

Wide Band Gap Semiconductor Nanowires For Optical Devices

Fundamental Properties of Semiconductor Nanowires Semiconductor Nanowires Semiconductor Nanowires II: Properties and Applications Nanowires for Energy Applications Semiconductor Nanowires I: Growth and Theory Wide Band Gap Semiconductor Nanowires 1 Novel Compound Semiconductor Nanowires Advances in III-V Semiconductor Nanowires and Nanodevices Optical Resonances of Semiconductor Nanowires Nanowire Electronics Semiconductor Nanowires Nanowires and Nanobelts Semiconductor Nanowires for Nanoelectronics and Optoelectronics Semiconductor Nanowires for Nanotechnology III-V Semiconductor Nanowires for High Performance Electronic and Photodetection Applications Wide Band Gap Semiconductor Nanowires 2 Semiconductor Nanowires Assembly and Integration of Semiconductor Nanowires for Functional Nanosystems Semiconductor Nanowires Naoki Fukata J Arbiol Wei Lu Vincent Consonni Fumitaro Ishikawa Jianye Li Linyou Cao Guozhen Shen Shadi A. Dayeh Zhong Lin Wang Yajie Dong Yi Cui Vincent Consonni Guihua Yu

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this book covers virtually all aspects of semiconductor nanowires from growth to related applications in detail first it addresses nanowires growth mechanism one of the most important topics at the forefront of nanowire research the focus then shifts to surface functionalization nanowires have a high surface to volume ratio and thus are well suited to surface modification which effectively functionalizes them the book also discusses the latest advances in the study of impurity doping a crucial process in nanowires in addition considerable attention is paid to characterization techniques such as nanoscale and in situ methods which are indispensable for understanding the novel properties of nanowires theoretical calculations are also essential to understanding nanowires characteristics particularly those that derive directly from their special nature as one dimensional nanoscale structures in closing the book considers future applications of nanowire structures in devices such as fets and lasers

semiconductor nanowires promise to provide the building blocks for a new generation of nanoscale electronic and optoelectronic devices semiconductor nanowires materials synthesis characterization and applications covers advanced materials for nanowires the growth and synthesis of semiconductor nanowires including methods such as solution growth movpe mbe and self organization characterizing the properties of semiconductor nanowires is covered in chapters describing studies using tem spm and raman scattering applications of semiconductor

nanowires are discussed in chapters focusing on solar cells battery electrodes sensors optoelectronics and biology explores a selection of advanced materials for semiconductor nanowires outlines key techniques for the property assessment and characterization of semiconductor nanowires covers a broad range of applications across a number of fields

semiconductor nanowires were initially discovered in late 90 s and since then there has been an explosion in the research of their synthesis and understanding of their structures growth mechanisms and properties the realisation of their unique electrical optical and mechanical properties has led to a great interest for their use in electronics energy generation and storage this book provides a timely reference on semiconductor nanowires including an introduction to their synthesis and properties and specific chapters focusing on the different applications including photovoltaics nanogenerators transistors biosensors and photonics this is the first book dedicated to semiconductor nanowires and provides an invaluable resource for researchers already working in the area as well as those new to the field edited by leading experts in the field and with contributions from well known scientists the book will appeal to both those working on fundamental nanomaterial research and those commercially interested in their applications

semiconductor nanowires part b and volume 94 in the semiconductor and semimetals series focuses on semiconductor nanowires includes experts contributors who review the most important recent literature contains a broad view including examination of semiconductor nanowires

nanowires for energy applications volume 98 covers the latest breakthrough research and exciting developments in nanowires for energy applications this volume focuses on various aspects of nanowires for energy applications presenting interesting sections on electrospun semiconductor metal oxide nanowires for energy and sensing applications integration into flexible and functional materials nanowire based bulk heterojunction solar cells semiconductor nanowires for thermoelectric generation energy scavenging mechanical thermoelectric and nanowire synthesis growth methods and more features the latest breakthroughs and research and development in nanowires for energy applications covers a broad range of topics including a wide variety of materials and many important aspects of solar fuels includes in depth discussions on materials design growth and synthesis engineering characterization and photoelectrochemical studies

semiconductor nanowires part a number 93 in the semiconductor and semimetals series focuses on semiconductor nanowires contains comments from leading contributors in the field semiconductor nanowires provides reviews of the most important recent literature presents a broad view including an examination of semiconductor nanowires comprises up to date advancements in the technological development of nanowire devices and systems and is comprehensive enough to be used as a reference book on nanowires as well as a graduate student text book

gan and zno nanowires can be grown using a wide variety of methods from physical vapor deposition to wet chemistry for optical devices this book starts by presenting the similarities and differences between gan and zno materials as well as the assets and current limitations of nanowires for their use in optical devices including feasibility and perspectives it then focuses on the nucleation and growth mechanisms of zno and gan nanowires grown by various chemical and physical methods finally it describes the formation of nanowire heterostructures applied to optical devices

one dimensional electronic materials are expected to be key components owing to their potential applications in nanoscale electronics optics energy storage and biology besides compound

semiconductors have been greatly developed as epitaxial growth crystal materials molecular beam and metalorganic vapor phase epitaxy approaches are representative techniques achieving 0d 2d quantum well wire and dot semiconductor iii v heterostructures with precise structural accuracy with atomic resolution based on the background of those epitaxial techniques high quality single crystalline iii v heterostructures have been achieved iii v nanowires have been proposed for the next generation of nanoscale optical and electrical devices such as nanowire light emitting diodes lasers photovoltaics and transistors key issues for the realization of those devices involve the superior mobility and optical properties of iii v materials i e nitride phosphide and arsenide related heterostructure systems further the developed epitaxial growth technique enables electronic carrier control through the formation of quantum structures and precise doping which can be introduced into the nanowire system the growth can extend the functions of the material systems through the introduction of elements with large miscibility gap or alternatively by the formation of hybrid heterostructures between semiconductors and another material systems this book reviews recent progresses of such novel iii v semiconductor nanowires covering a wide range of aspects from the epitaxial growth to the device applications prospects of such advanced 1d structures for nanoscience and nanotechnology are also discussed

semiconductor nanowires exhibit novel electronic and optical properties due to their unique one dimensional structure and quantum confinement effects in particular iii v semiconductor nanowires have been of great scientific and technological interest fo

semiconductor nanowires are one of the most exciting frontiers of materials research due to their potential applications in a wide range of important fields including information technology biomedicine sustainable energy and artificial intelligence embarking on these exciting applications heavily hinges on deep understanding of fundamental properties of the nanowires for the first time we experimentally demonstrate the general existence of strong tunable optical resonances in semiconductor nanowires and propose a theoretical model leaky mode resonances lmrs that provides an intuitive understanding of the optical resonances the optical resonances enable to engineer light absorption scattering and emission of the nanowires for the rational design of high performance optoelectronic devices including photodetectors solar cells and light emitters more interestingly coupled optical resonances in a complex nanowire structure can give rise to many novel optical functionalities that do not exist in stand alone nanowires for example coupled nanowire optical waveguiding physically the optical resonances arise from strong and resonant coupling of light with leaky modes supported by the nanowires when the light wavelength matches one of the allowed lmrs the high refractive index wire can capture and trap the light by multiple internal reflections at its boundary and build up strong electromagnetic field inside as a consequence the photoresponses of the nanowire at the specific wavelength or wavelength bands including absorption scattering and emission can be dramatically enhanced by tuning the nw diameter both the number of allowed lmrs in the nanowire and the spectral position of specific lmrs can be precisely controlled this size dependent tunability provides a powerful guidance for the rational design of photonic devices with desired spectral polarization response features the technological promise of this approach is illustrated in efficient germanium photodetectors in near infrared regime silicon solar cells with 250% enhancement in solar absorption efficiency and multicolored silicon nanostructures optical coupling between neighboring nanowires provides extra latitudes to manipulate light at the nanoscale the essence of the optical coupling lies in the exchange of photons between the nanowires much like the exchange of electrons between neighboring atoms in molecules experimentally it can be observed by monitoring the light scattering spectra of a bi nanowire structure that consists of two nanowires with similar diameter and parallel to each other by taking into account the leaky nature of optical modes in the nanowire resonator we propose a theoretical model coupled leaky mode theory clmt to account for the experimental observations and to point towards rational designs of complex nanostructures with desirable light matter interaction features for nanophotonic applications such as efficient transfer of optical power at the nanoscale through a chain of coupled nanowires overall these results represent the first systematic studies of optical resonances of semiconductor nanowires the demonstrated general existence of the lmrs and the

coupled lmrs cast new light on semiconductor nanostructures and open up enormous opportunities to explore novel optical and optoelectronic funtionalities in semiconductor nanostructures for photonics applications

this book gives a comprehensive overview of recent advances in developing nanowires for building various kinds of electronic devices specifically the applications of nanowires in detectors sensors circuits energy storage and conversion etc are reviewed in detail by the experts in this field growth methods of different kinds of nanowires are also covered when discussing the electronic applications through discussing these cutting edge researches the future directions of nanowire electronics are identified

volume 1 metal and semiconductor nanowires covers a wide range of materials systems from noble metals such as au ag cu single element semiconductors such as si and ge compound semiconductors such as inp cds and gaas as well as heterostructures nitrides such as gan and si3n4 to carbides such as sic the objective of this volume is to cover the synthesis properties and device applications of nanowires based on metal and semiconductor materials the volume starts with a review on novel electronic and optical nanodevices nanosensors and logic circuits that have been built using individual nanowires as building blocks then the theoretical background for electrical properties and mechanical properties of nanowires is given the molecular nanowires their quantized conductance and metallic nanowires synthesized by chemical technique will be introduced next finally the volume covers the synthesis and properties of semiconductor and nitrides nanowires

this book the second of two volumes describes heterostructures and optoelectronic devices made from gan and zno nanowires over the last decade the number of publications on gan and zno nanowires has grown exponentially in particular for their potential optical applications in leds lasers uv detectors or solar cells so far such applications are still in their infancy which we analyze as being mostly due to a lack of understanding and control of the growth of nanowires and related heterostructures furthermore dealing with two different but related semiconductors such as zno and gan but also with different chemical and physical synthesis methods will bring valuable comparisons in order to gain a general approach for the growth of wide band gap nanowires applied to optical devices

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Introduction

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