

Nanostructure Science and Technology  
*Series Editor: David J. Lockwood*

Fan Zhang

# Photon Upconversion Nanomaterials



Springer

# Photon Upconversion Nanomaterials Nanostructure Science And Technology

**Mahdi Karimi, Parham Sahandi  
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Hamblin**



## **Photon Upconversion Nanomaterials Nanostructure Science And Technology:**

Photon Upconversion Nanomaterials Fan Zhang, 2014-12-11 This book introduces the latest advances made in both fundamental studies and potential applications of upconversion nanomaterials particularly in the field of high resolution in vitro bioanalysis and in vivo imaging This book starts with the synthesis and characterization and focuses on applications ranging from materials science to biology Above all it describes cutting edge advances in upconversion nanophosphor UCNP based applications in multiplexed encoding guest delivery and release systems photodynamic therapy PDT solar cells photocatalysis and so on The major barriers that currently prevent UCNPs from being used in mainstream applications are also presented in detail

Upconverting Nanoparticles Vineet K. Rai, 2022-04-14 Modern learning resource providing broad coverage of the rapidly advancing field of upconverting nanoparticles This modern reference explains photon upconversion technology using nanoparticles from first principles to novel and future applications in imaging sensing catalysis energy technology biomedicine and many other areas Expert authors discuss both established and novel materials and applications going far beyond the coverage of previously published books on the subject Key topics covered in the book include Synthesis characterization and basic properties of nanoparticles with photon upconverting properties New types of upconverting nanoparticles including transition metal and rare earth doped materials metal organic frameworks core shell particles and surface modified particles Current and emerging application areas for upconverting nanoparticles including heating lighting sensing and detection Biomedical uses of nanoparticles including photodynamic therapy Photon upconversion using nanoparticles has opened the door to a new universe of light powered technology This book is a key resource for scientists physicists and chemists across a wide range of disciplines who wish to master the theory methods and applications of this powerful new technology

*Upconversion Nanocrystals for Sustainable Technology* Vijay B. Pawade, Sanjay J. Dhoble, Kartik N. Shinde, Hendrik C. Swart, 2024-09-03 Upconversion Nanocrystals for Sustainable Technology focuses on the current research directions in upconverting nanocrystals and their role in the development of sustainable technology The book focuses on the development of low cost nontoxic and energy efficient upconverting nanocrystals for a wide range of applications In particular it reviews size control synthesis techniques of nanostructured materials in different dimensions size dependent properties and the relationship between material properties and performance The book discusses the use of upconversion materials for lasers display lighting energy and biomedical applications with a focus on the use of these materials to develop more sustainable technologies Upconversion Nanocrystals for Sustainable Technology is suitable for new entrants in academia and R D with a scientific background in materials science and engineering chemistry and chemical engineering Introduces upconverting nanocrystals and their preparation and characterization strategies properties and applications Reviews methods to develop low cost and energy efficient technologies based on upconverting nanocrystals Discusses essential parameters including properties materials performance and their scope in the development of sustainable

technology      **Handbook of Materials Science, Volume 1** Raghumani S. Ningthoujam, A. K. Tyagi, 2023-11-21 This book presents the state of the art coverage of optical materials and their application in various areas The contents range from basic principles to quantum cutting luminescent materials advances in plasmonic and photonic substrate coupled fluorescence lanthanide doped materials for optical applications thermoluminescence and optical material for sensing radioactive elements It also discusses synthesis characterization and properties of optical materials including nanomaterials luminescent nanomaterials for anti counterfeiting carbon materials based nanoscale optics and plasmonics optoelectronics applications of two dimensional materials and applications of lanthanide ion doped phosphors This book is of immense value to those in academia and industry working in the areas of material science especially optical materials      **Upconversion**

**Nanophosphors** Sabu Thomas, Kanchan Upadhyay, Raunak Kumar Tamrakar, Nandakumar Kalarikkal, 2021-11-04 Upconversion Nanophosphors provides detailed information about various lanthanide based upconversion nanoparticles and their application in different fields It will also help solve fundamental and applied problems of inorganic phosphor materials showing upconversion behavior as well as generate innovative ideas related to the application of inorganic phosphor materials This book will prove to be an invaluable reference work for scientists engineers industrial experts and masters and PhD students working in the field of upconversion and materials science Covers the synthesis and characterization of upconversion nanophosphors and their applications Highlights which classes of upconversion materials are suitable for a specific application Explores processes to engineer upconversion nanoparticles for state of the art technologies including upconversion labelling and counterfeiting highly sensitive and selective biosensing and upconversion activated drug delivery

**Recent Advances in Thin Film Photovoltaics** Udai P. Singh, Nandu B. Chaure, 2022-09-02 This book provides recent development in thin film solar cells TFSC TFSC have proven the promising approach for terrestrial and space photovoltaics TFSC have the potential to change the device design and produce high efficiency devices on rigid flexible substrates with significantly low manufacturing cost TFSC have several advantages in manufacturing compared to traditional crystalline Si solar cells like less requirement of materials can be prepared with earth's abundant materials less processing steps easy to dispose etc Several universities research institutes industry in India and abroad are involved in the research area of thin film solar cells The book helps the readers to find the details about different thin film technologies and its advancement at one place Each chapter covers properties of materials its suitability for PV applications simple manufacturing processes and recent and past literature survey The issues related to the development of high efficiency TFSC devices over large area and its commercial and future prospects are discussed      **Springer Handbook of Aerogels** Michel A. Aegerter, Nicholas Leventis, Matthias Koebel, Stephen A. Steiner III, 2023-10-01 This indispensable handbook provides comprehensive coverage of the current state of the art in inorganic organic and composite aerogels from synthesis and characterization to cutting edge applications and their potential market impact Built upon Springer's successful Aerogels Handbook published in 2011

this handbook features extensive revisions and timely updates reflecting the changes in this fast growing field Aerogels are the lightest solids known to man Up to 1000 times lighter than glass and with a density only four times that of air they possess extraordinarily high thermal electrical and acoustic insulation properties and boast numerous entries in Guinness World Records Originally based on silica R D efforts have extended this class of materials to incorporate non silicate inorganic oxides natural and synthetic organic polymers carbon metal and ceramic materials Composite systems involving polymer crosslinked aerogels and interpenetrating hybrid networks have been developed and exhibit remarkable mechanical strength and flexibility Even more exotic aerogels based on clays chalcogenides phosphides quantum dots and biopolymers such as chitosan are opening new applications for the construction transportation energy defense and healthcare industries Applications in electronics chemistry mechanics engineering energy production and storage sensors medicine nanotechnology military and aerospace oil and gas recovery thermal insulation and household uses are being developed Readers of this fully updated and expanded edition will find an exhaustive source for all aerogel materials known today their fabrication upscaling aspects physical and chemical properties and the most recent advances towards applications and commercial use This key reference is essential reading for a combined audience of graduate students academic researchers and industry professionals

**Upconversion Nanoparticles (UCNPs) for Functional Applications** Vijay Kumar,Irfan Ayoub,Hendrik C. Swart,Rakesh Sehgal,2023-08-16 This book explores upconversion nanoparticles UCNPs at both the fundamental as well as applied levels for functional applications It provides a broad perspective about the synthesis approaches of UCNPs with the preferred size improved and tunable upconversion luminescence along with the combined multifunctionality for various applications It highlights the fundamentals and systematic developments in the tuning of UC emission and surface engineering of UCNPs that make UCNPs convenient for use in a large range of applications Moreover it gives an understanding of the imposed limitations and challenges associated with these methods to achieve the desired performance in targeted applications It also includes the latest multifunctional lanthanide based UCNPs which efficiently convert low energy photons into high energy photons and their applications in fluorescent microscopy deep tissue bioimaging nanomedicine optogenetics solid state lighting solar cells security labeling and volumetric display

**Upconverting Nanomaterials** Claudia Altavilla,2016-10-03 Upconverting Nanomaterials Perspectives Synthesis and Applications serves as a powerful instrument that explores cutting edge research knowledge on the topic of upconverting nanosystems while simultaneously providing the necessary fundamental background for nonspecialist readers The various aspects of upconverting materials are approached both from a theoretical point of view particularly upconverting phenomenon and a practical one By presenting synthetic strategies functionalization production of core shell structures and nanocomposites this book supplies PhD students researchers and scientists with a wealth of ideas they can apply to different fields of research Thirty five renowned scientists from around the world have collaborated to produce 11 chapters that help to make a voyage

through the most important aspects of UPNPs including syntheses mechanism functionalization and applications

*Photon-based Nanoscience and Nanobiotechnology* Jan J. Dubowski, Stoyan Tanev, 2007-04-24 Light has always played a significant role in the synthesis of materials and formation of small scale solid structures The invention of holographic and phase mask projection has enabled engineers to fabricate devices with characteristic features much smaller than the wavelength of the light used for processing A further reduction of device dimensions has been achieved by implementing the processes that rely strongly on the non linear effects of light matter interaction The intention of this book was to provide the Reader primarily graduate students and young researchers in materials engineering bio chem physics medical physics and biophysics with a set of articles reviewing state of the art research and recent advancements in the field of photon matter interaction for micro nanomaterials synthesis and manipulation of properties of biological and inorganic materials at the atomic level Photon based nanoscience and related technologies have created exciting opportunities for the fabrication and characterization of nano bio material devices and systems and it is expected to significantly contribute to the development of Nanobiophotonics and Nanomedicine

**Luminescent Nanomaterials** Odireleng Martin Ntwaeaborwa, 2022-05-18 In recent decades luminescent nanomaterials have generated great interest in the scientific community due to their unique properties which are different from those of their bulk counterparts and their use in a wide variety of applications Today luminescent nanomaterials are used in a number of applications such as displays solid state lighting solar cells long afterglow dosimetry theft prevention medical imaging phototherapy and quantum and gas sensing This book presents cutting edge research from experts in the field of synthesis and characterization of luminescent nanomaterials and their potential applications It covers interesting topics in semiconductor physics photochemistry physical chemistry materials science and luminescence and will be useful for beginners and advanced researchers interested in this field

**Nanophotonics** Paras N. Prasad, 2004-03-30 The only comprehensive treatment of nanophotonics currently available Photonics is an all encompassing optical science and technology which has impacted a diverse range of fields from information technology to health care Nanophotonics is photonic science and technology that utilizes light matter interactions on the nanoscale where researchers are discovering new phenomena and developing technologies that go well beyond what is possible with conventional photonics and electronics These new technologies could include efficient solar power generation high bandwidth and high speed communications high capacity data storage and flexible and high contrast displays In addition nanophotonics will continue to impact biomedical technologies by providing new and powerful diagnostic techniques as well as light guided and activated therapies Nanophotonics provides the only available comprehensive treatment of this exciting multidisciplinary field offering a wide range of topics covering Foundations Materials Applications Theory Fabrication Nanophotonics introduces students to important and timely concepts and provides scientists and engineers with a cutting edge reference The book is intended for anyone who wishes to learn about light matter interactions on the nanoscale as well as applications

of photonics for nanotechnology and nanobiotechnology Written by an acknowledged leader in the field this text provides an essential resource for those interested in the future of materials science and engineering nanotechnology and photonics

**Upconversion Nanoparticles for Biomedical Applications** Kalim Deshmukh, Kevin D. Belfield, Chaudhery Mustansar Hussain, 2025-09-01 Upconversion Nanoparticles for Biomedical Applications provides a comprehensive overview of the chemistry properties characterization and emerging applications of lanthanide doped upconversion nanoparticles UCNPs focusing on upconversion mechanisms fluorescent properties and biomedical applications The emerging applications of UCNPs include cancer diagnostics and therapy biosensing and bioassays bioimaging drug and gene delivery cellular optogenetics and the detection of small biomolecules and ions The biocompatibility biodegradability bio distribution toxicity and regulatory considerations of upconversion are fully considered This book offers a unique reference resource for researchers bringing together a global authorship to cover the fundamentals state of the art current challenges and future perspectives of upconversion nanoparticles

Progress in Nanophotonics 1 Motoichi Ohtsu, 2011-07-29 This book focuses on the recent progress in nanophotonics technology to be used to develop novel nano optical devices fabrication technology and security systems It begins with a review of the concept of dressed photons and applications to devices fabrication and systems principles and applications Further topics include DNA process for quantum dot chain photon enhanced emission microscopy near field spectroscopy of metallic nanostructure self organized fabrication of composite semiconductor quantum dots formation of metallic nanostructure and nanophotonic information systems with security These topics are reviewed by seven leading scientists This overview is a variable resource for engineers and scientists working in the field of nanophotonics

*Photonanotechnology for Therapeutics and Imaging* Seok Ki Choi, 2020-02-14 Photonanotechnology for Therapeutics and Imaging surveys major concepts and recent advances in the use of photonanotechnology with nanomaterials reported in various interdisciplinary fields including chemistry materials science biomedical engineering and biomedicine This book discusses the impact of this technology on the advancement of therapeutic modalities and imaging methods in cancers infectious diseases and other serious diseases Photonanotechnology studies the design principle application and development of photoactive nanomaterials It applies light controlled strategies for the development of nanotherapeutics imaging agents and diagnostic nanodevices Provides the latest information on photocontrolled drug delivery systems Details how photoactive nanomaterials are designed to release reactive oxygen species ROS for photodynamic therapy PDT Explains how photoactive nanomaterials have the ability to induce surface plasmonic heating for photothermal therapeutic PTT effects

Smart External Stimulus-Responsive Nanocarriers for Drug and Gene Delivery Mahdi Karimi, Parham Sahandi Zangabad, Amir Ghasemi, Michael R Hamblin, 2015-12-01 The concept of smart drug delivery vehicles involves designing and preparing a nanostructure or microstructure that can be loaded with a cargo this can be a therapeutic drug a contrast agent for imaging or a nucleic acid for gene therapy The nanocarrier serves to protect the cargo

from degradation by enzymes in the body to enhance the solubility of insoluble drugs to extend the circulation half life and to enhance its penetration and accumulation at the target site Importantly smart nanocarriers can be designed to be responsive to a specific stimulus so that the cargo is only released or activated when desired In this volume we cover smart nanocarriers that respond to externally applied stimuli that usually involve application of physical energy This physical energy can be applied from outside the body and can either cause cargo release or can activate the nanostructure to be cytotoxic or both The stimuli covered include light of various wavelengths ultraviolet visible or infrared temperature increased or decreased magnetic fields used to externally manipulate nanostructures and to activate them ultrasound and electrical and mechanical forces Finally we discuss the issue of nanotoxicology and the future scope of the field

**Dressed Photons** Motoichi Ohtsu, 2013-11-25 Authored by the developer of dressed photon science and technology as well as nanophotonics this book outlines concepts of the subject using a novel theoretical framework that differs from conventional wave optics It provides a quantum theoretical description of optical near fields and related problems that puts matter excitation such as electronic and vibrational ones on an equal footing with photons By this description optical near fields are interpreted as quasi particles and named dressed photons which carry the material excitation energy in a nanometric space The author then explores novel nanophotonic devices fabrications and energy conversion based on the theoretical picture of dressed photons Further this book looks at how the assembly of nanophotonic devices produces information and communication systems Dressed photon science and technology is on its way to revolutionizing various applications in devices fabrications and systems Promoting further exploration in the field this book presents physically intuitive concepts theories and technical details for students engineers and scientists engaged in research and development in dressed photon science and technology as well as nanophotonics

**Three-dimensional Nanostructures and Nanoparticles for Efficient Photon Management** Bo Hua, 2013 *Responsive Photonic Nanostructures* Yadong Yin, 2013-05-24 Photonic crystal nanostructures whose photonic properties can be tuned in response to external stimuli are desired for a wide range of applications in colour displays biological and chemical sensors and inks and paints Until now there is no single resource which gives a complete overview of these exciting smart materials *Responsive Photonic Nanostructures* Smart Nanoscale Optical Materials details the fabrication of photonic crystal structures through self assembly approaches general strategies and approaches for creating responsive photonic structures for different responsive systems such as chemical optical electrical and magnetic as well as their applications With contributions from leading experts in the field this comprehensive summary on *Responsive Photonic Nanostructures* is suitable for postgraduates and researchers in academia and industry interested in smart materials and their potential applications

**Applied Spectroscopy and the Science of Nanomaterials** Prabhakar Misra, 2014-11-04 This book focuses on several areas of intense topical interest related to applied spectroscopy and the science of nanomaterials The eleven chapters in the book cover the following areas of interest relating to applied spectroscopy and



nanoscience Raman spectroscopic characterization modeling and simulation studies of carbon nanotubes Characterization of plasma discharges using laser optogalvanic spectroscopy Fluorescence anisotropy in understanding protein conformational disorder and aggregation Nuclear magnetic resonance spectroscopy in nanomedicine Calculation of Van der Waals interactions at the nanoscale Theory and simulation associated with adsorption of gases in nanomaterials Atom precise metal nanoclusters Plasmonic properties of metallic nanostructures two dimensional materials and their composites Applications of graphene in optoelectronic devices and transistors Role of graphene in organic photovoltaic device technology Applications of nanomaterials in nanomedicine

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