

Guokai Liu  
Bernard Jacquier (Eds.)

# Spectroscopic Properties of Rare Earths in Optical Materials



 Springer

# Spectroscopic Properties Of Rare Earths In Optical Materials

**Guillaume Favre**

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## **Spectroscopic Properties Of Rare Earths In Optical Materials:**

**Spectroscopic Properties of Rare Earths in Optical Materials** Guokui Liu, Bernard Jacquier, 2005-06-29 Aimed at researchers and graduate students this book provides up to date information for understanding electronic interactions that impact the optical properties of rare earth ions in solids Its goal is to establish a connection between fundamental principles and the materials properties of rare earth activated luminescent and laser optical materials The theoretical survey and introduction to spectroscopic properties include electronic energy level structure intensities of optical transitions ion phonon interactions line broadening and energy transfer and up conversion An important aspect of the book lies in its deep and detailed discussions on materials properties and the potential of new applications such as optical storage information processing nanophotonics and molecular probes that have been identified in recent experimental studies This volume will be a valuable reference book on advanced topics of rare earth spectroscopy and materials science [Spectroscopic Properties of Rare Earths in Optical Materials](#) Guokui Liu, Bernard Jacquier (physicien.), 2005 *Spectroscopic Properties of Rare Earths in Optical Materials* Guokui Liu, Bernard Jacquier, 2006-01-29 Aimed at researchers and graduate students this book provides up to date information about the electronic interactions that impact the optical properties of rare earth ions in solids Its goal is to establish a connection between fundamental principles and the materials properties of rare earth activated luminescent and laser optical materials The theoretical survey and introduction to spectroscopic properties covers electronic energy level structure intensities of optical transitions ion phonon interactions line broadening and energy transfer and up conversion An important aspect of the book lies in its deep and detailed discussions of materials properties and the potential of new applications such as optical storage information processing nanophotonics and molecular probes that have been identified in recent experimental studies This volume will be a valuable reference book on advanced topics of rare earth spectroscopy and materials science **Spectroscopy of Solid-state Laser and Luminescent Materials** Zundu Luo, Yidong Huang, Xueyuan Chen, 2007 Solid state laser and luminescent materials activated by rare earth or transition metals ions are widely used for solid state lasers luminescent lamps flat displays optical fibre communication systems and other photonic devices The unique solid state electronic properties enable the activators in solids to emit photons efficiently in visible and IR regions The rapid advances in both materials science and optoelectronics particularly the development of new methods of material synthesis and device fabrication have been stimulating the growing interests in the deep insights of spectroscopic properties of solid state laser and luminescent materials This book brings together essential and practical knowledge of spectroscopic physics This includes atomic spectroscopy mathematical theory rare earth ions in materials light emission and absorption spectral properties non radiative transitions and energy migration [Handbook on the Physics and Chemistry of Rare Earths](#), 2016-10-31 Handbook on the Physics and Chemistry of Rare Earths Including Actinides is a continuous series of books covering all aspects of rare earth science including chemistry life sciences materials science and

physics The book's main emphasis is on rare earth elements Sc Y and the lanthanides La through Lu but whenever relevant information is also included on the closely related actinide elements Individual chapters are comprehensive broad up to date critical reviews written by highly experienced invited experts The series which was started in 1978 by Professor Karl A Gschneidner Jr combines and integrates both the fundamentals and applications of these elements with two published volumes each year Presents up to date overviews and new developments in the field of rare earths covering both their physics and chemistry Contains Individual chapters that are comprehensive and broad with critical reviews Provides contributions from highly experienced invited experts

**Frontiers Developments in Optics and Spectroscopy** , This book is based on the Proceedings of the Institute Frontier Developments in Optics and Spectroscopy held in Erice Sicily Italy from the 17th of June to the 2nd of July 2007 The meeting was organized by the International School of Atomic and Molecular Spectroscopy of the Ettore Majorana Center for Scientific Culture Other Institutes organized by this School are listed on pp vii The book can be downloaded for free through the Buy this book link on the right side of this page

*Collective Plasmon-Modes in Gain Media* V.A.G. Rivera,O.B. Silva,Y. Ledemi,Y. Messaddeq,E. Marega Jr.,2014-09-03 This book represents the first detailed description including both theoretical aspects and experimental methods of the interaction of rare earth ions with surface plasmon polariton from the point of view of collective plasmon photon interactions via resonance modes metal nanoparticles or nanostructure arrays with quantum emitters rare earth ions These interactions are of particular interest for applications to optical telecommunications optical displays and laser solid state technologies Thus our main goal is to give a more precise overview of the rapidly emerging field of nanophotonics by means of the study of the quantum properties of light interaction with matter at the nanoscale In this way collective plasmon modes in a gain medium result from the interaction coupling between a quantum emitter created by rare earth ions with a metallic surface inducing different effects such as the polarization of the metal electrons so called surface plasmon polariton SPP a field enhancement sustained by resonance coupling or transfer of energy due to non resonant coupling between the metallic nanostructure and the optically active surrounding medium These effects counteract the absorption losses in the metal to enhance luminescence properties or even to control the polarization and phase of quantum emitters The engineering of plasmons SPP in gain media constitutes a new field in nanophotonics science with a tremendous technological potential in integrated optics photonics at the nanoscale based on the control of quantum effects This book will be an essential tool for scientists engineers and graduate and undergraduate students interested not only in a new frontier of fundamental physics but also in the realization of nanophotonic devices for optical telecommunication

**Lanthanide Luminescence** Pekka Hänninen,Harri Härmä,2011-06-21 Lanthanides have fascinated scientists for more than two centuries now and since efficient separation techniques were established roughly 50 years ago they have increasingly found their way into industrial exploitation and our everyday lives Numerous applications are based on their unique luminescent properties which are highlighted in this volume

It presents established knowledge about the photophysical basics relevant lanthanide probes or materials and describes instrumentation related aspects including chemical and physical sensors The uses of lanthanides in bioanalysis and medicine are outlined such as assays for in vitro diagnostics and research All chapters were compiled by renowned scientists with a broad audience in mind providing both beginners in the field and advanced researchers with comprehensive information on on the given subject **Phosphors for Energy Saving and Conversion Technology** Vijay B. Pawade, Sanjay J.

Dhoble, 2018-09-03 This text deals with the advantages of rare earth activated phosphors for the development of solid state lighting technology and in enhancing the light conversion efficiency of Si solar cells The book initiates with a short overview of the atomic and semiconductor theory followed by introduction to phosphor its working mechanism role of rare earth ions in the lighting and PV devices and host materials being used Further it introduces the applications of inorganic phosphor for the development of green energy and technology including advantages of UP DC conversion phosphor layers in the enhancing the cell response of PV devices Key Features Focuses on discussion of phosphors for both solid state lighting and photovoltaics applications Provides introduction for practical applications including synthesis and characterization of phosphor materials Includes broad in depth introduction of semiconductors and related theory Enhances the basic understanding of optical properties for rare earth phosphors Covers up conversion and down conversion phosphor for energy harvesting applications Advances in Ceramics Costas Sikalidis, 2011-08-09 The current book contains twenty two

chapters and is divided into three sections Section I consists of nine chapters which discuss synthesis through innovative as well as modified conventional techniques of certain advanced ceramics e g target materials high strength porous ceramics optical and thermo luminescent ceramics ceramic powders and fibers and their characterization using a combination of well known and advanced techniques Section II is also composed of nine chapters which are dealing with the aqueous processing of nitride ceramics the shape and size optimization of ceramic components through design methodologies and manufacturing technologies the sinterability and properties of ZnNb oxide ceramics the grinding optimization the redox behaviour of ceria based and related materials the alloy reinforcement by ceramic particles addition the sintering study through dihedral surface angle using AFM and the surface modification and properties induced by a laser beam in pressings of ceramic powders Section III includes four chapters which are dealing with the deposition of ceramic powders for oxide fuel cells preparation the perovskite type ceramics for solid fuel cells the ceramics for laser applications and fabrication and the characterization and modeling of protonic ceramics Nanomaterials and Nanoarchitectures M. Bardosova, T.

Wagner, 2015-08-31 The current work consists of nine contributions describing recent progress in the interdisciplinary of Nanoscience which involves physics chemistry engineering biology and medicine and one essay outlining some important historical and socioeconomic factors pertaining to recent developments in nanoscale science and technology All 10 chapters have been written by eminent experts in their respective fields The authors employ the terms nanomaterials as building

blocks of a range of materials nanoarchitecture represents the design and nanotechnology the means to produce a particular device or functionality Two of the chapters are devoted to novel materials and two others focus on analyzing techniques which can be used to enable molecular control of the film architecture Additionally the reader will find material devoted to photonic and hybrid plasmonic photonic crystals as well as sections which address their applications such as the use of plasmonic particles and nanostructures for new sensing concepts and ultrasensitive detection techniques This work will be of interest to graduate students researchers and practitioners alike

*Handbook on the Physics and Chemistry of Rare Earths* Jean-Claude G. Bunzli, Vitalij K. Pecharsky, 2022-08-09 Handbook on the Physics and Chemistry of Rare Earths Including Actinides Volume 61 presents the latest release in this continuous series that covers all aspects of rare earth science including chemistry life sciences materials science and physics Presents up to date overviews and new developments in the field of rare earths covering both their physics and chemistry Contains individual chapters that are comprehensive and broad along with critical reviews Provides contributions from highly experienced invited experts

*Long Afterglow Phosphorescent Materials* Suli Wu, Zaifa Pan, Runfeng Chen, Xiaogang Liu, 2017-08-27 This book presents the fundamental scientific principles of long afterglow phosphorescent materials and a comprehensive review of both commercialized afterglow materials and the latest advances in the development of novel long afterglow materials It is designed to supply much needed information about inorganic and organic afterglow materials including detailed treatment of structure classification preparation techniques characterization surface modification chemistry and optical measurements Special attention is given to technological applications such as photovoltaics photocatalytic reactions and lighting and molecular sensing Although traditional long afterglow phosphors have been widely investigated and used in industry and significant efforts have recently been made toward the use of these materials for bioimaging there is to date no scientific monograph dedicated to afterglow materials This book not only provides a beginners guide to the fundamentals of afterglow luminescence and materials but also gives skilled researchers essential updates on emerging trends and efforts The work provides a special focus on organic afterglow materials which offer several advantages such as light weight flexible and wide varieties mild preparation conditions and good processability This book is aimed at postgraduate students researchers and technologists who are engaged in the synthesis development and commercialization of afterglow materials It represents essential reading on interdisciplinary frontiers in the materials science chemistry photophysics and biological aspects of afterglow materials

**Rare Earth Chemistry** Rainer Pöttgen, Thomas Jüstel, Cristian A. Strassert, 2020-10-26 This work introduces into the chemistry materials science and technology of Rare Earth Elements The chapters by experienced lecturers describe comprehensively the recent studies of their characteristics properties and applications in functional materials Due to the broad range of covered topics as hydrogen storage materials LEDs or permanent magnets this work gives an up to date presentation of this fascinating research

*Lanthanide-Doped Luminescent Nanomaterials* Xueyuan

Chen, Yongsheng Liu, Datao Tu, 2013-11-04 Lanthanide Doped Luminescent Nanomaterials reviews the latest advances in the development of lanthanide doped luminescent inorganic nanoparticles for potential bioapplications. This book covers the chemical and physical fundamentals of these nanoparticles such as the controlled synthesis methodology, surface modification chemistry, optical physics, and their promising applications in diverse bioassays with an emphasis on heterogeneous and homogeneous in vitro biodetection of tumor biomarkers. This book is intended for those readers who are interested in systematically understanding the materials design strategy, optical behavior of lanthanide ions, and practical bioapplications of lanthanide nanoparticles. It primarily focuses on the interdisciplinary frontiers in chemistry, physics, and biological aspects of luminescent nanomaterials. All chapters were written by scientists active in this field and for a broad audience providing both beginners and advanced researchers with comprehensive information on the subject. Xueyuan Chen is a Professor at Fujian Institute of Research on the Structure of Matter, FJIRSM, Chinese Academy of Sciences. Yongsheng Liu is a Research Associate Professor at FJIRSM, Chinese Academy of Sciences. Datao Tu is a Research Assistant Professor at FJIRSM, Chinese Academy of Sciences.

**The Rare Earth Elements** David A. Atwood, 2013-02-19 Lanthanides are of great importance for the electronic industries; this new book from the EIBC Book Series provides a comprehensive coverage of the basic chemistry, particularly inorganic chemistry, of the lanthanoid elements, those having a 4f shell of electrons. A chapter is describing the similarity of the Group 3 elements Sc, Y, La, the group from which the lanthanoids originate, and the group 13 elements, particularly aluminum, having similar properties. Inclusion of the group 3 and 13 elements demonstrates how the lanthanoid elements relate to other more common elements in the Periodic Table. Beginning chapters describe the occurrence and mineralogy of the elements with a focus on structural features observed in compounds described in later chapters. The majority of the chapters is organized by the oxidation state of the elements: Ln(0), Ln(II), Ln(III), and Ln(IV). Within this organization, the chapters are further distinguished by type of compound: inorganic oxides and hydroxides, aqueous speciation, halides, alkoxides, amides, and thiolates and chelates, and organometallic. Concluding chapters deal with diverse and critically important applications of the lanthanoids in electronic and magnetic materials and medical imaging.

Luminescence of Lanthanide Ions in Coordination Compounds and Nanomaterials Ana de Bettencourt-Dias, 2014-11-17 This comprehensive book presents the theoretical principles, current applications, and latest research developments in the field of luminescent lanthanide complexes, a rapidly developing area of research which is attracting increasing interest amongst the scientific community. Luminescence of Lanthanide Ions in Coordination Compounds and Nanomaterials begins with an introduction to the basic theoretical and practical aspects of lanthanide ion luminescence and the spectroscopic techniques used to evaluate the efficiency of luminescence. Subsequent chapters introduce a variety of different applications, including circularly polarized luminescence, luminescence bioimaging with lanthanide complexes, two-photon absorption of lanthanide complexes, chemosensors, upconversion luminescence, excitation spectroscopy, heterometallic complexes.

containing lanthanides Each chapter presents a detailed introduction to the application followed by a description of experimental techniques specific to the area and an extensive review of recent literature This book is a valuable introduction to the literature for scientists new to the field as well as providing the more experienced researcher with a comprehensive resource covering the most relevant information in the field a one stop shop for all key references

*Quantum Optics Devices on a Chip* Inamuddin,Tariq Altalhi,Naif Ahmed Alshehri,Jorddy Neves Cruz,2025-06-18 Quantum Optics Devices on a Chip provides a comprehensive understanding of how the integration of advanced quantum technologies and photonics is revolutionizing multiple industries making it essential for anyone interested in the future of quantum innovation Quantum Optics Devices on a Chip is situated at the intersection of several disciplines and industries driving advancements in quantum technology and integrated photonics The development of quantum optics devices on a chip represents a significant breakthrough Chip scale integration involves designing and fabricating optical devices such as waveguides modulators detectors and light sources on a micro or nanoscale chip This miniaturization enables the integration of multiple components on a single chip leading to compact efficient and scalable quantum optical systems Quantum sensing applications such as magnetometry gyroscopy and biosensing can benefit from miniaturized high performance devices integrated on a chip allowing for the seamless integration of quantum optical functionalities with existing photonic circuits This integration holds promise for applications in telecommunications data communication and optical signal processing Overall the development of quantum optics devices on a chip represents a significant step forward in the advancement of quantum technology It brings together principles from physics materials science engineering and computer science to enable the practical implementation of quantum phenomena for a wide range of applications across industries Quantum Optics Devices on a Chip serves as a comprehensive guide to this rapidly evolving field providing insights and knowledge exploring the contributions it has made to the disciplinary and industrial development of quantum optics devices on a chip

*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     *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

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