Addressing recent advancements in technology and improvement in material synthesis the book outlines how functionalized CNMs are used in nanobiotechnology for active sorbent materials and in pharmaceutical applications Chapters cover macro scale applications biosensors and drug delivery and treatment in cancer and coronavirus diseases Key features Through up to date references this book demonstrates that carbon based nanomaterials are one of the most promising nanomaterials in medical applications such as drug and gene delivery carriers as well as nonmedical environmental applications Discusses the synthesis methods of processing CQDs GQDs CPDs and g C<sub>3</sub>N<sub>4</sub> materials based nanocomposites for biotechnological applications Chapters address various classes of carbon nanomaterials and their innovative technologies Opens up further exploration of environmental nanotechnology bionanotechnology and biomedical applications of novel carbon nanomaterials Full references can be found via the Support Material [www.routledge.com/9781032635934](http://www.routledge.com/9781032635934) Written by a leading expert this volume provides the reader with thorough coverage of bionanotechnology

and biomedical applications of novel carbon nanomaterials

### **Handbook of Functionalized Carbon Nanostructures**

Ahmed Barhoum, Kalim Deshmukh, 2024-10-03 This book highlights all newly reported carbon nanostructures including graphene and its derivatives carbon nanotubes metal organic frameworks fullerenes nanorods nanospheres nano onions porous nanoparticles nanohorns nanofibers and nanoribbons nanodiamonds graphitic carbon nitrides carbon aerogels and hydrogels graphdiyne and graphenylene It presents the historical development of carbon nanostructures technologies different types and classifications and different fabrication and functionalization techniques including outer inner surface functionalization and covalent and noncovalent functionalization This Handbook discusses the unique properties of functionalized carbon nanostructures that can be obtained by modifying their structures composition and surface It gives the reader an in depth look at the current achievements of research and practice while pointing you ahead to new possibilities in functionalizing and using carbon nanomaterials Finally it covers the various applications of functionalized carbon nanostructures including adsorbents additives active materials in energy accumulating systems batteries hydrogen storage systems and supercapacitors filtering media catalysts or supports for catalysts sensors or substrates for sensors additives for polymers ceramic composites metal and carbon alloys glasses digital textiles and composite materials

*Encyclopedia of Physical Organic Chemistry, 6 Volume Set* Zerong Wang, Uta Wille, Eusebio Juaristi, 2017-04-17 Winner of 2018 PROSE Award for MULTIVOLUME REFERENCE SCIENCE This encyclopedia offers a comprehensive and easy reference to physical organic chemistry POC methodology and techniques It puts POC a classical and fundamental discipline of chemistry into the context of modern and dynamic fields like biochemical processes materials science and molecular electronics Covers basic terms and theories into organic reactions and mechanisms molecular designs and syntheses tools and experimental techniques and applications and future directions Includes coverage of green chemistry and polymerization reactions Reviews different strategies for molecular design and synthesis of functional molecules Discusses computational methods software packages and more than 34 kinds of spectroscopies and techniques for studying structures and mechanisms Explores applications in areas from biology to materials science The Encyclopedia of Physical Organic Chemistry has won the 2018 PROSE Award for MULTIVOLUME REFERENCE SCIENCE The PROSE Awards recognize the best books journals and digital content produced by professional and scholarly publishers Submissions are reviewed by a panel of 18 judges that includes editors academics publishers and research librarians who evaluate each work for its contribution to professional and scholarly publishing You can find out more at [proseawards.com](http://proseawards.com) Also available as an online edition for your library for more details visit Wiley Online Library

*Advances in Organometallic Chemistry*, 2024-07-25 Advances in Organometallic Chemistry Volume 82 the latest release in this longstanding serial is known for its comprehensive coverage of topics in organometallic synthesis reactions mechanisms homogeneous catalysis and more Chapters in this new release include Pd catalysis a useful tool in the field of polymer synthesis Recent advances and applications Modern Mechanistic Approaches for the Depolymerization of

Commodity Plastics via Homogeneous Metal Catalysis Functionalization of fullerenes by transition metal catalyzed cyclization reactions and Synergistic Metal Ligand Reactivity in Half Sandwich Complexes of Fe Co and Ni for Bond Activation and Catalysis Contains contributions from leading authorities in the field of organometallic chemistry Covers topics in organometallic synthesis reactions mechanisms homogeneous catalysis and more Informs and updates readers on the latest developments in the field Carefully edited to provide easy to read material     Phosphorus Chemistry II Jean-Luc Montchamp, 2015-03-06 Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed The coverage is not intended to be an exhaustive summary of the field or include large quantities of data but should rather be conceptual concentrating on the methodological thinking that will allow the non specialist reader to understand the information presented Contributions also offer an outlook on potential future developments in the field     **Dietary Interventions in Liver Disease** Ronald Ross Watson, Victor R Preedy, 2019-01-10 Dietary Interventions in Liver Disease Foods Nutrients and Dietary Supplements provides valuable insights into the agents that affect metabolism and other health related conditions in the liver It provides nutritional treatment options for those suffering from liver disease Information is presented on a variety of foods including herbs fruits soy and olive oil thus illustrating that variations in intake can change antioxidant and disease preventing non nutrients that affect liver health and or disease promotion This book is a valuable resource for biomedical researchers who focus on identifying the causes of liver diseases and food scientists targeting health related product development Provides information on agents that affect metabolism and other health related conditions in the liver Explores the impact of composition including differences based on country of origin and processing techniques Addresses the most positive results from dietary interventions using bioactive foods to impact liver disease including reduction of inflammation and improved function     *Fullerenes and Atomic Clusters*, 1997     **The Two Faces of Nanomaterials** Dong-Wook Han, Timur Sh. Atabaev, 2020-06-23 Due to properties differing from those of larger materials nanomaterials have been extensively used in different areas including nanomedicine drug delivery theragnosis and bioimaging in recent years Evaluating the toxicity profile i e biocompatibility of nanomaterials and their impact on health is essential to support the potential biomedical applications This book deals with the two faces of nanomaterials toxicity and bioactivity hoping to aid with their development for clinical applications reducing the possible risks associated with their use



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