



Optical Microcavities

Chyong-Hua Chen



Optical Microcavities:

Optical Microcavities Kerry Vahala, 2004-12-10 Optical microcavities are structures that enable confinement of light to microscale volumes. The universal importance of these structures has made them indispensable to a wide range of fields. This important book describes the many applications and the related physics providing both a review and a tutorial of key subjects by leading researchers from each field. The topics include cavity QED and quantum information nanophotonics and nanostructure interactions wavelength switching and modulation in optical communications optical chaos and biosensors.

Handbook of Optical Microcavities Anthony H. W. Choi, 2014-10-06 The book covers a wide range of topics pertaining to resonance in optical cavities. The topics include theory design simulation fabrication and characterization of micrometer and nanometer scale structures and devices that support cavity resonance via various mechanisms such as Fabry Perot whispering gallery photonic bandgap and plasmonic modes. The chapters discuss optical cavities that resonate from UV to IR wavelengths and are based on prominent III V material systems including Al In and Ga nitrides ZnO and GaAs.

Ultra-high-q Optical Microcavities Yun-feng Xiao, Chang-ling Zou, Qihuang Gong, Lan Yang, 2020-10-29 Confinement and manipulation of photons using microcavities have triggered intense research interest in both basic and applied physics for more than a decade. Prominent examples are whispering gallery microcavities which confine photons by means of continuous total internal reflection along a curved and smooth surface. The long photon lifetime strong field confinement and in plane emission characteristics make them promising candidates for enhancing light matter interactions on a chip. In this book we will introduce different ultra high Q whispering gallery microcavities and focus on their applications in enhancing light matter interaction such as ultralow threshold microlasing highly sensitive optical biosensing nonlinear optics cavity quantum electrodynamics and cavity optomechanics.

Spontaneous Emission and Laser Oscillation in Microcavities Hiroyuki Yokoyama, Kikuo Ujihara, 1995-08-30 In spite of the increasing importance of microcavities device physics or the observable phenomena in optical microcavities such as enhanced or inhibited spontaneous emission and its relation with the laser oscillation has not been systematically well described until now. Spontaneous Emission and Laser Oscillation in Microcavities presents the basics of optical microcavities. The volume is divided into ten chapters each written by respected authorities in their areas. The book surveys several methods describing free space spontaneous emission and discusses changes in the feature due to the presence of a cavity. The effect of dephasing of vacuum fields on spontaneous emission in a microcavity and the effects of atomic broadening on spontaneous emission in an optical microcavity are examined. The book details the splitting in transmission peaks of planar microcavities containing semiconductor quantum wells. A simple but useful way to consider the change in the spontaneous emission rate from the viewpoint of mode density alteration by wavelength sized cavities is provided. Authors also discuss the spontaneous emission in dielectric planar microcavities. Spontaneous emission in microcavity surface emitting lasers is covered as are the effects of electron confinement in semiconductor quantum wells.

wires and boxes also given The volume extends the controlling spontaneous emission phenomenon to laser oscillation Starting from the Fermi golden rule the microcavity laser rate equations are derived and the oscillation characteristics are analyzed Recent progress in optical microcavity experiments is summarized and the applicability in massively optical parallel processing systems and demands for the device performance are explored This volume is extremely useful as a textbook for graduate and postgraduate students and works well as a unique reference for researchers beginning to study in the field

Optical Processes In Microcavities Richard K Chang,A J Campillo,1996-04-12 The dielectric microstructures act as ultrahigh Q factors optical cavities which modify the spontaneous emission rates and alter the spatial distributions of the input and output radiation The editors have selected leading scientists who have made seminal contributions in different aspects of optical processes in microcavities Every attempt has been made to unify the underlying physics pertaining to microcavities of various shapes This book begins with a chapter on the role of microcavity modes with additional chapters on how these microcavity modes affect the spontaneous and stimulated emission rates enhance nonlinear optical processes used in cavity QED and chemical physics experiments aid in single molecule detection influence the design of microdisk semiconductor lasers and how deformed cavities can be treated with classical chaos theory

Optical and Electronic Fibers Lei Wei,2024-12-04 Understand the cutting edge of fiber technology with this comprehensive guide Because of their sensitivity and flexible capabilities functional fibers have an enormous range of applications across many industries In particular advanced optical and electronic fibers have been integrated into numerous cutting edge technologies and their applications are growing year on year There is an expanding need for scientists and professionals particularly in the healthcare and sensor industries to be familiar with the complex web of factors underlying functional fibers Optical and Electronic Fibers builds this familiarity with an up to date highly readable presentation It introduces both the characteristics and applications of different functional fiber materials before moving to future opportunities for research and development The result is an accessible overview of an emerging technology with boundless potential Optical and Electronic Fibers readers will also find More than 150 figures many in full color Applications in industries ranging from optical waveguides to neural interfaces Detailed treatment of fiber materials including soft glasses carbon materials liquids and semiconductors Optical and Electronic Fibers is a useful reference for materials scientists electrical engineers and semiconductor and sensor professionals

Confined Electrons and Photons Elias Burstein,Claude Weisbuch,1995-05-31 Proceedings of a NATO ASI held in Erice Italy held July 13 26 1993

Microcavity Semiconductor Lasers Yong-zhen Huang,Yue-de Yang,2021-05-24 Microcavity Semiconductor Lasers Explore this thorough overview of integrable microcavity semiconductor lasers and their applications from two leading voices in the field Attracting a great deal of attention over the last decades for their promising applications in photonic integration and optical interconnects microcavity semiconductor lasers continue to develop via advances in fundamental physics theoretical analysis and numerical simulations In a new work that will be of interest to

researchers and practitioners alike Microcavity Semiconductor Lasers Principles Design and Applications delivers an application oriented and highly relevant exploration of the theory fabrication and applications of these practical devices The book focuses on unidirectional emission microcavity lasers for photonic integrated circuits including polygonal microresonators microdisk and microring lasers After an introductory overview of optical microcavities for microlasers and detailed information of the lasers themselves including mode structure control and characteristics and lasing properties the distinguished authors discuss fabrication and applications of different microcavity lasers Prospects for future research and potential new applications round out the book Readers will also benefit from the inclusion of A thorough introduction to multilayer optical waveguides the FDTD Method and Pad Approximation and deformed chaos and unidirectional emission microdisk lasers An exploration of mode analysis for triangle and square microresonators similar as FP Cavity Practical discussions of mode analysis and control for deformed square microlasers An examination of hexagonal microcavity lasers and polygonal microcavities along with vertical radiation loss for 3D microcavities Perfect for laser specialists semiconductor physicists and solid state physicists Microcavity Semiconductor Lasers Principles Design and Applications will also earn a place in the libraries of materials scientists and professionals working in the semiconductor and optical industries seeking a one stop reference for integrable microcavity semiconductor lasers

Optical Microcavities for Real-time Detection of Bacteria Hala Ghali,2016 **Microcavities and Photonic Bandgaps: Physics and Applications** J.G. Rarity,Claude Weisbuch,1996-08-31 The control of optical modes in microcavities or in photonic bandgap PBG materials is coming of age Although these ideas could have been developed some time ago it is only recently that they have emerged due to advances in both atomic physics and in fabrication techniques be it on the high quality dielectric mirrors required for high finesse Fabry Perot resonators or in semiconductor multilayer deposition methods Initially the principles of quantum electro dynamics QED were demonstrated in elegant atomic physics experiments Now solid state implementations are being investigated with several subtle differences from the atomic case such as those due to their continuum of electronic states or the near Boson nature of their elementary excitations the exciton Research into quantum optics brings us ever newer concepts with potential to improve system performance such as photon squeezing quantum cryptography reversible taps photonic de Broglie waves and quantum computers The possibility of implementing these ideas with solid state systems gives us hope that some could indeed find their way to the market demonstrating the continuing importance of basic research for applications be it in a somewhat more focused way than in earlier times for funding **Optoelectronic Materials and Devices for Optical Communications** Shinji Tsuji,Jens Buus,Yi Luo,2005 Proceedings of SPIE present the original research papers presented at SPIE conferences and other high quality conferences in the broad ranging fields of optics and photonics These books provide prompt access to the latest innovations in research and technology in their respective fields Proceedings of SPIE are among the most cited references in patent literature **Multiparty Secure Quantum and Semiquantum Computations** Tianyu

Ye,Nanrun Zhou,Mingxing Luo,Amiya Nayak,Xiubo Chen,2023-11-07 **Green Power, Materials and Manufacturing Technology and Applications II** Shao Bo Zhong,Zhi Gang Liu,2012-11-12 Selected peer reviewed papers from the 2nd International Conference on Green Power Materials and Manufacturing Technology and Applications GPMMTA 2012 July 17 19 2012 Kunming China Semiconductor Optical Microcavities for Chip-based Cavity QED Kartik Srinivasan,2006

Journal of the Optical Society of America ,2003 **Optical Cavities for Optical Atomic Clocks, Atom**

Interferometry and Gravitational-Wave Detection Miguel Dovale Álvarez,2019-08-10 Devised at the beginning of the 20th century by french physicists Charles Fabry and Alfred Perot the Fabry Perot optical cavity is perhaps the most deceptively simple setup in optics and today a key resource in many areas of science and technology This thesis delves deeply into the applications of optical cavities in a variety of contexts from LIGO s 4 km long interferometer arms that are allowing us to observe the universe in a new way by measuring gravitational waves to the atomic clocks used to realise time with unprecedented accuracy which will soon lead to a redefinition of the second and the matterwave interferometers that are enabling us to test and measure gravity in a new scale The work presented accounts for the elegance and versatility of this setup which today underpins much of the progress in the frontier of atomic and gravitational experimental physics

Electrically Tunable Micromirrors and Microcavities Wei Liu,2005 **Optical Microcavities for Quantum Communication with Single Atoms** Manuel Uphoff,2017 **Design, Fabrication and Characterization of Optical Microcavities for Application Specific Optical Devices** Chyong-Hua Chen,2006 Microresonators are widely used in the creation of optical devices which exploit their unique properties and characteristics such as spectral selectivity and field localization We investigate two applications for microresonator devices that integrate multiple functionalities into the same volume through application specific design optimization The first application is in free space optical communications where we develop a bandpass filter and an optical receiver which are integrated together The second is in the guided wave application where we develop a waveguide polarizer and a waveguide bandpass filter For the first free space communication application we examine how the functionalities of a flat top passband and a wide angular bandwidth can be integrated with a photodetector by exploiting properties of 1 D photonic crystals with multiple defects In the first part of the research we achieve a thin film bandpass filter by optimally choosing the optical thickness ratio of high to low refractive index materials in dispersive mirrors and experimentally characterize the fabricated device demonstrating a bandwidth of 65 nm and field of view of 50 In the second part we integrate a photodetector into the resonator using the dispersive mirrors to achieve these functionalities We fabricate and characterize the resulting device a back illuminated In0.47Ga0.53As based resonant cavity enhanced PIN photodiode showing 0.80 peak quantum efficiency 35.96nm spectral bandwidth and 30 angular bandwidth For our second application involving guided wave components we develop two devices a waveguide polarizer and a waveguide bandpass filter The waveguide polarizer device uses nanostructures to realize highly birefringent waveguides With an

appropriately sized nanostructure a waveguide can be fashioned that allows only TM like modes to propagate through the waveguide We create such a polarizer using nanostructures of 26 m lengths in a GaAs AlAs ridge waveguide providing an insertion loss of 0 54 dB and an extinction ratio of 20 dB In the waveguide bandpass filter device the methodology used to design thin film filters in our first free space application is extended and optimized for designs using microcavities in a photonic bandgap monorail waveguide We present a square waveguide filter centered at 1554 nm with a maximum transmission of 0 88 and a FWHM of 13 6 nm **Quantum Logic Using Excitonic Quantum Dots in External Optical Microcavities** ,2003 An experimental project was undertaken to develop means to achieve quantum optical strong coupling between a single GaAs quantum dot and the optical mode of a microcavity for the purpose of quantum control of dot and photon states for quantum information processing Good progress was made in design and fabrication of the quantum dot structure and the microcavity and initial results were obtained

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Table of Contents Optical Microcavities

1. Understanding the eBook Optical Microcavities
 - The Rise of Digital Reading Optical Microcavities
 - Advantages of eBooks Over Traditional Books
2. Identifying Optical Microcavities
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Optical Microcavities
 - User-Friendly Interface
4. Exploring eBook Recommendations from Optical Microcavities
 - Personalized Recommendations
 - Optical Microcavities User Reviews and Ratings
 - Optical Microcavities and Bestseller Lists

5. Accessing Optical Microcavities Free and Paid eBooks
 - Optical Microcavities Public Domain eBooks
 - Optical Microcavities eBook Subscription Services
 - Optical Microcavities Budget-Friendly Options
6. Navigating Optical Microcavities eBook Formats
 - ePUB, PDF, MOBI, and More
 - Optical Microcavities Compatibility with Devices
 - Optical Microcavities Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Optical Microcavities
 - Highlighting and Note-Taking Optical Microcavities
 - Interactive Elements Optical Microcavities
8. Staying Engaged with Optical Microcavities
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Optical Microcavities
9. Balancing eBooks and Physical Books Optical Microcavities
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Optical Microcavities
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Optical Microcavities
 - Setting Reading Goals Optical Microcavities
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Optical Microcavities
 - Fact-Checking eBook Content of Optical Microcavities
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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