

# Electron-Phonon Interactions in Low-Dimensional Structures

*Edited by*  
Lawrence Challis



# Electron Phonon Interactions In Low Dimensional Structures

**Vladimir G. Plekhanov**



## **Electron Phonon Interactions In Low Dimensional Structures:**

Electron-phonon Interactions in Low Dimensional Structures David Romwald Leadley, 1989

### **Electron-phonon**

**Interactions in Low-dimensional Structures** Lawrence John Challis, 2003 The study of electrons and holes confined to two one and even zero dimensions has uncovered a rich variety of new physics and applications This book describes the interaction between these confined carriers and the optic and acoustic phonons within and around the confined regions Phonons provide the principal channel of energy transfer between the carriers and their surroundings and also the main restriction to their room temperature mobility But they have many other roles they provide for example an essential feature of the operation of the quantum cascade laser Since their momenta at relevant energies are well matched to those of electrons they can also be used to probe electronic properties such as the confinement width of 2D electron gases and the dispersion curve of quasiparticles in the fractional quantum Hall effect The book describes both the physics of the electron phonon interaction in the different confined systems and the experimental and theoretical techniques that have been used in its investigation The experimental methods include optical and transport techniques as well as techniques in which phonons are used as the experimental probe The aim of the book is to provide an up to date review of the physics and its significance in device performance It is also written to be explanatory and accessible to graduate students and others new to the field

**Electron-phonon Interactions in Low-dimensional Structures** Lawrence John Challis, 2003 The study of electrons and holes confined to two one and even zero dimensions has uncovered a rich variety of new physics and applications This book describes the interaction between these confined carriers and the optic and acoustic phonons within and around the confined regions

Isotope Low-Dimensional Structures Vladimir G. Plekhanov, 2012-05-08 This Briefs volume describes the properties and structure of elementary excitations in isotope low dimensional structures Without assuming prior knowledge of quantum physics the present book provides the basic knowledge needed to understand the recent developments in the sub disciplines of nanoscience isotopetronics novel device concepts and materials for nanotechnology It is the first and comprehensive interdisciplinary account of the newly developed scientific discipline isotopetronics

*Phonons in Low Dimensional Structures* Vasilios N. Stavrou, 2018-12-12 The field of low dimensional structures has been experiencing rapid development in both theoretical and experimental research Phonons in Low Dimensional Structures is a collection of chapters related to the properties of solid state structures dependent on lattice vibrations The book is divided into two parts In the first part research topics such as interface phonons and polaron states carrier phonon non equilibrium dynamics directional projection of elastic waves in parallel array of N elastically coupled waveguides collective dynamics for longitudinal and transverse phonon modes and elastic properties for bulk metallic glasses are related to semiconductor devices and metallic glasses devices The second part of the book contains among others topics related to superconductor phononic crystal carbon nanotube devices such as phonon dispersion calculations using density functional theory for a range

of superconducting materials phononic crystal based MEMS resonators absorption of acoustic phonons in the hyper sound regime in fluorine modified carbon nanotubes and single walled nanotubes phonon transport in carbon nanotubes quantization of phonon thermal conductance and phonon Anderson localization      **Low-dimensional Nitride**

**Semiconductors** Bernard Gil, 2002 Optoelectronics and electronics of the years to come are likely to change dramatically Most of the outdoor lighting systems will be replaced by light emitting diodes that operate in the whole visible part of the electromagnetic spectrum Transistors operating at high frequency and with high power are under development and likely to hit the market very rapidly Compact solid state lasers that operate in the near ultraviolet range are going to be utilized for such widely used applications as read write tasks in printer and CD drives Ultraviolet detectors will be used at a wide scale for many application ranging from flame detectors to medical instruments This book concerns itself with the questions why nitride semiconductors are so promising over such a wide range of applications what the current issues are in the research laboratories and what the prospects of new electronic devices are in the dawn of the twenty first century      *Introduction to Isotopic Materials Science* Vladimir G. Plekhanov, 2018-12-05 This book describes new trends in the nanoscience of isotopic materials science Assuming a background in graduate condensed matter physics and covering the fundamental aspects of isotopic materials science from the very beginning it equips readers to engage in high level professional research in this area The book s main objective is to provide insight into the question of why solids are the way they are either because of how their atoms are bonded with one another because of defects in their structure or because of how they are produced or processed Accordingly it explores the science of how atoms interact connects the results to real materials properties and demonstrates the engineering concepts that can be used to produce or improve semiconductors by design In addition it shows how the concepts discussed are applied in the laboratory The book addresses the needs of researchers graduate students and senior undergraduate students alike Although primarily written for materials science audience it will be equally useful to those teaching in electrical engineering materials science or even chemical engineering or physics curricula In order to maintain the focus on materials concepts however the book does not burden the reader with details of many of the derivations and equations nor does it delve into the details of electrical engineering topics      **Plasmonic Effects in**

**Metal-Semiconductor Nanostructures** Alexey A. Toropov, Tatiana V. Shubina, 2015-04-02 Metal semiconductor nanostructures represent an important new class of materials employed in designing advanced optoelectronic and nanophotonic devices such as plasmonic nanolasers plasmon enhanced light emitting diodes and solar cells plasmonic emitters of single photons and quantum devices operating in infrared and terahertz domains The combination of surface plasmon resonances in conducting structures providing strong concentration of an electromagnetic optical field nearby with sharp optical resonances in semiconductors which are highly sensitive to external electromagnetic fields creates a platform to control light on the nanoscale The design of the composite metal semiconductor system imposes the consideration of both

the plasmonic resonances in metal and the optical transitions in semiconductors a key issue being their resonant interaction providing a coupling regime In this book the reader will find descriptions of electrodynamics of conducting structures quantum physics of semiconductor nanostructures and guidelines for advanced engineering of metal semiconductor composites These constituents form together the physical basics of the metal semiconductor plasmonics underlying many effective practical applications The list of covered topics also includes the review of recent results such as the achievement of a strong coupling regime and the preservation of non classical statistics of photons in plasmonic cavities combined with semiconductor nanostructures

**III-Nitride Semiconductors and their Modern Devices** Bernard Gil, 2013-08-22 This book is dedicated to GaN and its alloys AlGaInN III V nitrides semiconductors with intrinsic properties well suited for visible and UV light emission and electronic devices working at high temperature high frequency and harsh environments There has been a rapid growth in the industrial activity relating to GaN with GaN now ranking at the second position after Si among all semiconductors This is mainly thanks to LEDs but also to the emergence of lasers and high power and high frequency electronics GaN related research activities are also diversifying ranging from advanced optical sources and single electron devices to physical chemical and biological sensors optical detectors and energy converters All recent developments of nitrides and of their technology are gathered here in a single volume with chapters written by world leaders in the field This third book of the series edited by B Gil is complementary to the preceding two and is expected to offer a modern vision of nitrides and of their devices to a large audience of readers

**Physics of Semiconductors in High Magnetic Fields** Noboru Miura, 2008 This book summarizes most of the fundamental physical phenomena which semiconductors and their modulated structures exhibit in high magnetic fields Readers can learn not only the basic theoretical background but also the present state of the art from the most advanced data in this rapidly growing research area

**Coherent Vibrational Dynamics** Guglielmo Lanzani, Giulio Cerullo, Sandro De Silvestri, 2007-11-29 Remarkable developments in the spectroscopy field regarding ultrashort pulse generation have led to the possibility of producing light pulses ranging from 50 to 5 fs and frequency tunable from the near infrared to the ultraviolet range Such pulses enable us to follow the coupling of vibrational motion to the electronic transitions in molecules and

**Light-Driven Alignment** Boris P. Antonyuk, 2009 This book deals with influencing the properties of solids by light driven electron transport The theoretical basis of these effects light driven ordering and self organisation as well as optical motors are presented With light as a tool new ways to produce materials are opened

**Electron and Photon Confinement in Semiconductor Nanostructures** Benoît Deveaud, Antonio Quattropani, Paolo Schwendimann, Società italiana di fisica, 2003 The purpose of this course was to give an overview of the physics of artificial semiconductor structures confining electrons and photons It furnishes the background for several applications in particular in the domain of optical devices lasers light emitting diodes or photonic crystals The effects related to the microactivity polaritons which are mixed electromagnetic radiation exciton states inside a semiconductor

microactivity are covered The study of the characteristics of such states shows strong relations with the domain of cavity quantum electrodynamics and thus with the investigation of some fundamental theoretical concepts      Length-Scale Dependent Phonon Interactions Subhash L. Shindé, Gyaneshwar P. Srivastava, 2013-10-29 This book presents a comprehensive description of phonons and their interactions in systems with different dimensions and length scales Internationally recognized leaders describe theories and measurements of phonon interactions in relation to the design of materials with exotic properties such as metamaterials nano mechanical systems next generation electronic photonic and acoustic devices energy harvesting optical information storage and applications of phonon lasers in a variety of fields The emergence of techniques for control of semiconductor properties and geometry has enabled engineers to design structures in which functionality is derived from controlling electron behavior As manufacturing techniques have greatly expanded the list of available materials and the range of attainable length scales similar opportunities now exist for designing devices whose functionality is derived from controlling phonon behavior However progress in this area is hampered by gaps in our knowledge of phonon transport across and along arbitrary interfaces the scattering of phonons with crystal defects interface roughness and mass mixing delocalized electrons collective electronic excitations and solid acoustic vibrations when these occur in structures with small physical dimensions This book provides a comprehensive description of phonons and their interactions in systems with different dimensions and length scales Theories and measurements of phonon interactions are described in relation to the design of materials with exotic properties such as metamaterials nano mechanical systems next generation electronic photonic and acoustic devices energy harvesting optical information storage and applications of phonon lasers in a variety of fields      *Thermoelectric Nanomaterials* Kunihiro Koumoto, Takao Mori, 2013-07-20 Presently there is an intense race throughout the world to develop good enough thermoelectric materials which can be used in wide scale applications This book focuses comprehensively on very recent up to date breakthroughs in thermoelectrics utilizing nanomaterials and methods based in nanoscience Importantly it provides the readers with methodology and concepts utilizing atomic scale and nanoscale materials design such as superlattice structuring atomic network structuring and properties control electron correlation design low dimensionality nanostructuring etc Furthermore also indicates the applications of thermoelectrics expected for the large emerging energy market This book has a wide appeal and application value for anyone being interested in state of the art thermoelectrics and or actual viable applications in nanotechnology

*Thermoelectrics Handbook* D.M. Rowe, 2018-10-03 Ten years ago D M Rowe introduced the bestselling CRC Handbook of Thermoelectrics to wide acclaim Since then increasing environmental concerns desire for long life electrical power sources and continued progress in miniaturization of electronics has led to a substantial increase in research activity involving thermoelectrics Reflecting the latest trends and developments the Thermoelectrics Handbook Macro to Nano is an extension of the earlier work and covers the entire range of thermoelectrics disciplines Serving as a convenient reference as well as a

thorough introduction to thermoelectrics this book includes contributions from 99 leading authorities from around the world Its coverage spans from general principles and theoretical concepts to material preparation and measurements thermoelectric materials thermoelements modules and devices and thermoelectric systems and applications Reflecting the enormous impact of nanotechnology on the field as the thermoelectric properties of nanostructured materials far surpass the performance of conventional materials each section progresses systematically from macro scale to micro nano scale topics In addition the book contains an appendix listing major manufacturers and suppliers of thermoelectric modules There is no longer any need to spend hours plodding through the journal literature for information The Thermoelectrics Handbook Macro to Nano offers a timely comprehensive treatment of all areas of thermoelectrics in a single unified reference

**Room-temperature Superconductivity** Andrei Mourachkine,2004 Annotation The first book dealing with the subject of room temperature conductivity

**Quantum-based Electronic Devices And Systems, Selected Topics In Electronics And Systems, Vol 14** Mitra Dutta,1998-10-23 This volume includes highlights of the theories and experimental findings that underlie essential phenomena occurring in quantum based devices and systems as well as the principles of operation of selected novel quantum based electronic devices and systems A number of the emerging approaches to creating new types of quantum based electronic devices and systems are also discussed

Physics of Low-Dimensional Semiconductor Structures Paul N. Butcher,Norman H. March,Mario P. Tosi,2013-11-11 Presenting the latest advances in artificial structures this volume discusses in depth the structure and electron transport mechanisms of quantum wells superlattices quantum wires and quantum dots It will serve as an invaluable reference and review for researchers and graduate students in solid state physics materials science and electrical and electronic engineering

Semiconductor Detector Systems Helmuth Spieler,2005-08-25 Semiconductor sensors patterned at the micron scale combined with custom designed integrated circuits have revolutionized semiconductor radiation detector systems Designs covering many square meters with millions of signal channels are now commonplace in high energy physics and the technology is finding its way into many other fields ranging from astrophysics to experiments at synchrotron light sources and medical imaging This book is the first to present a comprehensive discussion of the many facets of highly integrated semiconductor detector systems covering sensors signal processing transistors and circuits low noise electronics and radiation effects The diversity of design approaches is illustrated in a chapter describing systems in high energy physics astronomy and astrophysics Finally a chapter Why things don t work discusses common pitfalls Profusely illustrated this book provides a unique reference in a key area of modern science

## Unveiling the Magic of Words: A Overview of "**Electron Phonon Interactions In Low Dimensional Structures**"

In a world defined by information and interconnectivity, the enchanting power of words has acquired unparalleled significance. Their capability to kindle emotions, provoke contemplation, and ignite transformative change is actually awe-inspiring. Enter the realm of "**Electron Phonon Interactions In Low Dimensional Structures**," a mesmerizing literary masterpiece penned by way of a distinguished author, guiding readers on a profound journey to unravel the secrets and potential hidden within every word. In this critique, we shall delve into the book is central themes, examine its distinctive writing style, and assess its profound impact on the souls of its readers.

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