Characterization Of Nanoparticles In The Leachate Of

The use of biological sources such as microbes and plants can help in synthesizing nanoparticles in a reliable and eco-friendly way. The synthesis of nanoparticles by these natural sources is characterized by processes that take place near to ambient temperature and pressures and also near neutral pH. This edited volume authored by subject specialists, provides all the latest research and builds a database of bioreduction agents to various metal nanoparticles using different precursor systems. The book also highlights the different strategies such as simplicity, cost-effectiveness, environment-friendly and easily scalable, and includes parameters for controlling the size and shape of the materials developed from the various greener methods. In order to exploit the utmost potential metal nanoparticles synthesis from the different sources such as agricultural waste, flora and fauna, food waste, microbes and biopolymer systems, it is also crucial to recognize the biochemical and molecular mechanisms of production of nanoparticles and their characterization.

The techniques and methods that can be applied to materials characterization on the microscale are numerous and well-established. Divided into two parts, Characterization of Nanostructures provides thumbnail sketches of the most widely used techniques and methods that apply to nanostructures, and discusses typical applications to single nanoscale objects, as well as to ensembles of such objects. Section I: Techniques and Methods overviews the physical principles of the main techniques and describes those operational modes that are most relevant to nanoscale characterization. It provides sufficient technical detail so that readers and prospective users can gain an appreciation of the strengths and limitations of particular techniques. The section covers both mainstream and less commonly used techniques. Section II: Applications of Techniques to Structures of Different Dimensionalities and Functionalities deals with the methods for materials characterization of generic types of systems, using carefully chosen illustrations from the literature. Each chapter begins with a brief description of the materials and supplies a context for the methods for characterization. The volume concludes with a series of flow charts and brief descriptions of tactical issues. The authors focus on the needs of the research laboratory but also address those of quality control, industrial troubleshooting, and online analysis. Characterization of Nanostructures describes those techniques and their operational modes that are most relevant to nanoscale characterization. It is especially relevant to systems of different dimensionalities and functionalities. The book builds a bridge between generalists, who play vital roles in the post-disciplinary area of nanotechnology, and specialists, who view themselves as more in the context of the discipline.

In recent years, there have been many exciting breakthroughs in the application of nanotechnology to medicine. In Characterization of Nanoparticles Intended for Drug Delivery, expert researchers explore the latest advances in the field, providing a set of basic methods for the characterization of nanomaterials for medical use. Chapters provide methods to characterize the physiochemical properties (size, aggregation, and surface chemistry) and in vitro immunological and biological characteristics of nanomaterials. Composed in the highly successful Methods in Molecular BiologyTM series format, each chapter contains a brief introduction, step-by-step methods, a list of necessary materials, and a Notes section which shares tips on troubleshooting and avoiding known pitfalls. Comprehensive and informative, Characterization of Nanoparticles Intended for Drug Delivery is an essential survey of methods that are crucial to the preclinical characterization of nanomedicines.

Microscopy Methods in Nanomaterials Characterization fills an important gap in the literature with a detailed look at microscopic and X-ray based characterization of nanomaterials. These microscopic techniques are used for the determination of surface morphology and the dispersion characteristics of nanomaterials. This book deals with the detailed discussion of these aspects, and will provide the reader with a fundamental understanding of morphological tools, such as instrumentation, sample preparation and different kinds of analyses, etc. In addition, it covers the latest developments and trends morphological characterization using a variety of microscopes. Materials scientists, materials engineers and scientists in related disciplines, including chemistry and physics, will find this to be a detailed, method-orientated guide to microscopy methods of nanocharacterization. Takes a method-orientated approach that includes case studies that illustrate how to carry out each characterization technique Discusses the advantages and disadvantages of each microscopy characterization technique, giving the reader greater understanding of conditions for different techniques Presents an in-depth discussion of each technique, allowing the reader to gain a detailed understanding of each

Nanoscience and Nanotechnology in Drug Delivery

In-situ Characterization Techniques for Nanomaterials

Properties, Synthesis, Characterization, and Applications

Characterization and Applications

Thermal and Rheological Measurement Techniques for Nanomaterials Characterization

Synthetic Methods and Characterization Including Extended X-ray Absorption-fine Structure

Analysis and Characterisation of Metal-Based Nanomaterials, Volume 93 in the Comprehensive Analytical Chemistry series, introduces recent developments in analytical methodologies for detection, characterization and quantification of metal-based nanomaterials and their applications to a variety of complex environmental, biological and food samples as well as different consumer products. Single-particle inductively coupled plasma mass spectrometry is highlighted as a powerful analytical tool for number-based concentration and size distribution, also from the metrological viewpoint. An emerging approach for the measurement of multi-metal nanoparticles by single-particle inductively coupled plasma time-of-flight mass spectrometry is discussed. Imaging of metal-based nanoparticles by hyphenated inductively coupled plasma-based techniques is also introduced. The potential of different liquid chromatography and field flow fractionation separation techniques hyphenated to inductively coupled plasma mass spectrometry is emphasized as a powerful tool in particular for complex matrices and small particles sizes. The use of different microscopic techniques for the characterization of metal-based nanoparticles and characterization of metal-based nanoparticles as contrast agents for magnetic resonance imaging are presented. Moreover, occurrence, behaviour and fate of inorganic nanoparticles in the environment is overviewed. Finally, the need for quality control standards and reference nano-materials is emphasized throughout. Presents recent developments in analytical methodologies based on mass spectrometry, light scattering and microscopic techniques for detection, characterization and quantification of metal-based nanomaterials Describes applications of the nanoparticle analysis in a variety of complex environmental, biological and food samples as well as different consumer products Provides the metrological aspects for the analysis of metal-based nanoparticles when using emerging techniques such as single-particle inductively coupled plasma mass spectrometry

?What are lipid nanoparticles? How are they structured? How are they formed? What techniques are best to characterize them? How great is their potential as drug delivery systems? These questions and more are answered in this comprehensive and highly readable work on lipid nanoparticles. This work sets out to provide the reader with a clear and understandable understanding of the current practices in formulation, characterization and drug delivery of lipid nanoparticles. A comprehensive description of the current understanding of synthesis, characterization, stability optimization and drug incorporation of solid lipid nanoparticles is provided. Nanoparticles have attracted great interest over the past few decades with almost exponential growth in their research and application. Their small particle size and subsequent high surface area make them ideal in many uses, but particularly as drug carrier systems. Nanoparticles made from lipids are especially attractive because of their enhanced biocompatibility imparted by the lipid. The work provides a detailed description of the types of lipid nanoparticles available (e.g. SLN, NLC, LDC, PLN) and how they range from imperfect crystalline to amorphous in structure. Current thoughts on where drugs are situated (e.g. in the core, or at the interface) and how this can be manipulated are discussed. The many techniques for production, including the author's own variant of microwave heating, are fully discussed. Techniques for measuring arguably the most important characteristics of particle size and polydispersity are discussed, along with techniques to measure crystallinity, shape and drug capacity. Finally, a full chapter on techniques for measuring stability, both in the absence and presence of drugs, is discussed, along with suggestions on how to optimize that stability. This work appeals to students of colloid science, practitioners of research into drug delivery and academics alike.

This book describes the different methodologies for producing and synthesizing silver nanoparticles (AgNPs) of various shapes and sizes. It also provides an in-depth understanding of the new methods for characterizing and modifying the properties of AgNPs as well as their properties and applications in various fields. This book is a useful resource for a wide range of readers, including scientists, engineers, doctoral and postdoctoral fellows, and scientific professionals working in specialized fields such as medicine, nanotechnology, spectroscopy, analytical chemistry diagnostics, and plasmonics.

This book summarizes the fundamental and established methods for the synthesis of nanoparticles, providing readers with an organized and comprehensive insight into the field of nanoparticle technology. In addition to exploring the characterization and applications of nanoparticles, it also focuses on the recently explored corona discharge micromachining - Electrical Discharge Micromachining (EDMM) - method to synthesize inorganic nanoparticles. In the synthesis of nanoparticles, organic materials often play an indispensable role, such as providing stabilizers in the form of capping agents. This book will be of interest to advanced undergraduate and graduate students studying physics and engineering, as well as professionals and academics looking for an introduction to the nature and foundations of nanoparticle synthesis. Features: Provides diagnostic tools for the characterization of nanoparticles Explores the cutting-edge EDMM method for the synthesis and characterization of nanoparticles Discusses possible methods to overcome agglomeration of nanoparticles and achieve stable dispersion, in addition to examining the application suitability of synthesized nanoparticles

Nanoparticles' Promises and Risks

Green Synthesis, Characterization and Applications of Nanoparticles

Silver Nanoparticles

Research Anthology on Synthesis, Characterization, and Applications of Nanomaterials

Characterization of Nanophase Materials

Characterization of Nanomaterials

The focus of this interdisciplinary volume is on four areas of nanoparticle research: characterization, manipulation, and potential effects on humanity and the environment. The book includes a comprehensive collection of data on industrial nanoparticle creation and the characterization of the nanoscale products of these processes. The authors describe the effects of these nanoscale structures on human health and discuss prospective implementations for detection and characterization of nanoparticles in the environment. They recommend, utilizing the most up-to-date understanding of nanotechnology, methods for limiting the negative effects of these products on the environment and human health through manipulation, sorting, and filtration.

Characterization of Nanoparticles: Measurement Processes for Nanoparticles surveys this fast growing field, including established methods for the physical and chemical characterization of nanoparticles. The book focuses on sample preparation issues (including potential pitfalls), with measurement procedures described in detail. In addition, the book explores data reduction, including the quantitative evaluation of the final result and its uncertainty of measurement. The results of published inter-laboratory comparisons are referred to, along with the availability of reference materials necessary for instrument calibration and method validation. The application of these methods are illustrated with practical examples on what is routine and what remains a challenge. In addition, this book summarizes promising methods still under development and analyzes the need for complementary methods to enhance the quality of nanoparticle characterization with solutions already in operation. Helps readers decide which nanocharacterization method is best for each measurement problem, including limitations, advantages and disadvantages Shows which nanocharacterization methods are best for different classes of nanomaterial Demonstrates the practical use of a method based on selected case studies

Intended as a reference for basic and practical knowledge about the synthesis, characterization, and applications of nanotechnology for students, engineers, and researchers, this book focuses on the production of different types of nanomaterials and their applications, particularly synthesis of different types of nanomaterials, characterization of different types of nanomaterials, applications of different types of nanomaterials, including the nanocomposites.

Thermal and Rheological Measurement Techniques for Nanomaterials Characterization, Second Edition covers thermal and rheological measurement techniques, including their principle working methods, sample preparation and interpretation of results. This important reference is an ideal source for materials scientists and industrial engineers who are working with nanomaterials and need to know how to determine their properties and behaviors. Outlines key characterization techniques to determine the thermal and rheological behavior of different nanomaterials Explains how the thermal and rheological behavior of nanomaterials affect their usage Provides a method-orientated approach that explains how to successfully use each technique

Nanomaterial Characterization

Characterization of Nanomaterials in Complex Environmental and Biological Media

Characterization, Processing, and Applications

Corona Discharge Micromachining for the Synthesis of Nanoparticles

Fundamentals of Nanoparticles

Fabrication, Characterization and Applications

Nanomaterials: Synthesis, Characterization, Hazards and Safety explains the fundamental properties of nanomaterials, covering their types and classifications. The book includes methods of preparation and characterization of nanostructured materials. It explains the principles and fundamentals of nanomaterials, with information on both pure and composite-based materials with e nanostructures, outlines the latest developments and advances in nanomaterials, and highlights toxic effects and protection. This book is designed to appeal to a wide readership of academic and industrial researchers, focusing on nanotechnology and nanomaterials, sustainable chemistry, energy conversion and storage, nanotechnology, chemical engineering, environmental protection, optoelectronics, sensors, and surface and interface science. Provides information on major concepts and advances made in the areas of nanomaterials properties and nano safety Identifies the major physiochemical properties of nanomaterials Explores the toxicity of different class of nanomaterials and how they can be used safely

In this concise handbook leading experts give a broad overview of the latest developments in this emerging and fascinating field of nano-sized materials. Coverage includes new techniques for the synthesis of nanoparticles as well as an in-depth treatment of their characterization and chemical and physical properties. The future applications of these advanced materials are also discussed. The wealth of information included makes this an invaluable guide for graduate students as well as scientists in materials science, chemistry or physics - looking for a comprehensive treatment of the topic.

The subject matter of this book is the application of EMR/ESR/EPR spectroscopy for characterization of nanomaterials. Initial chapters deal with nanomaterials and their classification. Characterization of metallic nanoparticles, metal oxide nanoparticles and rare earth impurity doped nanoparticles from the (ESR) spectrum parameters are covered in the chapters that follow. A special feature of the book is EMR/ESR/EPR spectroscopic characterization of nanoparticles which are important due to their bactericidal and anticancerous properties. Strength of continuous wave (CW) is explained with the help of suitable examples. The book focuses on applications and data interpretation avoiding extensive use of mathematics so that it also caters to the need of young scientists in the life science disciplines. The book includes a comparison with other spectroscopic characterization methods so as to give an integrated approach to the reader. It will prove useful to biomedical scientists and engineers, chemists, and materials engineers in student, researcher, and practitioner positions.

Synthesis of Inorganic Nanomaterials: Advances and Key Technologies discusses the latest advancements in the synthesis of various types of nanomaterials. The book's main objective is to provide a comprehensive review regarding the latest advances in synthesis protocols that includes up-to-date data records on the synthesis of all kinds of inorganic nanostructures using various physical and chemical methods. The synthesis of all important nanomaterials, such as carbon nanostructures, Core-shell Quantum dots, Metal and metal oxide nanostructures, Nanoferrites, polymer nanostructures, nanofibers, and smart nanomaterials are discussed, making this a one-stop reference resource on research accomplishments in this area. Leading researchers from industry, academia, government and private research institutions across the globe have contributed to the book. Academics, researchers, scientists, engineers and students working in the field of polymer nanocomposites will benefit from its solutions for material problems. Provides an up-to-date data record on the synthesis of all kinds of organic and inorganic nanostructures using various physical and chemical methods Presents the latest advances in synthesis protocols Includes the latest techniques used in the physical and chemical characterization of nanomaterials Covers the characterization of all the important materials groups, such as carbon nanostructures, core-shell quantum dots, metal and metal oxide nanostructures, Nano ferrites, polymer nanostructures and nanofibers

Measurement Processes for Nanoparticles

Dendrimer-encapsulated Nanoparticles

Electron Microscopy Characterization of Nanoparticles for Biomedical Application

Nanomaterials

Synthesis of Inorganic Nanomaterials

An Introduction

Design, Fabrication, and Characterization of Multifunctional Nanomaterials covers major techniques for the design, synthesis, and development of multifunctional nanomaterials. The chapters highlight the main characterization techniques, including X-ray diffraction, scanning electron microscopy, high-resolution transmission electron microscopy, energy dispersive X-ray spectroscopy, and scanning probe microscopy. The book explores major synthesis methods and functional studies, including: Brillouin spectroscopy; Temperature-dependent Raman spectroscopic studies; Magnetic, ferroelectric, and magneto-electric coupling analysis; Organ-on-a-chip methods for testing nanomaterials; Magnetron sputtering techniques; Pulsed laser deposition techniques; Positron annihilation spectroscopy to prove defects in nanomaterials; Electroanalytic techniques. This is an important reference source for materials science students, scientists, and engineers who are looking to increase their understanding of design and fabrication techniques for a range of multifunctional nanomaterials. Explains the major design and fabrication techniques and processes for a range of multifunctional nanomaterials; Demonstrates the design and development of magnetic, ferroelectric, multiferroic, and carbon nanomaterials for electronic applications, energy generation, and storage; Green synthesis techniques and the development of nanofibers and thin films are also emphasized.

Nanomaterials and Nanocomposites: Characterization, Processing, and Applications discusses the most recent research in nanomaterials and nanocomposites for a range of applications as well as modern characterization tools and techniques. It deals with nanocomposites that are dispersed with nanosized particulates and carbon nanotubes in their matrices (polymer, metal, and ceramic). In addition, the work: Describes different nanomaterials, such as metal and metal oxides, clay and POSS, carbon nanotubes, cellulose, and biobased polymers in a structured manner Examines the processing of carbon nanotube-based nanocomposites, layered double hydroxides, and cellulose nanoparticles as functional fillers and reinforcement materials Covers size effect on thermal, mechanical, optical, magnetic, and electrical properties Details machining and joining aspects of nanocomposites Discusses the development of smart nanotextiles (intelligent textiles), self-cleaning glass, sensors, actuators, ferrofluids, and wear-resistant nanocoatings. This book enables an efficient comparison of properties and capabilities of these advanced materials, making it relevant for materials scientists and chemical engineers conducting academic research and industrial R&D into nanomaterial processing and applications.

Green Synthesis, Characterization and Applications of Nanoparticles shows how eco-friendly nanoparticles are engineered and used. In particular, metal nanoparticles, metal oxide nanoparticles and other categories of nanoparticles are discussed. The book outlines a range of methodologies and explores the appropriate use of each. Characterization methods include spectroscopic, microscopic and diffraction methods, but magnetic resonance methods are also included as they can be used to understand the mechanism of nanoparticle synthesis using organisms. Applications covered include targeted drug delivery, water purification and hydrogen generation. This is an important research resource for those wishing to learn more about how eco-efficient nanoparticles can best be used. Theoretical details and mathematical derivations are kept to a necessary minimum to suit the need of interdisciplinary audiences and those who may be relatively new to

the field. Explores recent trends in growth, characterization, properties and applications of nanoparticles Gives readers an understanding on how they are applied through the use of case studies and examples Assesses the advantages and disadvantages of a variety of synthesis and characterization techniques for green nanoparticles in different situations

Seventh volume of a 40 volume series on nanoscience and nanotechnology, edited by the renowned scientist Challa S.S.R. Kumar. This handbook gives a comprehensive overview about In-situ Characterization Techniques for Nanomaterials. Modern applications and state-of-the-art techniques are covered and make this volume an essential reading for research scientists in academia and industry.

Preparation, Characterization, and Applications

Advances and Key Technologies

Lipid Nanoparticles: Production, Characterization and Stability

Green Metal Nanoparticles

Quantitative Computational and Experimental Characterization of Functionalized Nanoparticles

Characterization of NanoparticlesMeasurement Processes for Nanoparticles

A state-of-the-art reference, Metal Nanoparticles offers the latest research on the synthesis, characterization, and applications of nanoparticles. Following an introduction of structural, optical, electronic, and electrochemical properties of nanoparticles, the book elaborates on nanoclusters, hyper-Raleigh scattering, nanoarrays, and several applications including single electron devices, chemical sensors, biomolecule sensors, and DNA detection. The text emphasizes how size, shape, and surface chemistry affect particle performance throughout. Topics include synthesis and formation of nanoclusters, nanosphere lithography, modeling of nanoparticle optical properties, and biomolecule sensors.

Third volume of a 40volume series on nanoscience and nanotechnology, edited by the renowned scientist Challa S.S.R. Kumar. This handbook gives a comprehensive overview about Transmission electron microscopy characterization of nanomaterials. Modern applications and state-of-the-art techniques are covered and make this volume an essential reading for research scie academia and industry.

Advances in Nanomedicine for the Delivery of Therapeutic Nucleic Acids addresses several issues related to safe and effective delivery of nucleic acids (NAs) using nanoparticles. A further emphasis would be laid on the mechanism of delivery of NAs, the barriers encountered and the strategies adapted to combat them. An exhaustive account of the advantages as well shortcor all the delivery vectors being employed in delivery of various NAs will be provided. On final note the regulatory aspects of nanoparticles mediated NA would be discussed, with focus on their clinical relevance. The design and development of nucleic acid-based therapeutics for the treatment of diseases arising from genetic abnormalities has made significant progress over the pa years. NAs have been widely explored for the treatment of cancer and infectious diseases or to block cell proliferation and thereby caused diseases. Advances in synthetic oligonucleotide chemistry resulted in synthesis of NAs that are relatively stable in in vivo environments. However, cellular targeting and intracellular delivery of NAs still remains a challenge. Further developme NA-based therapeutics depends on the progress of safe and effective carriers for systemic administration. Nanomedicine has facilitated availability of vectors with diminished cytotoxicity and enhanced efficacy which are rapidly emerging as systems of choice. These vectors protect NAs from enzymatic degradation by forming condensed complexes along with targeted tissue and cellular delivery. During the past few years, a myriad reports have appeared reporting delivery of NAs mediated by nanoparticles. This book will provide an overview of nanoparticles being employed in the in vitro and in vivo delivery of therapeutically relevant NAs like DNA, siRNA, LNA, PNA, etc. Provides a complete overview of the applicatiosn of nanomedicine in the delivery c nucleic acids, from characterization of nanoparticles, to in vitro and in vivo studies Discusses delivery issues of less well explored nucleic acids, like PNAs, Ribozymes, DNAzymes, etc. Summarizes the current state of research in nucleic acid delivery and underscores the future of nanomedicine in this field

Advances in Nanomedicine for the Delivery of Therapeutic Nucleic Acids

Nanoparticles in Analytical and Medical Devices

Characterization of Nanoparticles Intended for Drug Delivery

Characterization of Nanoparticles

Transmission Electron Microscopy Characterization of Nanomaterials

Spectroscopic Methods for Nanomaterials Characterization

Engineering of nanophase materials and devices is of vital interest in electronics, semiconductors and optics, catalysis, ceramics and magnetism. Research associated with nanoparticles has widely spread and diffused into every field of scientific research, forming a trend of nanocrystal engineered materials. The unique properties of nanophase materials are entirely determined by their atomic scale structures, particularly the structures of interfaces and surfaces. Development of nanotechnology involves several steps, of which characterization of nanoparticles is indespensable to understand the behavior and properties of nanoparticles, aiming at implementing nanotechnolgy, controlling their behavior and designing new nanomaterials systems with super performance. The book will focus on structural and property characterization of nanocrystals and their assemblies, with an emphasis on basic physical approach, detailed techniques, data interpretation and applications. Intended readers of this comprehensive reference work are advanced graduate students and researchers in the field, who are specialized in materials chemistry, materials physics and materials science.

Introduces basic knowledge for nanomaterial characterization focusing on key properties and the different analytical techniques available Provides a quick reference to different analytical methods for a given property highlighting their pros and cons Presents numerous case studies, ranging from characterizing nanomaterials in coffee creamer suspension to measurement of airborne dust exposure levels Provides an introduction to other topics that are strongly related to nanomaterial characterization e.g. synthesis, reference material and metrology Includes state of the art techniques: scanning tunneling microscopy under extreme conditions, novel strategy for biological characterization and methods to visualize multidimensional characterization data

Characterization of Nanomaterials: Advances and Key Technologies discusses the latest advancements in the synthesis of various types of nanomaterials. The book's main objective is to provide a comprehensive review regarding the latest advances in synthesis protocols that includes up-to-date data records on the synthesis of all kinds of inorganic nanostructures using various physical and chemical methods. The synthesis of all important nanomaterials, such as carbon nanostructures, Core-shell Quantum dots, Metal and metal oxide nanostructures, Nanoferrites, polymer nanostructures, nanofibers, and smart nanomaterials are discussed, making this a one-stop reference resource on research accomplishments in this area. Leading researchers from industry, academia, government and private research institutions across the globe have contributed to the book. Academics, researchers, scientists, engineers and students working in the field of polymer nanocomposites will benefit from its solutions for material problems. Provides an up-to-date data record on the synthesis of all kinds of organic and inorganic nanostructures using various physical and chemical methods Presents the latest advances in synthesis protocols Presents latest techniques used in the physical and chemical characterization of nanomaterials Covers characterization of all the important materials groups such as: carbon nanostructures, core-shell quantumdots, metal and metal oxide nanostructures, nanoferrites, polymer nanostructures and nanofibers A broad range of applications is covered including the performance of batteries, solar cells, water filtration, catalysts, electronics, drug delivery, tissue engineering, food packaging, sensors and fuel cells Leading researchers from industry, academia, government and private research institutes have contributed to the books

The use of nanotechnologies continues to grow, as nanomaterials have proven their versatility and use in many different fields and industries within the scientific profession. Using nanotechnology, materials can be made lighter, more durable, more reactive, and more efficient leading nanoscale materials to enhance many everyday products and processes. With many different sizes, shapes, and internal structures, the applications are endless. These uses range from pharmaceutics to materials such as cement or cloth, electronics, environmental sustainability, and more. Therefore, there has been a recent surge of research focused on the synthesis and characterizations of these nanomaterials to better understand how they can be used, their applications, and the many different types. The Research Anthology on Synthesis, Characterization, and Applications of Nanomaterials seeks to address not only how nanomaterials are created, used, or characterized, but also to apply this knowledge to the multidimensional industries, fields, and applications of nanomaterials and nanoscience. This includes topics such as both natural and manmade nanomaterials; the size, shape, reactivity, and other essential characteristics of nanomaterials; challenges and potential effects of using nanomaterials; and the advantages of nanomaterials with multidisciplinary uses. This book is ideally designed for researchers, engineers, practitioners, industrialists, educators, strategists, policymakers, scientists, and students working in fields that include materials engineering, engineering science, nanotechnology, biotechnology, microbiology, drug design and delivery, medicine, and more.

UV-VIS and Photoluminescence Spectroscopy for Nanomaterials Characterization

Characterization of Nanostructures

Characterization and Biology of Nanomaterials for Drug Delivery

Classifications, Synthesis Methods, Properties and Characterization

Synthesis, Characterization, and Applications

Raman Spectroscopy for Nanomaterials Characterization

Over the past two decades, nanotechnology has demonstrated great potential in the field of biology and medicine. Nanomaterials, such as gold nanoparticles, with their superior chemical and physical properties, are widely used in a variety of biomedical research, ways ranging from cancer early detection (e.g. liquid biopsy) to treatment (e.g. hyperthermia therapy). On the other hand, advances in nano characterization techniques have enabled new investigations of naturally occurring nanoscale features in the body, in order to understand the pathological processes associated with them. This dissertation describes the use of advanced electron microscopy to characterize nanomaterials of relevance to the field of medicine. Some nanoparticles are lithographically fabricated, some are chemically synthesized, and others are directly extracted from tissues and cells. The morphological, crystallographic, chemical, optical and other physical properties of these nanoparticles are evaluated using a combination of imaging, diffraction and advanced spectroscopy techniques in a transmission electron microscope (TEM) and scanning electron microscope (SEM). In the first part of this work, surface enhanced Raman scattering (SERS) gold nanoparticles were optimized for sensitive detection of tumors by correlating localized surface plasmon resonances (LSPR) with surface enhancement. Electron beam lithography was used to prototype gold nanostructures with a wide variety of shapes, size, interspacing and in different dielectric environments. The LSPR of these structures were measured using electron energy loss spectroscopy (EELS) in a transmission electron microscope operated in scanning mode (STEM) with monochromation. It is found that nanoparticle size and dielectric environment have the most significant effects on localized surface plasmons, which is collective oscillation modes of the free electron gas at the metal surface. By contrast, interspacing has a weaker influence on surface plasmons for the range studied in this dissertation. Larger nanoparticle size and higher dielectric constant result in lower surface plasmon energies. The novelty of this work is that the LSPR from various nanostructure arrays were correlated with their Raman spectra acquired at different illuminating laser energies after incubation with a Raman dye. It is demonstrated that the largest Raman signal intensities are obtained when the illuminating laser energy coincides with, or is slightly higher than, the gold nanoparticle surface plasmon resonance energies (e.g. 90 nm diameter nanodisc particles with a LSPR energy of 1.94 eV show strongest Raman signal enhancement under a 638 nm (1.94 eV) wavelength laser excitation). By comparing various nanostructure shapes with similar surface plasmon energies, it is shown that sharper nanostructures tend to exhibit stronger surface enhancement. This information is useful in designing nanoparticle combinations to generate the largest SERS enhancement for detection of early stage medical problems such as cancer. The second part of this work is focused on naturally occurring particles, in particular, iron deposits in the hippocampal region of a brain to understand the pathological processes related to Alzheimer's diseases (AD). Recent work on iron accumulation in AD brains has led researchers to hypothesize that the oxidation state of iron may be related to neurodegeneration because ferrous iron, compared with ferric iron, may cause oxidative damage and antioxidant depletion on neurons. First, iron rich regions from AD brain tissues were located using correlative magnetic resonance imaging (MRI), optical microscopy (OM), SEM and energy dispersive spectroscopy (EDS). Cross-sections of tissue containing iron deposits were then extracted using focused ion beam (FIB) and subsequently thinned to make them electron transparent. The relative concentrations of ferric and ferrous ions within the iron deposits were determined by studying the intensity ratios of Fe L3:L2 edges from the energy loss near edge structure (ELNES) of the Fe L edge using monochromated STEM-EELS as above. Massive correlation across biological and physical microscopy and spectroscopy techniques was demonstrated for the first time in this work. These observations and insights provide supporting evidence of ferrous iron as being possibly associated with AD. The third and final section addresses characterization of artificial and natural nanoparticle composites. These hybrid nanoparticles, fabricated via a simple extrusion method, can greatly increase the target specificity and cellular uptake in various biomedical applications such as cancer imaging and drug delivery. A negative staining technique was utilized to provide contrast of biological components of these nanoparticles in TEM, and specific proteins of interest were labeled with antibodies conjugated to 100 nm diameter gold iron oxide nanoparticles (GIONs). The combination of superior magnetic, photonic and other physical properties from artificial nanoparticles, along with cellular specificity and biological compatibility from natural nanoparticles makes these hybrid nanoparticles useful for multi-modality imaging and possible medical treatment. Overall, electron microscopy is a versatile and powerful methodology for characterization of a wide variety of nanomaterials. Advanced microscopic and spectroscopic techniques such as monochromatic STEM-EELS and EDS, which are rarely used in the life sciences, have great potential in bringing unique insight into biomedical research.

Characterization of Nanomaterials in Complex Environmental and Biological Media covers the novel properties of nanomaterials and their applications to consumer products and industrial processes. The book fills the growing gap in this challenging area, bringing together disparate strands in chemistry, physics, biology, and other relevant disciplines. It provides an overview on nanotechnology, nanomaterials, nano(eco)toxicology, and nanomaterial characterization, focusing on the characterization of a range of nanomaterial physicochemical properties of relevance to environmental and toxicological studies and their available analytical techniques. Readers will find a multidisciplinary approach that provides highly skilled scientists, engineers, and technicians with the tools they need to understand and interpret complicated sets of data obtained through sophisticated analytical techniques. Addresses the requirements, challenges, and solutions for nanomaterial characterization in environmentally complex media Focuses on technique limitations, appropriate data collection, data interpretation, and analysis Aids in understanding and comparing nanomaterial characterization data reported in the literature using different analytical tools Includes case studies of characterization relevant complex media to enhance understanding

Fundamentals of Nanoparticles: Classifications, Synthesis Methods, Properties and Characterization explores the nanoparticles and architecture of nanostructured materials being used today in a comprehensive, detailed manner. This book focuses primarily on the characterization, properties and synthesis of nanoscale materials, and is divided into three major parts. This is a valuable reference for materials scientists, and chemical and mechanical engineers working in R&D and academia, who want to learn more about how nanoparticles and nanomaterials are characterized and engineered. Part one covers nanoparticles formation, self-assembly in the architecture nanostructures, types and classifications of nanoparticles, and signature physical and chemical properties, toxicity and regulations. Part two presents different ways to form nanometer particles, including bottom-up and top-down approaches, the classical and non-classical theories of nanoparticles formation and self-assembly, surface functionalization and other surface treatments to allow practical use. Part three covers characterization of nanoparticles and nanostructured materials, including the determination of size and shape, in addition to atomic and electronic structures and other important properties. Includes new physical and chemical techniques for the synthesis of nanoparticles and architecture nanostructures Features an in-depth treatment of nanoparticles and nanostructures, including their characterization and chemical and physical properties Explores the unusual properties of materials that are developed by modifying their shape and composition and by manipulating the arrangement of atoms and molecules Explains important techniques for the synthesis, fabrication and the characterization of complex nano-architectures

Nanoparticles are widely used in many fields of science and can often be found in everyday commercial products. This widespread use of nanoparticles in our daily lives and the industry have raised several concerns regarding the safety and environmental impact of these nanoparticles. In the biomedical field, understanding how nanoparticles interact with the biological environment is crucial for public safety and advancing the development of nanomedicine. In this work, both computational and experimental methods were developed to aid the surface chemical characterization of functionalized nanoparticles. The major experimental project focuses on controlling and probing the orientation of immobilized proteins on gold nanoparticles. Protein G B1, a protein that will selectively bind to the Fc region of IgG, was immobilized onto gold NPs (AuNPs) functionalized with oligo(ethylene glycol)-Maleimide (OEG-MEG) self-assembled monolayers (SAMs). The orientation of the protein can be controlled via a site-specific maleimide-sulfhydryl reaction between the OEG-MEG SAMs and the cysteine amino acid in the protein. Utilizing site-specific chemistry and surface sensitive analysis techniques of X-ray photoelectron spectroscopy (XPS) and time-of-flight secondary ion mass spectrometry (ToF-SIMS), it was possible to both control and determine the orientation of immobilized Protein G B1on gold nanoparticles. In addition to experimental analysis, robust computer simulations using the Simulation of Electron Spectra for Surface Analysis (SESSA) program were incorporated to aid the characterization of a wide variety of nanoparticles. It was demonstrated that SESSA can accurately simulate XPS spectra and peak intensities of nanoparticles and verify existing methods of calculating overlayer thickness of core-shell nanoparticles. Further, SESSA can be applied to assess the structure and thickness of various SAMs on both flat and nanoparticle surfaces by incorporating experimentally collected XPS and sum-frequency generation (SFG) results. In another study, SESSA was applied to model citrate stabilized Au/Ag-core/shell nanoparticles with complex geometrical properties. The Au/Ag-core/shell NPs were polydispersed in size, non-spherical, and contained off-centered Au-cores. The NPs were characterized using XPS and scanning transmission electron microscopy (STEM) to determine the composition and morphology of the NPs. Simulating NPs with average dimensions and not accounting for the geometrical properties of the NPs resulted in significant underestimation of the gold intensity. Simulations based on the combined effect of NP non-sphericity and off-centered Au-core resulted in reduced effective Ag-shell thickness and provided simulated elemental compositions that matched the experimental XPS results.

Nanomaterials: Synthesis, Characterization, Hazards and Safety

Characterization, Manipulation, and Potential Hazards to Humanity and the Environment

Analysis and Characterisation of Metal-Based Nanomaterials

Nanocharacterization Techniques

Nanomaterials and Nanocomposites

Nanoparticles and Nanostructured Films

Nanoparticles in Analytical and Medical Devices presents the latest information on the use of nanoparticles for a diverse range of analytical and medical applications. Covers basic principles, proper use of nanoparticles in analytical and medical applications, and recent progress in the field. This comprehensive reference helps readers grasp the full potential of nanoparticles in their analytical research or medical practice. Chapters on cutting-edge topics bring readers up to date on the latest research and usage of nanoparticles, and a chapter on commercially available devices that utilize nanoparticles guides readers in overcoming issues with marketing biodevices. Synthesizes nanoparticle conjugation and other critical methods Covers nanoparticles in analytical methods and real analytical devices currently used in the medical field Provides useful new information not covered in the current literature in chapters on surface chemical functionalization for bio-immobilization and nanoparticle production from natural sources

This work describes the synthesis of dendrimer-encapsulated nanoparticles (DENs) and the expansion of the characterization ability for these materials. The dendrimer-template method for the synthesis of nanoparticles allows precise control over the size, composition and structure of nanoparticles in the 40-250 atom range. In this size regime, the surface structure of the nanoparticles dominates their catalytic properties. The long term goal of this research is to correlate the structure of these nanoparticles to their catalytic activity, improving the ability to predict superior catalysts a priori. As a prerequisite for this analysis, the precise structure of the catalytically active nanoparticle must be determined. Characterization of nanoparticles in the 1-2 nm region is significantly more difficult than more commonly used nanoparticles of 3-5 nm diameter or larger. Typical characterization of these nanoparticles involves UV-vis spectroscopy for Mie absorbance and transmission electron microscopy for size analysis. This work involves the use of extended X-ray absorption-fine structure (EXAFS) to determine the local structure of the nanoparticles. For monometallic Pt DENs, EXAFS was combined with UV-vis, TEM, X-ray photoelectron spectroscopy (XPS) and electrochemistry to determine that the Pt system is not simply nanoparticles but a more complex, bimodal state. EXAFS has also been used to differentiate between different bimetallic structures. For PdAu DENs, there are two synthetic methods used. When both metals are reduced simultaneously, the resulting nanoparticles have a quasi-random alloy structure. These nanoparticles were then extracted from the dendrimer into an organic solvent by use of alkanethiols. The extraction process changed the alloy structure into Au-core/Pd-shell. When Pd and Au were reduced in sequence, the DENs were formed as a Au-core/Pd-shell material, regardless of the order of the reduction of the metals. The Au-core/Pd-shell structure was also present after extraction. In addition to structural analysis to determine the result of different synthetic methods, EXAFS was also used in situ to measure the structure of Pt DENs during the oxidation of absorbed CO. These in situ measurements are important for determining the structure of the actual catalyst rather than the precursor nanoparticle. In this case, the Pt DENs changed from a bimodal distribution into fully reduced nanoparticles by the application of a reducing potential. The binding of CO to the Pt DENs and subsequent oxidation did not cause measurable agglomeration of the nanoparticles. This reduction of the Pt system by electrochemical means was also explored as a synthetic method. The Pt-dendrimer complex was placed on a TEM grid for electrochemical treatment. A potential step was shown to reduce some of the Pt-dendrimer

complexes into Pt nanoparticles of the expected size. However, most of the complexes were not reduced. Therefore, only the standard chemical reduction followed by electrochemical treatment is sufficient to fully reduce the nanoparticle samples. This work has explored additional synthetic methods for the synthesis of monometallic and bimetallic DENs. The use of EXAFS, as well as other advanced characterization techniques, has advanced knowledge of the structure of various DENs. Both the characterization toolset and the synthetic methods will provide a basis for investigations of catalytically active materials.

First volume of a 40-volume series on nanoscience and nanotechnology, edited by the renowned scientist Challa S.S.R. Kumar. This handbook gives a comprehensive overview about Raman spectroscopy for the characterization of nanomaterials. Modern applications and state-of-the-art techniques are covered and make this volume essential reading for research scientists in academia and industry.

Nanocharacterization Techniques covers the main characterization techniques used in nanomaterials and nanostructures. The chapters focus on the fundamental aspects of characterization techniques and their distinctive approaches. Significant advances that have taken place over recent years in refining techniques are covered, and the mathematical foundations needed to use the techniques are also explained in detail. This book is an important reference for materials scientists and engineers looking for a through analysis of nanocharacterization techniques in order to establish which is best for their needs. Includes a detailed analysis of different nanocharacterization techniques, allowing readers to explore which one is best for their particular needs Provides examples of how each characterization technique has been used, giving readers a greater understanding of how each technique can be profitably used Covers the mathematical background needed to utilize each of these techniques to their best effect, meaning that readers can gain a full understanding of the theoretical principles behind each technique covered Serves as an important, go-to reference for materials scientists and engineers

Synthesis, Characterization and their Applications

Microscopy Methods in Nanomaterials Characterization

Design, Fabrication, and Characterization of Multifunctional Nanomaterials

EMR/ESR/EPR Spectroscopy for Characterization of Nanomaterials

Metal Nanoparticles

Silver Micro-Nanoparticles

Nanomaterials Characterization Techniques, Volume Two, part of an ongoing series, offers a detailed analysis of the different types of spectroscopic methods currently being used in nanocharacterization. These include, for example, the Raman spectroscopic method for the characterization of carbon nanotubes (CNTs). This book outlines the different kinds of spectroscopic tools being used for the characterization of nanomaterials and discusses under what conditions each should be used. The book is intended to cover all the major spectroscopic techniques for nanocharacterization, making it an important resource for both the academic community at the research level and the industrial community involved in nanomanufacturing. Explores how spectroscopy and X-ray-based nanocharacterization techniques are applied in modern industry Analyzes all the major spectroscopy and X-ray-based nanocharacterization techniques, allowing the reader to choose the best for their situation Presents a method-orientated approach that explains how to successfully use each technique Characterization and Biology of Nanomaterials for Drug Delivery: Nanoscience and Nanotechnology in Drug Delivery describes the techniques successfully employed for the application of nanocarriers loaded with the antioxidant enzyme, catalase, and thus targeted to endothelial cells. Methods of nanocarrier synthesis, loading within various systems, and the characterization of nanocarriers for targeting activities are covered, as are their advantages, disadvantages and applications. Reflecting the interdisciplinary nature of the subject matter, this book includes contributions by experts from different fields, all with various backgrounds and expertise. It will appeal to researchers and students from different disciplines, such as materials science, technology and various biomedical fields. Enables readers from different fields to access recent research and protocols across traditional boundaries Focuses on protocols and techniques, as well as the knowledge base of the field, thus enabling those in R&D to learn about, and successfully deploy, cutting-edge techniques Explores both current and emerging classes of nanomaterials, along with their fundamentals and applications

Second volume of a 40-volume series on nanoscience and nanotechnology, edited by the renowned scientist Challa S.S.R. Kumar. This handbook gives a comprehensive overview about UV-visible and photoluminescence spectroscopy for the characterization of nanomaterials. Modern applications and state-of-the-art techniques are covered and make this volume essential reading for research scientists in academia and industry in the related fields.