



# **DNA in Supramolecular Chemistry and Nanotechnology**

*Editor* | **Dr. Christian Paul**

# Dna In Supramolecular Chemistry And Nanotechnology

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## **Dna In Supramolecular Chemistry And Nanotechnology:**

**DNA in Supramolecular Chemistry and Nanotechnology** Eugen Stulz, Guido H. Clever, 2015-09-28 This book covers the emerging topic of DNA nanotechnology and DNA supramolecular chemistry in its broader sense By taking DNA out of its biological role this biomolecule has become a very versatile building block in materials chemistry supramolecular chemistry and bio nanotechnology Many novel structures have been realized in the past decade which are now being used to create molecular machines drug delivery systems diagnosis platforms or potential electronic devices The book combines many aspects of DNA nanotechnology including formation of functional structures based on covalent and non covalent systems DNA origami DNA based switches DNA machines and alternative structures and templates This broad coverage is very appealing since it combines both the synthesis of modified DNA as well as designer concepts to successfully plan and make DNA nanostructures Contributing authors have provided first a general introduction for the non specialist reader followed by a more in depth analysis and presentation of their topic In this way the book is attractive and useful for both the non specialist who would like to have an overview of the topic as well as the specialist reader who requires more information and inspiration to foster their own research

**DNA Nanotechnology and Supramolecular Chemistry in Biomedical Therapy Applications** Peter James Cail, 2018 *Templated DNA Nanotechnology* Thimmaiah Govindaraju, 2019-01-30 Nucleic acids have structurally evolved over billions of years to effectively store and transfer genetic information In the 1980s Nadrian Seeman s idea of constructing a 3D lattice from DNA led to utilizing DNA as nanomolecular building blocks to create emergent molecular systems and nanomaterial objects This bottom up approach to construct nanoscale architectures with DNA marked the beginning of a new field DNA nanotechnology contributing significantly to the broad area of nanoscience and nanotechnology The molecular architectonics of small designer molecules and short DNA sequences through complementary binding interaction engenders well defined functional nanoarchitectures with realistic applications in areas ranging from biology to materials science and is termed DNA nanoarchitectonics This book discusses novel approaches adapted by leading researchers from all over the world to create functional nucleic acid molecular systems and nanoarchitectures Individual chapters contributed by active practitioners provide fundamental and advanced knowledge emanated from their own and others work Each chapter includes numerous illustrations historical perspectives case studies and practical examples critical discussions and future prospects This book can serve as a practical handbook or as a textbook for advanced undergraduate and graduate level students of nanotechnology and DNA nanotechnology supramolecular chemistry and nanoarchitectonics and researchers working on macromolecular science nanotechnology chemistry biology and medicine especially those with an interest in sensors biosensors nanoswitches and nanodevices diagnostics drug delivery and therapeutics

*Modern Avenues in Metal-Nucleic Acid Chemistry* Jens Müller, Bernhard Lippert, 2023-04-24 Volume 25 entitled Modern Avenues in Metal Nucleic Acid Chemistry of the series Metal Ions in Life Sciences MILS provides a timely

overview of selected relevant developments in a field which previously had a pronounced focus on fundamental chemistry aspects such as coordination principles structural chemistry and consequences for biological processes and disease related medicinal issues More recently also as a consequence of the advent of supramolecular chemistry advancements in nanochemistry and new bio analytical methods novel aspects of this field have emerged MILS 25 gives a state of the art account on the present state of research in this field addressing among others porous materials non covalent interactions stimuli responsive bioconjugates DNA templated metal arrays and nanoclusters genotyping guanine quadruplexes and riboswitches It consists of 15 comprehensive chapters with over 1600 citations 160 figures 90 of them in color with key contributions from 40 international experts from Europe Asia and America It is an essential resource for scientists from numerous disciplines ranging from materials science to biochemistry by way of classical chemistry and physics It offers an update on nucleic acid metal complex bioconjugates and their applications It provides an insight into coordination polymers involving nucleic acid components It covers a wide range of nucleic acids from DNA duplexes triplexes and quadruplexes to RNA

*Molecular Architectonics and Nanoarchitectonics* Thimmaiah Govindaraju, Katsuhiko Ariga, 2021-10-27 This book is the ultimate assembly of recent research activities on molecular architectonics and nanoarchitectonics by authors who are worldwide experts The book proposes new ways of creating functional materials at the nano level using the concepts of molecular architectonics and nanoarchitectonics which are expected to be the next generation approaches beyond conventional nanotechnology All the contents are categorized by types of materials organic materials biomaterials and nanomaterials For that reason non specialists including graduate and undergraduate students can start reading the book from any points they would like Cutting edge trends in nanotechnology and material sciences are easily visible in the contents of the book which is highly useful for both students and experimental materials scientists

*Emerging Applications of Nanoparticles and Architectural Nanostructures* Abdel Salam Hamdy Makhlouf, Ahmed Barhoum, 2018-03-22 Emerging Applications of Nanoparticles and Architecture Nanostructures Current Prospects and Future Trends discusses the most important current applications of nanoparticles and architecture nanostructures in a comprehensive detailed manner The book covers major applications of nanoparticles and architecture nanostructures taking into account their unusual shapes and high surface areas In particular coverage is given to applications in aerospace automotive batteries sensors smart textile design energy conversion color imaging printing computer chips medical implants pharmacy cosmetics and more In addition the book discusses the future of research in these areas This is a valuable reference for both materials scientists chemical and mechanical engineers working both in R D and academia who want to learn more on how nanoparticles and nanomaterials are commercially applied Provides an in depth look at the properties of nanoparticles and architecture nanostructures in terms of their applicability for industrial uses Analyzes the most recent advances and industrial applications of different types of nanoparticles and architecture nanostructures taking into account their unusual structures

and compositions Identifies novel nanometric particles and architectures that are of particular value for applications and the techniques required to use them effectively *Handbook of Bioanalytics* Bogusław Buszewski,Irena Baranowska,2022-06-30 This book presents an authoritative review of analytical methods used for diagnostics medical therapy and for forensic purposes Divided into 4 parts the book discusses new challenges in bioanalytics covers bioanalysis as a source of clinical pharmaceutical and forensic information explores natural resources as a source of biologically active compounds and offers new analytical strategies and equipment solutions Written by interdisciplinary expert academics this work will appeal to a wide readership of students researchers and professionals interested in the fields of medicine chemistry pharmaceutical life and health sciences engineering and environmental protection Clinicians and employees of forensic laboratories will also find this work instructive and informative *Fluorescence in Bio-inspired Nanotechnology* Jonas Hannestad,2013-07-20 In his thesis *Fluorescence in Bio inspired Nanotechnology* Jonas Hannestad describes the evolving field of DNA nanotechnology in a lucid and easily accessible way A central theme in the thesis is how biological structures and mechanisms constitute a basis for the design of novel technologies Hannestad discusses how self assembled nanometer scale DNA constructs can be functionalized using fluorescent labeling In particular he highlights how applications are based on fluorescence resonance energy transfer FRET Another important contribution is the development of a lipid monolayer platform for the step by step assembly of DNA nanoconstructs The work in the thesis is based on five peer reviewed papers published in high profile journals all of which involve major contributions from the author *Nucleic Acid Nanotechnology* Jørgen Kjems,Elena Ferapontova,Kurt V. Gothelf,2013-10-19 This volume on nucleic acid nanotechnology offers authoritative up to date and comprehensive coverage of nanotechnological studies and applications of nucleic acids It provides reviews of various aspects of nucleic acid nanotechnology each written by an internationally leading expert in the field and presents state of the art and recent advances in nucleic acid synthetic modifications nanoscale design manipulation and current and future applications in bioengineering medicine electronics genetic analysis chemistry molecular biology surface and material sciences It examines how nucleic acid research is merging with nanotechnology allowing the nanoscale properties of nucleic acid to be exploited in performing challenging nanotechnological tasks from nanorobotics and nanosensing to nucleic acid computing This book will above all benefit anyone who is interested in nanotechnological concepts of nucleic acid design and applications and offers a valuable resource for teaching these concepts It is essential reading for a broad audience of scientists both in academia and industry who wish to expand their expertise on the potential of nucleic acid functions and applications **The Nanotech Pioneers** Steven A. Edwards,2008-01-08 Hype hope or horror A vivid look at nanotechnology written by an insider and experienced science writer The variety of new products and technologies that will spin out of nanoscience is limited only by the imagination of the scientists engineers and entrepreneurs drawn to this new field Steve Edwards concentrates on the reader s self interest no military gadgets wild fantasies of horror nanobot predators and other sci fi stuff

but presents a realistic view of how this new field of technology will affect people in the near future He is in close contact with many pioneers in nanotechnology and includes their backgrounds to allow readers especially college students considering a career in the field to better imagine themselves in such positions However technology does not develop in a vacuum and this book also looks at the social political and economic changes attendant upon the development of nanotechnology For the science interested general public as well as chemists students lecturers chemical organizations materials scientists journalists politicians industry physicists and biologists

*Steps Forwards in Diagnosing and Controlling Influenza* Manal Mohammad Baddour, 2016-10-26 The World Health Organization WHO estimates that 3 5 million cases of severe influenza worldwide will result in 250 000 500 000 deaths annually Collectively data are shared via the WHO's Global Influenza Surveillance and Response System GISRS which includes 143 institutions in 113 WHO member states to help alert the emergence of antigenic variants or the beginning of a pandemic In April 2009 the Centers for Disease Control and Prevention CDC cited the first incidence of human to human transmission of pandemic H1N1 also referred to as swine influenza A which was antigenically distinct from other circulating human H1N1 As the first influenza pandemic of the twenty first century pandemic H1N1 was not included in the annual trivalent vaccine regimen leaving a large majority of the population unprotected from the newly emerging pathogen

*Nucleic Acid Photophysics and Photochemistry* Spiridoula Matsika, Andrew H. Marcus, 2024-11-16 This volume focuses on recent advancements in our current understanding of nucleic acid photochemistry and its relationship to biologically relevant phenomena Understanding the photophysical properties of nucleic acids is an area of longstanding and active research Over the years the field has greatly benefitted from steady advances in spectroscopic techniques and computational methods to study molecular excited states which have facilitated detailed studies of the behavior of nucleic acids and their components after they absorb light Experiments performed on ultrafast time scales femtoseconds picoseconds have permitted the accurate determination of excited state lifetimes while computational studies have provided detailed microscopic information about the mechanisms involved As our understanding of the fundamental photophysics of nucleic acids has advanced current studies now focus on systems of higher complexity and introduce novel optical techniques to investigate the interactions between nucleic acids and proteins Spectroscopic studies of nucleic acids particularly nucleic acid constructs labeled with optical probes can yield richly detailed information important to molecular biology biochemistry and biophysics This book is a must read for anyone interested in the photophysical properties of nucleic acids and their role in biologically relevant phenomena

*Glyconanotechnology* Tomáš Bertók, 2019-11-08 Glycomics a comprehensive study of glycans often denoted as the third alphabet of molecular biology besides nucleic acids and proteins relies on techniques that use heavy machinery such as mass spectrometry liquid chromatography and capillary electrophoresis The use of biosensors and biochips for glycan analysis offers the possibility of lower costs lower time and sample consumption and ease of use This highly interdisciplinary book introduces students

researchers and professionals to the broad scope of this area including the basics of nanotechnology and materials science glycomics and bioanalytical chemistry as well as several historical facts contexts and future perspectives The introductory chapters are utilized in the book later for the state of the art chapters on glycan based diagnostics and imaging enrichment techniques and therapy which makes this book unique and of great interest to a wide audience The authors are skilled specialists and research scientists with many years of experience in this area and former investigators on a prestigious European Research Council Starting Grant

Molecular Machine Fouad Sabry, 2025-03-10 Unlock the potential of the cuttingedge world of molecular machines with Molecular Machine a comprehensive guide that delves into the revolutionary field of DNA Nanotechnology Written by Fouad Sabry this book explores the intricate mechanisms at the heart of molecular motors and their applications Whether you re a professional in the field an undergraduate or graduate student or simply an enthusiast this book offers insights that will deepen your understanding and fuel your curiosity in molecular science and engineering

Chapters

Brief Overview

- 1 Molecular machine The foundational concepts of molecular machines setting the stage for advanced DNA nanotechnology
- 2 Nanomotor Introduction to the first practical applications of molecular motors at the nanoscale
- 3 Aptamer The role of aptamers in molecular recognition and their influence on DNA nanotechnology
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- 5 Host guest chemistry Understanding the significance of host guest interactions in the design of molecular machines
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nanotechnology The Molecular Machine book isn't just a collection of scientific concepts it's an essential resource that bridges the gap between theory and application in the dynamic field of DNA nanotechnology Perfect for professionals students and anyone with a fascination for how molecular systems can revolutionize the future of medicine engineering and beyond

**Aspects of Molecular Computing** Thomas J. Head, Natasha Jonoska, Gheorghe Păun, 2004-02-20 Molecular computing is a rapidly growing subarea of natural computing On the one hand molecular computing is concerned with the use of bio molecules for the purpose of actual computations while on the other hand it attempts to understand the computational nature of molecular processes going on in living cells The book presents a unique and authoritative state of the art survey on current research in molecular computing 30 papers by leading researchers in the area are drawn together on the occasion of the 70th birthday of Tom Head a pioneer in molecular computing Among the topics addressed are molecular tiling DNA self assembly splicing systems DNA based cryptography DNA word design gene assembly and membrane computing

*Memoirs of the Institute of Scientific and Industrial Research, Osaka University* Ōsaka Daigaku. Sangyō Kagaku Kenkyūjo, 2015

**Molecular Knot** Fouad Sabry, 2025-03-26 In the evolving field of DNA nanotechnology Molecular Knot provides a comprehensive exploration of molecular systems that promise to revolutionize science and technology This book is a vital resource for professionals students and enthusiasts seeking to understand the intricate world of molecular machines and mechanical interlocks Through an indepth examination of cuttingedge topics this book illustrates the profound implications of these technologies in various applications from molecular motors to bioengineering The importance of exploring DNA Walker systems cannot be overstated as they are at the forefront of modern science bridging the gap between chemistry biology and technology

**Molecular knot** This chapter introduces the concept of molecular knots essential in understanding molecular entanglement and their potential in DNA Walker systems

**Rotaxane** Explores the structure and function of rotaxanes providing insight into their role as molecular machines within the DNA Walker context

**Supramolecular chemistry** Focuses on the noncovalent interactions between molecules crucial for building complex DNAbased systems

**NonKekul molecule** Discusses molecules that deviate from traditional Kekul structures offering new perspectives for DNA Walker designs

**Polycatenane** Examines polycatenanes highlighting their significance in the development of mechanically interlocked molecules

**Catenane** Describes the formation of catenanes essential for understanding molecular mechanics within DNA walkers

**Molecular machine** Introduces molecular machines and their application in DNA nanotechnology laying the foundation for complex functional systems

**Click chemistry** Provides an overview of click chemistry emphasizing its utility in creating stable modular components for DNA Walker systems

**Cycloheximide** Focuses on cycloheximide and its relevance in molecular biology offering insights into DNArelated biochemical processes

**Phosphaalkyne** Discusses phosphaalkynes their unique properties and their role in advancing DNA nanotechnology

JeanPierre Sauvage Highlights the pioneering work of JeanPierre Sauvage in molecular machines showcasing his contributions to DNA Walker research

**Mechanically interlocked**



molecular architectures Examines how mechanically interlocked structures are fundamental to the development of DNA walkers and nanomachines David Leigh scientist Profiles David Leigh s work in molecular machines providing inspiration for those studying DNA Walker systems Molecular switch Explores the concept of molecular switches and their critical function in DNA Walker systems enabling dynamic responses DNAencoded chemical library Introduces DNAencoded libraries a revolutionary method for screening compounds and advancing DNA Walker technologies DNA nanotechnology Discusses the broader field of DNA nanotechnology highlighting its potential to create programmable molecular machines and complex systems Twodimensional polymer Investigates twodimensional polymers which hold promise for future DNA Walker systems due to their unique properties Harry Anderson chemist Discusses Harry Anderson s contributions to supramolecular chemistry and DNA nanotechnology providing historical context for modern developments Grid complex Focuses on the structure and function of grid complexes essential for creating programmable DNA Walker systems Cycloparaphenylene Explores cycloparaphenylenes their unique molecular structures and their potential applications in DNA Walker systems Nontrigonal pnictogen compounds Concludes with an exploration of nontrigonal pnictogen compounds which have significant implications for the future of molecular engineering

**Bionanotechnology** David S. Goodsell, 2004-04-16 Discussions of the basic structural nanotechnology and system engineering principles as well as an introductory overview of essential concepts and methods in biotechnology will be included Text is presented side by side with extensive use of high quality illustrations prepared using cutting edge computer graphics techniques Includes numerous examples such applications in genetic engineering Represents the only available introduction and overview of this interdisciplinary field merging the physical and biological sciences Concludes with the authors expert assessment of the future promise of nanotechnology from molecular tinkertoys to nanomedicine David Goodsell is author of two trade books Machinery of Life and Our Molecular Nature and Arthur Olson is the world s leader in molecular graphics and nano scale representation

**Spherical Nucleic Acids** Chad A. Mirkin, 2020-08-31 Spherical nucleic acids SNAs comprise a nanoparticle core and a densely packed and highly oriented nucleic acid shell typically DNA or RNA They have novel architecture dependent properties that distinguish them from all other forms of nucleic acids and make them useful in materials synthesis catalysis diagnostics therapeutics and optics plasmonics This book covers over two decades of Dr Mirkin s research on SNAs and their anisotropic analogues including synthesis and fundamental properties and applications in colloidal crystallization adaptive matter and nanomedicine spanning extra and intracellular diagnostics gene regulation and immunomodulation It is a reprint volume that compiles 101 key papers from high impact journals in this research area published by the Mirkin Group at Northwestern University Illinois USA within the International Institute for Nanotechnology and collaborators Volume 1 provides an overview and a historical framework of engineering matter from DNA modified constructs and discusses the enabling features of nucleic acid functionalized nanomaterials Volume 2 covers design rules for colloidal crystallization building blocks

for crystal engineering and DNA and RNA as programmable bonds Volume 3 discusses colloidal crystallization processes and routes to hierarchical assembly dynamic nanoparticle superlattices surface based and template confined colloidal crystallization optics and plasmonics with nanoparticle superlattices and postsynthetic modification and catalysis with nanoparticle superlattices Volume 4 covers diagnostic modalities and intracellular therapeutic and diagnostic schemes based upon nucleic acid functionalized nanomaterials

Green Nanoparticles Jayanta Kumar Patra, Leonardo F. Fraceto, Gitishree Das, Estefânia Vangelie Ramos Campos, 2020-04-06

Nanotechnology is the application of science to control matter at the molecular level It has become one of the most promising applied technologies in all areas of science Nanoparticles have multifunctional properties and have created very interesting applications in various fields such as medicine nutrition bioenergy agriculture and the environment But the biogenic syntheses of monodispersed nanoparticles with specific sizes and shapes have been a challenge in biomaterial science Nanoparticles are of great interest due to their extremely small size and large surface to volume ratio which lead to both chemical and physical differences in their properties e.g. mechanical properties biological and sterical properties catalytic activity thermal and electrical conductivity optical absorption and melting point compared to bulk of the same chemical composition Recently however synthesizing metal nanoparticles using green technology via microorganisms plants viruses and so on has been extensively studied and has become recognized as a green and efficient way for further exploiting biological systems as convenient nanofactories Thus the biological synthesis of nanoparticles is increasingly regarded as a rapid ecofriendly and easily scaled up technology Today researchers are developing new techniques and materials using nanotechnology that may be suitable for plants to boost their native functions Recently biological nanoparticles were found to be more pharmacologically active than physicochemically synthesized nanoparticles Various applications of biosynthesized nanoparticles have been discovered especially in the field of biomedical research such as applications to specific delivery of drugs use for tumor detection angiogenesis genetic disease and genetic disorder diagnosis photoimaging and photothermal therapy Further iron oxide nanoparticles have been applied to cancer therapy hyperthermia drug delivery tissue repair cell labeling targeting and immunoassays detoxification of biological fluids magnetic resonance imaging and magnetically responsive drug delivery therapy Nanoparticle synthesis for plant byproducts for biomedical applications has vast potential This book offers researchers in plant science and biomedicine the latest research and opportunity to develop new tools for the synthesis of environmentally friendly and cost effective nanoparticles for applications in biomedicine as well as other various fields

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