Metamaterials And Plasmonics Fundamentals Modelling Applications Nato Science For Peace And Security Series B Physics And Biophysics

Reviews in Plasmonics 2016, the third volume of the new book series from Springer, serves as a comprehensive collection of current trends and emerging hot topics in the field of Plasmonics and closely related disciplines. It summarizes the year's progress in surface plasmon phenomena and its applications, with authoritative analytical reviews in sufficient detail to be attractive to professional researchers, yet also appealing to the wider audience of scientists in related disciplines of Plasmonics. Reviews in Plasmonics offers an essential source of reference material for any lab working in the Plasmonics field and related areas. All academics, bench scientists, and industry professionals wishing to take advantage of the latest and greatest in the continuously emerging field of Plasmonics will find it an invaluable resource.

This book, edited by two of the most respected researchersin plasmonics, gives an overview of the current state inplasmonics and plasmonic-based metamaterials, with an emphasis onactive functionalities and an eye to future developments. This bookis multifunctional, useful for newcomers and scientists interestedin applications of plasmonics and metamaterials as well as forestablished researchers in this multidisciplinary area.

Contemporary engineering design is heavily based on computer simulations. Accurate, high-fidelity simulations are used not only for design verification but, even more importantly, to adjust parameters of the system to have it meet given performance requirements. Unfortunately, accurate simulations are often computationally very expensive with evaluation times as long as hours or even days per design, making design automation using conventional methods impractical. These and other problems can be alleviated by the development and employment of so-called surrogates that reliably represent the expensive, simulation-based model of the system or device of interest but they are much more reasonable and analytically tractable. This volume features surrogate-based modeling and optimization techniques, and their applications for solving difficult and computationally expensive engineering design problems. It begins by presenting the basic concepts and formulations of the surrogate-based modeling and optimization paradigm and then discusses relevant modeling techniques, optimization algorithms and design procedures, as well as state-of-the-art developments. The chapters are self-contained with basic concepts and formulations along with applications and examples. The book will be useful to researchers in engineering and mathematics, in particular those who employ computationally heavy simulations in their design work.

The interest towards photonic crystals and metamaterials and their strategic importance are evident in the steadily growing rate of topical publications. This

title addresses that ranges topics, including aspects pertaining to modeling, phenomenologies, experiments, technologies and applications.

The thesis covers a broad range of electronic, optical and opto-electronic devices and various predicted physical effects. In particular, it examines the quantum interference transistor effect in graphene nanorings; tunable spin-filtering and spin-dependent negative differential resistance in composite heterostructures based on graphene and ferromagnetic materials; optical and novel electro-optical bistability and hysteresis in compound systems and the real-time control of radiation patterns of optical nanoantennas. The direction of the main radiation lobe of a regular plasmonic array can be changed abruptly by small variations in external control parameters. This optical effect, apart from its relevance for applications, is a revealing example of the Umklapp process and, thus, is a visual manifestation of one of the most fundamental laws of solid state physics: the conservation of the quasi-momentum to within a reciprocal lattice vector. The thesis analyzes not only results for particular device designs but also a variety of advanced numerical methods which are extended by the author and described in detail. These methods can be used as a sound starting point for further research.

Metamaterials represent a new emerging innovative field of research which has shown rapid acceleration over the last couple of years. In this handbook, we present the richness of the field of metamaterials in its widest sense, describing artificial media with sub-wavelength structure for control over wave propagation in four volumes. Volume 1 focuses on the fundamentals of electromagnetic metamaterials in all their richness, including metasurfaces and hyperbolic metamaterials. Volume 2 widens the picture to include elastic, acoustic, and seismic systems, whereas Volume 3 presents nonlinear and active photonic metamaterials. Finally, Volume 4 includes recent progress in the field of nanoplasmonics, used extensively for the tailoring of the unit cell response of photonic metamaterials. In its totality, we hope that this handbook will be useful for a wide spectrum of readers, from students to active researchers in industry, as well as teachers of advanced courses on wave propagation. Contents: Volume 1: Electromagnetic Metamaterials (Ekaterina Shamonina): PrefaceElectromagnetic Metamaterials: Homogenization and Effective Properties of Mixtures (Ari Sihvola)Effective Medium Theory of Electromagnetic and Quantum Metamaterials (Mário G Silveirinha)Hyperbolic Metamaterials (Igor I Smolyaninov)Circuit and Analytical Modelling of Extraordinary Transmission Metamaterials (Francisco Medina, Francisco Mesa, Raul Rodríguez-Berral and Carlos Molero)Electromagnetic Metasurfaces: Synthesis, Realizations and Discussions (Karim Achouri and Christophe Caloz)Metasurfaces for General Control of Reflection and Transmission (Sergei Tretyakov, Viktar Asadchy and Ana Díaz-Rubio)Scattering at the Extreme with Metamaterials and Plasmonics (Francesco Monticone and Andrea Alù)All-Dielectric Nanophotonics: Fundamentals, Fabrication, and Applications (Alexander Krasnok, Roman Savelev, Denis Baranov and Pavel Belov)Tunable Metamaterials (Ilya V

Shadrivov and Dragomir N Neshev)Spatial Solitonic and Nonlinear Plasmonic Aspects of Metamaterials (Allan D Boardman, Alesandro Alberucci, Gaetano Assanto, Yu G Rapoport, Vladimir V Grimalsky, Vasyl M Ivchenko and Eugen N Tkachenko)Metamaterial Catheter Receivers for Internal Magnetic Resonance Imaging (Richard R A Syms, Ian R Young and Laszlo Solymar)Microwave Sensors Based on Symmetry Properties and Metamaterial Concepts (Jordi Naqui, Ali K Horestani, Christophe Fumeaux and Ferran Martín)Volume 2: Elastic, Acoustic, and Seismic Metamaterials (Richard Craster and Sébastien Guenneau): PrefaceDynamic Homogenization of Acoustic and Elastic Metamaterials and Phononic Crystals (Richard Craster, Tryfon Antonakakis and Sébastien Guenneau)Acoustic Metamaterial (Nicholas Fang, Jun Xu, Navid Nemati, Nicolas Viard and Denis Lafarge)Flat Lens Focusing of Flexural Waves in Thin Plates (Patrick Sebbah and Marc Dubois)Space–Time Cloaking (Martin W McCall and Paul Kinsler)Soda Cans Metamaterial: Homogenization and Beyond (Fabrice Lemoult, Geoffroy Lerosey, Nadège Kaïna and Mathias Fink)New Trends Toward Locally-Resonant Metamaterials at the Mesoscopic Scale (Philippe Roux, Matthieu Rupin, Fabrice Lemoult, Geoffroy Lerosey, Andrea Colombi, Richard Craster, Sébastien Guenneau, William A Kuperman and Earl G Williams)Seismic Metamaterials: Controlling Surface Rayleigh Waves Using Analogies with Electromagnetic Metamaterials (Stéphane Brûlé, Stefan Enoch, Sébastien Guenneau and

Most available books on computational electrodynamics are focused on FDTD, FEM, or other specific technique developed in microwave engineering. In contrast, Fourier Modal Method and Its Applications in Computational Nanophotonics is a complete guide to the principles and detailed mathematics of the up-to-date Fourier modal method of optical analysis. It takes readers through the implementation of MATLAB® codes for practical modeling of well-known and promising nanophotonic structures. The authors also address the limitations of the Fourier modal method. Features Provides a comprehensive guide to the principles, methods, and mathematics of the Fourier modal method Explores the emerging field of computational nanophotonics Presents clear, step-by-step, practical explanations on how to use the Fourier modal method for photonics and nanophotonics applications Includes the necessary MATLAB codes, enabling readers to construct their own code Using this book, graduate students and researchers can learn about nanophotonics simulations through a comprehensive treatment of the mathematics underlying the Fourier modal method and examples of practical problems solved with MATLAB codes. Positioning itself at the common boundaries of several disciplines, this work provides new perspectives on modern nanoscale problems where fundamental science meets technology and computer modeling. In addition to well-known computational techniques such as finite-difference schemes and Ewald summation, the book presents a new finite-difference calculus of Flexible Local Approximation Methods (FLAME) that qualitatively improves the numerical

accuracy in a variety of problems.

This book represents the first comprehensive overview over amorphous nano-optical and nano-photonic systems. Nanophotonics is a burgeoning branch of optics that enables many applications by steering the mould of light on length scales smaller than the wavelength with devoted nanostructures. Amorphous nanophotonics exploits self-organization mechanisms based on bottom-up approaches to fabricate nanooptical systems. The resulting structures presented in the book are characterized by a deterministic unit cell with tailored geometries; but their spatial arrangement is not controlled. Instead of periodic, the structures appear either amorphous or random. The aim of this book is to discuss all aspects related to observable effects in amorphous nanophotonic material and aspects related to their design, fabrication, characterization and integration into applications. The book has an interdisciplinary nature with contributions from scientists in physics, chemistry and materials sciences and sheds light on the topic from many directions.

The title of this book, Plasmonics: Principles and Applications, encompasses theory, technical issues, and practical applications which are of interest for diverse classes of the plasmonics. The book is a collection of the contemporary researches and developments in the area of plasmonics technology. It consists of 21 chapters that focus on interesting topics of modeling and computational methods, plasmonic structures for light transmission, focusing, and guiding, emerging concepts, and applications.

Theory and Phenomena of Metamaterials offers an in-depth look at the theoretical background and basic properties of electromagnetic artificial materials, often called metamaterials. A volume in the Metamaterials Handbook, this book provides a comprehensive guide to working with metamaterials using topics presented in a concise review format along with numerous references. With contributions from leading researchers, this text covers all areas where artificial materials have been developed. Each chapter in the text features a concluding summary as well as various cross references to address a wide range of disciplines in a single volume.

This dissertation investigates the phenomenon of negative capacitance in ferroelectric materials, which is promising for overcoming the fundamental limits of energy efficiency in electronics. The focus of this dissertation is on negative capacitance in hafnium oxide based ferroelectrics and the impact of ferroelectric domain formation.

Metamaterials and plasmonics are cross-disciplinary fields that are emerging into the mainstream of many scientific areas. Examples of scientific and technical fields which are concerned are electrical engineering, micro- and nanotechnology, microwave engineering, optics, optoelectronics, and semiconductor technologies. In plasmonics, the interplay between propagating electromagnetic waves and free-electron oscillations in materials are exploited to create new components and applications. On the other hand, metamaterials refer

to artificial composites in which small artificial elements, through their collective interaction, creates a desired and unexpected macroscopic response function that is not present in the constituent materials. This book charts the state of the art of these fields. In May 2008, world-leading experts in metamaterials and plasmonics gathered into a NATO Advanced Research Workshop in Marrakech, Morocco. The present book contains extended versions of 22 of the presentations held in the workshop, covering the general aspects of the field, as well as design and modelling questions of plasmonics and metamaterials, fabrication issues, and applications like absorbers and antennas.

This book presents a collection of extended contributions on the physics and application of optoelectronic materials and metamaterials. The book is divided into three parts, respectively covering materials, metamaterials and optoelectronic devices. Individual chapters cover topics including phonon-polariton interaction, semiconductor and nonlinear organic materials, metallic, dielectric and gyrotropic metamaterials, singular optics, parity-time symmetry, nonlinear plasmonics, microstructured optical fibers, passive nonlinear shaping of ultrashort pulses, and pulse-preserving supercontinuum generation. The book contains both experimental and theoretical studies, and each contribution is a self-contained exposition of a particular topic, featuring an extensive reference list. The book will be a useful resource for graduate and postgraduate students, researchers and engineers involved in optoelectronics/photonics, quantum electronics, optics, and adjacent areas of science and technology.

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This book discusses the active and passive radar cross section (RCS) estimation and techniques to examine the low observable aerospace platforms. It begins with the fundamentals of RCS, followed by the dielectric, magnetic and metamaterials parameters of the constituent materials and then explains various methods and the emerging trends followed in this area of study. The RCS estimation of phased array including the mutual coupling effect is also presented in detail in the book. The active RCS reduction is carefully touched upon through the performance of phased arrays, sidelobe cancellers and mitigation of multipath effect. Providing information on various adaptive algorithms like least mean square (LMS), recursive least square (RLS) and weighted least square algorithms, the authors also mention the recent developments in the area of embedded antennas, conformal load bearing antenna, metamaterials and frequency selective surface (FSS) based RCS reduction.

While many books are dedicated to individual aspects of nanofabrication, there is no single source that defines and explains the total vision of the field. Filling this gap, Nanofabrication Handbook presents a unique collection of new and the most important established approaches to nanofabrication. Contributors from leading research facilities and academic institutions around the world define subfields, offer practical instructions and examples, and pave the way for future research. Helping readers to select the proper fabricating technique for their experiments,

the book provides a broad vision of the most critical problems and explains how to solve them. It includes basic definitions and introduces the main underlying concepts of nanofabrication. The book also discusses the major advantages and disadvantages of each approach and offers a wide variety of examples of cutting-edge applications. Each chapter focuses on a particular method or aspect of study. For every method, the contributors describe the underlying theoretical basis, resolution, patterns and substrates used, and applications. They show how applications at the nanoscale require a different process and understanding than those at the microscale. For each experiment, they elucidate key solutions to problems relating to materials, methods, and surface considerations. A complete resource for this rapidly emerging interdisciplinary field, this handbook provides practical information for planning the experiments of any project that employs nanofabrication techniques. It gives readers a foundation to enter the complex world of nanofabrication and inspires the scientific community at large to push the limits of nanometer resolution.

Sensors, Transducers, Signal Conditioning and Wireless (Book Series 'Advances in Sensors: Reviews', Vol. 3) is a premier sensor review source and contains 19 chapters with sensor related state-of-the-art reviews and descriptions of latest achievements written by 55 authors from academia and industry from 19 countries: Botswana, Canada, China, Finland, France, Germany, India, Jordan, Mexico, Portugal, Romania, Russia, Senegal, Serbia, South Africa, South Korea, UK, Ukraine and USA. Coverage includes current developments in physical sensors and transducers, chemical sensors, biosensors, sensing materials, signal conditioning energy harvesters and wireless sensor networks. This book ensures that readers will stay at the cutting edge of the field and get the right and effective start point and road map for the further researches and developments.

This book offers the first comprehensive introduction to the optical properties of the catenary function, and includes more than 200 figures. Related topics addressed here include the photonic spin Hall effect in inhomogeneous anisotropic materials, coupling of evanescent waves in complex structures, etc. After familiarizing readers with these new physical phenomena, the book highlights their applications in plasmonic nanolithography, flat optical elements, perfect electromagnetic absorbers and polarization converters. The book will appeal to a wide range of readers: while researchers will find new inspirations for historical studies combining mechanics, mathematics, and optics, students will gain a wealth of multidisciplinary knowledge required in many related areas. In fact, the catenary function was deemed to be a “true mathematical and mechanical form” in architecture by Robert Hooke in the 1670s. The discovery of the mathematical form of catenaries is attributed to Gottfried Leibniz, Christiaan Huygens and Johann Bernoulli in 1691. As the founders of wave optics, however, Hooke and Huygens did not recognize the importance of catenaries in optics. It is only in recent decades that the link between catenaries and optics has been established.

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Since the concept was first proposed at the end of the 20th Century, metamaterials have been the subject of much research and discussion throughout the wave community. More than 10 years later, the number of related published articles is increasing significantly. On the one hand, this success can be attributed to dreams of new physical objects which are the consequences of the singular properties of metamaterials. Among them, we can consider the examples of perfect lensing and invisibility cloaking. On other hand, metamaterials also provide new tools for the design of well-known wave functions such as antennas for electromagnetic waves. The goal of this book is to propose an overview of the concept of metamaterials as a perspective on a new practical tool for wave study and engineering. This includes both the electromagnetic spectrum, from microwave to optics, and the field of acoustic waves. Contents 1. Overview of Microwave and Optical Metamaterial Technologies, Didier Lippens. 2. MetaLines: Transmission Line Approach for the Design of Metamaterial Devices, Bruno Sauviac. 3. Metamaterials for Non-Radiative Microwave Functions and Antennas, Divitha Seetharamdoo and Bruno Sauviac. 4. Toward New Prospects for Electromagnetic Compatibility, Divitha Seetharamdoo. 5. Dissipative Loss in Resonant Metamaterials, Philippe Tassin, Thomas Koschny, and Costas M. Soukoulis. 6. Transformation Optics and Antennas, André de Lustrac, Shah Nawaz Burokur and Paul-Henri Tichit. 7. Metamaterials for Control of Surface Electromagnetic and Liquid Waves, Sébastien Guenneau, Mohamed Farhat, Muamer Kadic, Stefan Enoch and Romain Quidant. 8. Classical Analog of Electromagnetically Induced Transparency, Philippe Tassin, Thomas Koschny and Costas M. Soukoulis.

This book discusses bulk solids that derive their mechanical properties not from those of their base materials, but from their designed microstructures. Focusing on the negative mechanical properties, it addresses topics that reveal the counter-intuitive nature of solids, specifically the negativity of properties that are commonly positive, such as negative bulk modulus, negative compressibility, negative hygroexpansion, negative thermal expansion, negative stiffness phase, and negative Poisson's ratio. These topics are significant not only due to the curiosity they have sparked, but also because of the possibility of designing

materials and structures that can behave in ways that are not normally expected in conventional solids, and as such, of materials that can outperform solids and structures made from conventional materials. The book includes illustrations to facilitate learning, and, where appropriate, reference tables. The presentation is didactic, starting with simple cases, followed by increasingly complex ones. It provides a solid foundation for graduate students, and a valuable resource for practicing materials engineers seeking to develop novel materials through the judicious design of microstructures and their corresponding mechanisms.

This reference offers tools for engineers, scientists, biologists, and others working with the computational techniques of nanophotonics. It introduces the key concepts of computational methods in a manner that is easily digestible for newcomers to the field. The book also examines future applications of nanophotonics in the technical industry and covers new developments and interdisciplinary research in engineering, science, and medicine. It provides an overview of the key computational nanophotonics and describes the technologies with an emphasis on how they work and their key benefits.

Dielectric Metamaterials: Fundamentals, Designs and Applications links fundamental Mie scattering theory with the latest dielectric metamaterial research, providing a valuable reference for new and experienced researchers in the field. The book begins with a historical, evolving overview of Mie scattering theory. Next, the authors describe how to apply Mie theory to analytically solve the scattering of electromagnetic waves by subwavelength particles. Later chapters focus on Mie resonator-based metamaterials, starting with microwaves where particles are much smaller than the free space wavelengths. In addition, several chapters focus on wave-front engineering using dielectric metasurfaces and the nonlinear optical effects, spontaneous emission manipulation, active devices, and 3D effective media using dielectric metamaterials. Highlights a crucial link in fundamental Mie scattering theory with the latest dielectric metamaterial research spanning materials, design and applications Includes coverage of wave-front engineering and 3D metamaterials Provides computational codes for calculating and simulating Mie resonances

Plasmonic nanostructures provide new ways of manipulating the flow of light with nanostructures and nanoparticles exhibiting optical properties never before seen in the macro-world. Covering plasmonic technology from fundamental theory to real world applications, this work provides a comprehensive overview of the field. • Discusses the fundamental theory of plasmonics, enabling a deeper understanding of plasmonic technology • Details numerical methods for modeling, design and optimization of plasmonic nanostructures • Includes step-by-step design guidelines for active and passive plasmonic devices, demonstrating the implementation of real devices in the standard CMOS nanoscale electronic-photonic integrated circuit to help cut design, fabrication and characterisation time and cost • Includes real-world case studies of plasmonic devices and sensors, explaining the benefits and downsides of different nanophotonic integrated circuits and sensing platforms. Ideal for researchers, engineers and graduate students in the fields of nanophotonics and nanoelectronics as well as optical biosensing.

This book discusses the development of Fano-based techniques and reveals the characteristic

properties of various wave processes by studying interference phenomena. It explains that the interaction of discrete (localized) states with a continuum of propagation modes leads to Fano interference effects in transmission, and explores novel coherent effects such as bound states in the continuum accompanied by collapse of Fano resonance. Originating in atomic physics, Fano resonances have become one of the most appealing phenomena of wave scattering in optics, microwaves, and terahertz techniques. The generation of extremely strong and confined fields at a deep subwavelength scale, far beyond the diffraction limit, plays a central role in modern plasmonics, magnonics, and in photonic and metamaterial structures. Fano resonance effects take advantage of the coupling of these bound states with a continuum of radiative electromagnetic waves. With their unique physical properties and unusual combination of classical and quantum structures, Fano resonances have an application potential in a wide range of fields, from telecommunication to ultrasensitive biosensing, medical instrumentation and data storage. Including contributions by international experts and covering the essential aspects of Fano-resonance effects, including theory, modeling and design, proven and potential applications in practical devices, fabrication, characterization and measurement, this book enables readers to acquire the multifaceted understanding required for these multidisciplinary challenges.

Recent technological breakthrough in the field of Terahertz radiation has triggered new applications in biology and biomedicine. Particularly, biological applications are based on the specific spectroscopic fingerprints of biological matter in this spectral region. Historically with the discovery of new electromagnetic wave spectrum, we have always discovered new medical diagnostic imaging systems. The use of terahertz wave was not realized due to the absence of useful terahertz sources. Now after successful generation of THz waves, it is reported that a great potential for THz wave exists for its resonance with bio-molecules. There are many challenging issues such as development of THz passive and active instrumentations, understanding of THz-Bio interaction for THz spectroscopy, THz-Bio nonlinear phenomena and safety guideline, and THz imaging systems. Eventually the deeper understanding of THz-Bio interaction and novel THz systems enable us to develop powerful THz biomedical imaging systems which can contribute to biomedical industry. This is a truly interdisciplinary field and convergence technology where the communication between different disciplines is the most challenging issue for the success of the great works. One of the first steps to promote the communications in this convergence technology would be teaching the basics of these different fields to the researchers in a plain language with the help of Convergence of Terahertz Science in Biomedical Systems which is considered to be 3-4th year college students or beginning level of graduate students. Therefore, this type of book can be used by many people who want to enter or understand this field. Even more it can be used for teaching in universities or research institutions.

Gold is used in a wide range of industrial and medical applications and accounts for over 10 percent of the annual demand for metal, worth billions of dollars annually. While much has been written about the mystique and trade of gold, very little has been written about the science and technology in which it is involved. Edited by two respected authorities from the World Gold Council, Gold: Science and Applications provides researchers with the definitive handbook on the current science and applications of this valuable and beautiful precious metal. Packed with contributions from the world’s leading experts, this volume brings in authoritative information from a number of sciences, including chemistry, physics, nanotechnology and metallurgy. The book presents a myriad of applications, ranging from electronics to medicine and optics. A comprehensive overview chapter provides historical perspectives of the element and each chapter describes potential further uses, including applications currently being developed. Gold Applications in Use Today Include: Medical Dental Electronics Engineering Industrial Pollution Control Photography Catalysts Nanotechnology

This book provides an overview of the use of toroidal moments. This includes methods of excitation, numerical analysis, and experimental measurements of associating structures. Special emphasis is placed on understanding the fundamental physics, characteristics, and real-world applications of toroidal multipoles. This book also covers a variety of both planar and 3D meta-atom and metamolecule schemes capable to sustain toroidal moments across a wide range of spectrum. It discusses the implementation of innovative approaches, for exploring the spectral features and excitation methodologies, predicting the properties of the correlating metasystems in their excited states. An applicable text for undergraduate, graduate, and postgraduate students, this book is also of interest to researchers, theorizers, and experimentalists working in optical physics, photonics, and nanotechnology.

The purpose of this book is to provide an up-to-date introduction to the time-domain finite element methods for Maxwell's equations involving metamaterials. Since the first successful construction of a metamaterial with both negative permittivity and permeability in 2000, the study of metamaterials has attracted significant attention from researchers across many disciplines. Thanks to enormous efforts on the part of engineers and physicists, metamaterials present great potential applications in antenna and radar design, sub-wavelength imaging, and invisibility cloak design. Hence the efficient simulation of electromagnetic phenomena in metamaterials has become a very important issue and is the subject of this book, in which various metamaterial modeling equations are introduced and justified mathematically. The development and practical implementation of edge finite element methods for metamaterial Maxwell's equations are the main focus of the book. The book finishes with some interesting simulations such as backward wave propagation and time-domain cloaking with metamaterials.

Electromagnetic complex media are artificial materials that affect the propagation of electromagnetic waves in surprising ways not usually seen in nature. Because of their wide range of important applications, these materials have been intensely studied over the past twenty-five years, mainly from the perspectives of physics and engineering. But a body of rigorous mathematical theory has also gradually developed, and this is the first book to present that theory. Designed for researchers and advanced graduate students in applied mathematics, electrical engineering, and physics, this book introduces the electromagnetics of complex media through a systematic, state-of-the-art account of their mathematical theory. The book combines the study of well posedness, homogenization, and controllability of Maxwell equations complemented with constitutive relations describing complex media. The book treats deterministic and stochastic problems both in the frequency and time domains. It also covers computational aspects and scattering problems, among other important topics. Detailed appendices make the book self-contained in terms of mathematical prerequisites, and accessible to engineers and physicists as well as mathematicians.

Metamaterials and Plasmonics: Fundamentals, Modelling, ApplicationsSpringer Science & Business Media

Examines the Low Resistivity, High Mobility, and Zero Bandgap of Graphene The Graphene Science Handbook is a six-volume set that describes graphene's special structural, electrical, and chemical properties. The book considers how these properties can be used in different applications (including the development of batteries, fuel cells, photovoltaic cells, and supercapacitors based on graphene) and produced on a massive and global scale. Volume One: Fabrication Methods Volume Two: Nanostructure and Atomic Arrangement Volume Three: Electrical and Optical Properties Volume Four: Mechanical and Chemical Properties Volume Five: Size-Dependent Properties Volume Six: Applications and Industrialization This handbook describes the fabrication

methods of graphene; the nanostructure and atomic arrangement of graphene; graphene's electrical and optical properties; the mechanical and chemical properties of graphene; the size effects in graphene, characterization, and applications based on size-affected properties; and the application and industrialization of graphene. Volume two is dedicated to nanostructure and atomic arrangement and covers: The potential applications of graphene heterostructures, particularly, graphene/h-BN heterostructures Atomic-scale defects in graphene and the huge impact they have on its low-energy electronic structure Recent findings on graphene plasmonics The storage of hydrogen between graphene and inside graphene-oxide frameworks (GOFs) The nitrogen contents, species, synthesis methods, and application on nitrogen-doped graphene Modification methods and applications of graphene and graphene oxide Phonon spectra and vibrational thermodynamic characteristics of graphene nanofilms The imaging of graphene by scanning electron microscopy (SEM) Advances in the formation of graphene-based three-dimensional (3D) architectures and more

This book provides a comprehensive overview of the theory and practical development of metamaterial-based perfect absorbers (MMPAs). It begins with a brief history of MMPAs which reviews the various theoretical and experimental milestones in their development. The theoretical background and fundamental working principles of MMPAs are then discussed, providing the necessary background on how MMPAs work and are constructed. There then follows a section describing how different MMPAs are designed and built according to the operating frequency of the electromagnetic wave, and how their behavior is changed. Methods of fabricating and characterizing MMPAs are then presented. The book elaborates on the performance and characteristics of MMPAs, including electromagnetically-induced transparency (EIT). It also covers recent advances in MMPAs and their applications, including multi-band, broadband, tunability, polarization independence and incidence independence. Suitable for graduate students in optical sciences and electronic engineering, it will also serve as a valuable reference for active researchers in these fields.

The design and study of materials is a pivotal component to new discoveries in the various fields of science and technology. By understanding the components and structures of materials, researchers can increase its applications across different industries. Modeling and Simulations for Metamaterials: Emerging Research and Opportunities is a critical scholarly resource that examines the physics of metamaterials with an emphasis on negative-index metamaterials and their applications at terahertz frequencies. Featuring coverage on a broad range of topics, such as electromagnetic waves, harmonic oscillator model, and scattering analysis, this book is geared towards academicians, researchers, engineers, industrialists, and graduate students researching in the field.

Gold Nanoparticles for Physics, Chemistry and Biology offers an overview of recent research into gold nanoparticles, covering their discovery, usage and

contemporary practical applications. This Second Edition begins with a history of over 2000 years of the use of gold nanoparticles, with a review of the specific properties which make gold unique. Updated chapters include gold nanoparticle preparation methods, their plasmon resonance and thermo-optical properties, their catalytic properties and their future technological applications. New chapters have been included, and reveal the growing impact of plasmonics in research, with an introduction to quantum plasmonics, plasmon assisted catalysis and electro-photon conversion. The growing field of nanoparticles for health is also addressed with a study of gold nanoparticles as radiosensibiliser for radiotherapy, and of gold nanoparticle functionalisation. This new edition also considers the relevance of bimetallic nanoparticles for specific applications. World-class scientists provide the most up-to-date findings for an introduction to gold nanoparticles within the related areas of chemistry, biology, material science, optics and physics. It is perfectly suited to advanced level students and researchers looking to enhance their knowledge in the study of gold nanoparticles.

Properties of wave localization play a decisive role both in applications of engineered microstructures and in the detection of cracks and flaws. The papers in this volume give an introduction into a variety of interrelated dynamic localization phenomena occurring in elasticity, acoustics and electromagnetism. In particular, these involve surface and edge waves and also trapped modes localized near defects, shape changes and the edges of elongated waveguides. The effects of layering, prestress, anisotropy, periodic microstructures as well as various multi-field phenomena are addressed with reference to underlying industrial problems. The essential and up-to-date numerical, asymptotic, and analytical techniques are covered as well as relevant continuum theories that are required to make progress in, and understand wave localization and allied effects. A major focus is on a qualitative physical insight into the mechanisms of dynamic localization.

The third, partly revised and enlarged edition of this introductory reference summarizes the terms and definitions, most important phenomena, and regulations occurring in the physics, chemistry, technology, and application of nanostructures. A representative collection of fundamental terms and definitions from quantum physics and chemistry, special mathematics, organic and inorganic chemistry, solid state physics, material science and technology accompanies recommended secondary sources for an extended study of any given subject. Each of the more than 2,200 entries, from a few sentences to a page in length, interprets the term or definition in question and briefly presents the main features of the phenomena behind it. Additional information in the form of notes ("First described in", "Recognition", "More details in") supplements the entries and gives a historical perspective of the subject with reference to further sources. Ideal for answering questions related to unknown terms and definitions among undergraduate and PhD students studying the physics of low-dimensional

structures, nanoelectronics, and nanotechnology.

This book opens a new avenue to an engendering field of applied physics, located at the “crossing” of modern photonics, electromagnetics, acoustics and material science. It also highlights the concept of “non-locality”, which proves to be not a special feature of quantum phenomena, but is shown to have an important counterpart in classical physics and its engineering applications too. Furthermore, it visualizes the physical results by means of simple analytical presentations, reduced sometimes to the elementary functions.

Contents:IntroductionNon-local Dispersion of Heterogeneous DielectricsGradient Photonic Barriers: Generalizations of the Fundamental ModelResonant Tunneling of Light Through Gradient Dielectric NanobarriersInteraction of Electromagnetic Waves with Continuously Structured DielectricsPolarization Phenomena in Gradient NanophotonicsGradient Optics of Guided and Surface Electromagnetic WavesNon-local Acoustic Dispersion of Gradient Solid LayersShear Acoustic Waves in Gradient Elastic SolidsShear Horizontal Surface Acoustic Waves on Graded Index Media Readership: For researchers, engineers and designers of communication systems, lecturers and graduate students. Keywords:Wave Propagation;Gradient Nanophotonics;Gradient Acoustics;Tunneling;Heterogeneous Dielectrics;Gradient Acoustics;NanofilmsKey Features:It is the first systematic presentation of a newly developing branch of wave physics, containing the series of “hot” results dispersed hitherto in different journalsIt's the first book, forming the cornerstones of the modern insight on the miniaturized gradient subwavelength structuresMoreover, it is the first book bringing together the physical fundamentals and mathematical basis of electromagnetic and acoustic wave processes in gradient metamaterialsReviews: “I recommend this book to a broad readership, including researchers and engineers as well as lecturers and graduate students, and even to designers of communication systems.” Optics & Photonics News