

OPTICAL SCIENCES

K. Sakoda

# Optical Properties of Photonic Crystals

Second Edition

 Springer

# Optical Properties Of Photonic Crystals 2nd Edition

**Ross McPhedran, Simon  
Gluzman, Vladimir Mityushev, Natalia  
Rylko**



## **Optical Properties Of Photonic Crystals 2nd Edition:**

*Optical Properties of Photonic Crystals* Kazuaki Sakoda, 2013-11-11 The interaction between the radiation field and matter is the most fundamental source of dynamics in nature. It brings about the absorption and emission of photons, elastic and inelastic light scattering, the radiative lifetime of electronic excited states and so on. The huge amount of energy carried from the sun by photons is the source of all activities of creatures on the earth. The absorption of photons by chlorophylls and the successive electronic excitation initiate a series of chemical reactions that are known as photosynthesis, which support all life on the earth. Radiative energy is also the main source of all meteorological phenomena. The fundamentals of the radiation field and its interaction with matter were clarified by classical electromagnetism and quantum electrodynamics. These theories we believe explain all electromagnetic phenomena. They not only provide a firm basis for contemporary physics but also generate a vast range of technological applications. These include television, radar, optical and microwave telecommunications, lasers, light emitting diodes, solar cells, etc. Now the interaction between the radiation field and matter is so fundamental that it may seem universal and invariant. But in fact it is controllable.

**Optical Properties of Photonic Structures** Mikhail F. Limonov, Richard De La Rue, 2016-04-19 The collection of articles in this book offers a penetrating shaft into the still burgeoning subject of light propagation and localization in photonic crystals and disordered media. While the subject has its origins in physics, it has broad significance and applicability in disciplines such as engineering, chemistry, mathematics and medicine.

*Foundations Of Photonic Crystal Fibres (2nd Edition)* Alexander Argyros, Andre Nicolet, Frederic Zolla, Gilles Renversez, Sebastien R L Guenneau, Boris Kuhlmeier, Didier Felbacq, Sergio G Leon-saval, 2012-06-11 The focus of this book lies at the meeting point of electromagnetic waveguides and photonic crystals. Although these are both widely studied topics, they have been kept apart until recently. The purpose of the first edition of this book was to give state of the art theoretical and numerical viewpoints about exotic fibres which use photonic crystal effects and consequently exhibit some remarkable properties. Since that first edition, photonic crystal fibres have become an important and effective optical device. In this second edition, the description of the theoretical and numerical tools used to study these fibres is enhanced, whilst up to date information about the properties, applications and fabrication of these fibres is added.

**Photonic Crystals** Kuon Inoue, Kazuo Ohtaka, 2013-11-11 Photonic Crystals details recent progress in the study of photonic crystals ranging from fundamental aspects to up to date applications in one unified treatment. It covers most of the worldwide frontier fields in photonic crystals, including up to date fabrication techniques, recent and future technological applications, and our basic understanding of the various optical properties of photonic crystals. Brand new theoretical and experimental data are also presented. The book is intended for graduate course students and specialists actively working in this field, but it will also be useful for newcomers, especially the extensive chapter dealing with fundamental aspects of photonic crystals, which paves the way to a full appreciation of the other topics addressed.

*Photonic Crystals* Pankaj Kumar Choudhury, 2019-10-09 The role of dielectric mirrors is very important in optics. These are used for several purposes like imaging, fabricating laser cavities and so on. The basis for the propagation of photons in dielectric mediums is the same as electrons in solid crystals. If the electrons can be diffracted by a periodic potential well, photons could also be equally well diffracted by a periodic modulation of the refractive index of the medium. This idea led to the development of many new artificial photonic materials and optical micro and nanostructures. Since the mechanism of light guidance is essentially due to the microstructural features of the medium, a wide variety of photonic structures e.g. photonic band gap fibers in 1D and photonic band gap crystals in 2D and 3D can be realized. *Photonic Crystals: A Glimpse of the Current Research Trends* essentially highlights the recent developments in the arena of photonic crystal research. It is expected to be useful for expert as well as novice researchers; the former group of readers would be abreast of recent research advancements whereas the latter group would benefit from grasping knowledge delivered by expert scientists.

**Theoretical Foundations and Application of Photonic Crystals** Alexander Vakhrushev, 2018-04-04 This book is devoted to the description of research and design of photonic crystals. Topics included in the book cover a wide range of research in the field of theoretical analysis and experimental investigation: the electromagnetic field in the photonic crystal; propagation of waves in the gyrotropic magnetophotonic crystals; low one-photon absorption; ultratransparent photonic crystals; colloidal assembly; photonic crystal application for development of all-optical computational system design strategies for PC devices; self-organization of liquid crystalline nanostructures and optical diodes. This book will be useful for engineers, technologists, researchers and postgraduate students interested in the research design, fabrication processes and applications of photonic crystals.

**Fundamentals of Photonics** Bahaa E. A. Saleh, Malvin Carl Teich, 2020-03-04 *Fundamentals of Photonics* is a complete, thoroughly updated, full-color third edition. *Fundamentals of Photonics*, Third Edition, is a self-contained and up-to-date introductory level textbook that thoroughly surveys this rapidly expanding area of engineering and applied physics. Featuring a blend of theory and applications coverage, it includes detailed accounts of the primary theories of light, including ray optics, wave optics, electromagnetic optics, and photon optics, as well as the interaction of light and matter. Presented at increasing levels of complexity, preliminary sections build toward more advanced topics such as Fourier optics and holography, photonic crystal optics, guided wave and fiber optics, LEDs and lasers, acousto-optic and electro-optic devices, nonlinear optical devices, ultrafast optics, optical interconnects and switches, and optical fiber communications. The third edition features an entirely new chapter on the optics of metals and plasmonic devices. Each chapter contains highlighted equations, exercises, problems, summaries, and selected reading lists. Examples of real systems are included to emphasize the concepts governing applications of current interest. Each of the twenty-four chapters of the second edition has been thoroughly updated.

**Photonics, Volume 2** David L. Andrews, 2015-01-28 Discusses the basic physical principles underlying the science and technology of nanophotonics, its materials and structures. This volume presents nanophotonic

structures and Materials Nanophotonics is photonic science and technology that utilizes light-matter interactions on the nanoscale where researchers are discovering new phenomena and developing techniques that go well beyond what is possible with conventional photonics and electronics. The topics discussed in this volume are Cavity Photonics, Cold Atoms and Bose-Einstein Condensates, Displays, E-paper, Graphene, Integrated Photonics, Liquid Crystals, Metamaterials, Micro and Nanostructure Fabrication, Nanomaterials, Nanotubes, Plasmonics, Quantum Dots, Spintronics, Thin Film Optics. Comprehensive and accessible coverage of the whole of modern photonics. Emphasizes processes and applications that specifically exploit photon attributes of light. Deals with the rapidly advancing area of modern optics. Chapters are written by top scientists in their field. Written for the graduate-level student in physical sciences, industrial and academic researchers in photonics, graduate students in the area, college lecturers, educators, policymakers, consultants, scientific and technical libraries, government laboratories, NIH.

**Physical Properties of Materials, Second Edition** Mary Anne White, 2011-06-28  
 Designed for advanced undergraduate students, *Physical Properties of Materials, Second Edition* establishes the principles that control the optical, thermal, electronic, magnetic, and mechanical properties of materials. Using an atomic and molecular approach, this introduction to materials science offers students a wide-ranging survey of the field and a basis to understand future materials. The author incorporates comments on applications of materials science, extensive references to the contemporary and classic literature, and problems at the end of each chapter. In addition, unique tutorials allow students to apply the principles to understand applications such as photocopying, magnetic devices, fiber optics, and more. This fully revised and updated second edition presents a discussion of materials sustainability, a description of crystalline structures, and discussion of current and recent developments including graphene, carbon nanotubes, nanocomposites, magnetocaloric effect, and spintronics. Along with a new capstone tutorial on the materials science of cymbals, this edition contains more than 60 new end-of-chapter problems, bringing the total to 300 problems. **Web Resource:** The book's companion website [www.physicalpropertiesofmaterials.com](http://www.physicalpropertiesofmaterials.com) provides updates to the further reading sections, links to relevant movies and podcasts for each chapter, video demonstrations, and additional problems. It also offers sources of demonstration materials for lectures and PowerPoint slides of figures from the book. More information can be found on a recent press release describing the book and the website.

**Nonlinear Optics of Photonic Crystals and Meta-Materials** Arthur R. McGurn, 2015-09-30  
 The study of dark matter in both astrophysics and particle physics has emerged as one of the most active and exciting topics of research in recent years. This book reviews the history behind the discovery of missing mass, or unseen mass, in the Universe and ties this into the proposed extensions to the Standard Model of Particle Physics, such as Supersymmetry, which were being proposed within the same time frame. This book is written as an introduction to these problems at the forefront of astrophysics and particle physics, with the goal of conveying the physics of dark matter to beginning undergraduate majors in scientific fields. The book goes on to describe existing and upcoming experiments and techniques which will be used to detect dark matter.

either directly or indirectly      2D and Quasi-2D Composite and Nanocomposite Materials Ross McPhedran, Simon Gluzman, Vladimir Mityushev, Natalia Rylko, 2020-06-05 2D and Quasi 2D Composite and Nanocomposite Materials Theory Properties and Photonic Applications covers the theory characterization and computational modeling of 2D composite materials and shows how they are used for the creation of materials for 3D structures The book covers three major themes Properties of 2D and quasi 2D composites are discussed in the context of homogenization theory Homogenization results are discussed for spatiotemporal material composites assembled from materials which are distributed on a micro scale in space and in time New types of transport phenomena and localization in random media are addressed with particular attention to the non reciprocity of transport coefficients Plasmonics and magneto optics are also of particular interest Magneto transport and sub wavelength resolution in electromagnetic and acoustic imaging are further considered This book is an important resource for materials scientists and engineers working on nanomaterials photonic composites and materials theory modeling and simulations Outlines major modelling techniques of 2D nanocomposites for photonic applications Explores how the properties of 2D nanocomposites make them suitable for use for building 3D structures Assesses the challenges of using 2D nanocomposites for designing new devices on a mass scale      **Optical Superresolution** David Mendlovic, 2012-12-06

This book explores ways to improve the classical resolution limits of an imaging system Various approaches dealing with exceeding the limitations of the lens aperture the pixel size in the camera and the noise generated at the detector are presented and analyzed The book starts by presenting the theoretical foundations and by introducing the background and the related terms and then proceeds into the desired system analysis Despite the fact that the book tends to provide the mathematical background required to follow the presented derivations it assumes that the reader has acquired a basic knowledge in optical Fourier processing If this is not the case we strongly advise using Goodman's book Introduction to Fourier Optics as mandatory prereading material The book is mainly intended for a graduated audience who may be researchers in an academy or engineers in the industry seeking information that may assist them in improving the performance of their electro optical system design The last chapter of the book is a more practical chapter that explores several industry related examples and applications that may use the superresolution techniques in real industrial electro optical systems The most important feature of this book is its attempt to address an important subject that has not been addressed before the subject of resolution and imaging and to discuss techniques of how to exceed these classical limitations

**Nanoplasmonics, Nano-Optics, Nanocomposites, and Surface Studies** Olena Fesenko, Leonid Yatsenko, 2015-07-08 This book highlights the most recent advances in nano science from leading researchers in Ukraine Europe and beyond It features contributions from participants of the 3rd International Summer School Nanotechnology From Fundamental Research to Innovations held in Yaremche Ukraine on August 23-26 2014 and of the 2nd International NANO 2014 Conference held in Lviv Ukraine on August 27-30 2014 These events took place within the framework of the European

Commission FP7 project Nano twinning and were organized jointly by the Institute of Physics of the National Academy of Sciences of Ukraine University of Tartu Estonia University of Turin Italy and Pierre and Marie Curie University France Internationally recognized experts from a wide range of universities and research institutions share their knowledge and key results in the areas of nanocomposites and nanomaterials nanostructured surfaces microscopy of nano objects nano optics and nano photonics nano plasmonics nano chemistry nano biotechnology and surface enhanced spectroscopy Covers nanocomposites nano structured surfaces and nano biotechnology Presents state of the art advances in nano plasmonics nanomaterials characterization and surface enhanced spectroscopy Represents essential reading for advanced undergraduate and graduate students through practicing university and industry researchers

**Diffraction Optics of Complex-Structured Periodic Media** Vladimir Belyakov, 2019-08-02 This book presents recent theoretical and experimental results of localized optical modes and low threshold lasing in spiral photonic media Efficient applications of localized modes for low threshold lasing at the frequencies of localized modes are a central topic of the book's new chapters Attention is paid to the analytical approach to the problem The book focuses on one of the most extensively studied media in this field cholesteric liquid crystals The chosen model in the absence of dielectric interfaces allows to remove the problem of polarization mixing at surfaces layers and defect structures It allows to reduce the corresponding equations to the equations for light of diffracting polarization only The problem concentrates then on the edge and defect optical modes The possibility to reduce the lasing threshold due to an anomalously strong absorption effect is presented theoretically for distributed feedback lasing It is shown that a minimum of the threshold pumping wave intensity can be reached for the pumping wave frequency coinciding with the localized mode frequency what can be reached for a pumping wave propagating at a certain angle to the helical axes Analytic expressions for transmission and reflection coefficients are presented In the present second edition experimental observations of theoretically revealed phenomena in spiral photonic media are discussed The main results obtained for spiral media are qualitatively valid for photonic crystals of any nature and therefore may be applied as a guide to investigations of other photonic crystals where the corresponding theory is more complicated and demands a numerical approach It is demonstrated that many optical phenomena occurring at the frequencies of localized modes reveal unusual properties which can be used for efficient applications of the corresponding phenomena efficient frequency conversion and low threshold lasing e.g. For the convenience of the reader an introduction is given to conventional linear and nonlinear optics of structured periodic media This book is valuable to researchers postgraduate and graduate students active in theoretical and experimental physics in the field of interaction of radiation with condensed matter

**Raman Amplifiers for Telecommunications 2** Mohammad N. Islam, 2007-06-04 I remember vividly the first time that I heard about the fiber amplifier At that time of course it was the erbium doped fiber amplifier the predecessor of the Raman amplifier that is the subject of this book It was an early morning in a forgotten year in Murray Hill New Jersey at one of our Bell Labs monthly research staff

meetings About twenty directors and executive directors of research organizations clustered around a long table in the imposing executive conference room Arno Penzias the vice president of research presided at the foot of the table Everyone who participated in those research staff meetings will long remember their culture and atmosphere Arno would pick an arbitrary starting point somewhere around the table and the designated person would head to the front of the table to give a short talk on something new in his or her research area This rst speaker would invariably ddle helplessly with the controls embedded in the podium that controlled the viewgraph projector but eventually we would hear machinery grinding in the back room as a large hidden mirror moved into place We would all wait quietly arranging and choosing our own viewgraphs from the piles that lay on the table in front of every participant

### **Progress in Nano-Electro-Optics II** Motoichi

Ohtsu,2012-12-06 Novel Devices and Atom Manipulation the second and concluding volume of Progress in Nano Electro Optics focuses on applications to novel devices and atom manipulation Each chapter is written by a leading scientists in the field Part II addresses the latest developments in nano optical techniques dealing with topics such as the reasons that the resolution of nano electro optical techniques extend beyond the diffraction limit applications of excitonic polaritons to opto electronic devices instrumentation of near field optical microscopy to study quantum confined systems and atom manipulation by optical near field techniques Together with volume I Basics and Theory of Near Field Optics these overviews are a valuable resource for engineers and scientists working in the field of nano electro optics

**Raman Amplifiers for Telecommunications 1** Mohammad N. Islam,2007-06-30 I remember vividly the rst time that I heard about the ber ampli er At that time of course it was the erbium doped ber ampli er the predecessor of the Raman ampli er that is the subject of this book It was an early morning in a forgotten year in Murray Hill New Jersey at one of our Bell Labs monthly research staff meetings About twenty directors and executive directors of research organizations clustered around a long table in the imposing executive conference room Arno Penzias the vice president of research presided at the foot of the table Everyone who participated in those research staff meetings will long remember their culture and atmosphere Arno would pick an arbitrary starting point somewhere around the table and the designated person would head to the front of the table to give a short talk on something new in his or her research area This rst speaker would invariably ddle helplessly with the controls embedded in the podium that controlled the viewgraph projector but eventually we would hear machinery grinding in the back room as a large hidden mirror moved into place We would all wait quietly arranging and choosing our own viewgraphs from the piles that lay on the table in front of every participant

### UV-Visible Reflection Spectroscopy of Liquids Jukka A.

Räty,Kai-Erik Peiponen,Toshimitsu Asakura,2013-03-20 An up to date overview of reflectometers used for optical spectroscopy of various kinds of liquids ranging from well known transparent liquids to pathological industrial liquids The book reviews and explains basic materials for anyone wanting to get to know the theory spectral analysis and modern devices needed for the measurement of refractive index and absorption of liquids Moreover the book gives an introduction to



reflectivity from optically nonlinear liquids such as liquids containing nanoparticles      **Superconductivity** Adir Luiz, 2011-07-18 Superconductivity was discovered in 1911 by Kamerlingh Onnes Since the discovery of an oxide superconductor with critical temperature  $T_c$  approximately equal to 35 K by Bednorz and Muller 1986 there are a great number of laboratories all over the world involved in research of superconductors with high  $T_c$  values the so called High  $T_c$  superconductors This book contains 15 chapters reporting about interesting research about theoretical and experimental aspects of superconductivity You will find here a great number of works about theories and properties of High  $T_c$  superconductors materials with  $T_c$  30 K In a few chapters there are also discussions concerning low  $T_c$  superconductors  $T_c$

**Microoptics** Karl-Heinz Brenner, Jürgen Jahns, 2013-03-20 Microoptics is still an emerging field with a huge potential for a large number of applications This monograph brings together the most recent developments in order to give a broad overview

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