



# Point Contact Spectroscopy

**Manabu Kiguchi**



## **Point Contact Spectroscopy:**

Point-Contact Spectroscopy Yu.G. Naidyuk, I.K. Yanson, 2019-04-04 The main goal of solid state physics is investigation of the properties of the matter including the mechanical electrical optical magnetic and so on with the aim of developing new materials with defined characteristics Nowadays the synthesis of superconductors with high critical temperature it consists of or fabrication of new heterostructures on the base of semiconductors in creation of layered amorphous organic or nanofabricated structures and many others To do all of these the various methods of investigation are developed during the past Because it is impossible to find an universal method to investigate a variety of materials which are either conducting or insulating crystalline or amorphous thin layered or bulk magnetic or segnetoelectric and so on various kind of spectroscopies like optical neutron electron tunnel and so on are widely used in solid state physics Recently a new type of spectroscopy namely the Point Contact Spectroscopy PCS was designed for study of the conduction electron interaction mechanism with a whole class of elementary excitations in the solids In PCS a small constriction about a few nanometers large between two conductors plays a role of a spectrometer Namely because of inelastic scattering of accelerated electrons the I V characteristic of such a tiny metallic contact is nonlinear versus an applied voltage and its second derivative surprisingly turns out to be proportional to the electron quasiparticle interaction spectrum **Nanobiophysics** Victor A.

Karachevtsev, 2016-01-05 Nanobiophysics is a new branch of science that operates at the interface of physics biology chemistry material science nanotechnology and medicine This book is the first one devoted to nanobiophysics and introduces this field with a focus on some selected topics related to the physics of biomolecular nanosystems including nucleosomal DNA and **Functional Nanostructures and Sensors for CBRN Defence and Environmental Safety and Security** Anatolie

Sidorenko, Horst Hahn, 2020-03-17 Over the last decade techniques for materials preparation and processing at nanometer scale have advanced rapidly leading to the introduction of novel principles for a new generation of sensors and detectors At the same time the chemical industry transport and agriculture produce huge amounts of dangerous waste gases and liquids leading to soil air and water contamination One more modern threat international terrorism demands that scientists make efforts to apply new principles and technologies to protect society against chemical biological radiological and nuclear CBRN attacks and to develop novel effective technologies for the remediation of large contaminated areas Accordingly the main goal of this book is to bring together experts theorists experimentalists engineers and technologists for an extensive discussion covering novel principles for functional nanostructures and detector fabrication and implementation the development of novel technologies for the deactivation of CBRN agents their experimental realization and their application in novel monitoring and control systems and technological processes for soil and water remediation with a view to environmental protection and defence against CBRN based terrorism In keeping with the book's main goal the following topics are highlighted and discussed Sensors and detectors detection of chemicals principles of artificial nose and chemical

micro lab on a chip design surface and underground water quality monitoring systems molecular electronics superconducting electronic devices quantum detectors and Qubits Environmental protection and CBRN detection of infrared microwave X ray and terahertz radiation Principles for novel IR UV and Terahertz wave devices for the detection of low contrast objects Novel technological processes for CBRN destruction and deactivation All these topics are strongly interrelated both with regard to fundamental aspects and to fabrication and implementation technologies in addition they are highly promising for application in novel functional devices computer logics sensing and detection of low concentration chemicals weak and extremely weak magnetic and microwave fields infrared and ultraviolet radiation Given its scope the book will be a useful and interesting guide for a broad readership of engineers scientists PhD students and experts in the area of defence against environmental terrorism Atlas of Point Contact Spectra of Electron-Phonon Interactions in Metals A.V. Khotkevich, Igor K.

Yanson, 2013-11-27 The characteristics of electrical contacts have long attracted the attention of researchers since these contacts are used in every electrical and electronic device Earlier studies generally considered electrical contacts of large dimensions having regions of current concentration with diameters substantially larger than the characteristic dimensions of the material the interatomic distance the mean free path for electrons the coherence length in the superconducting state etc 110 The development of microelectronics presented to scientists and engineers the task of studying the characteristics of electrical contacts with ultra small dimensions Characteristics of point contacts such as mechanical stability under continuous current loads the magnitudes of electrical fluctuations inherent sensitivity in radio devices and nonlinear characteristics in connection with electromagnetic radiation can not be understood and altered in the required way without knowledge of the physical processes occurring in contacts Until recently it was thought that the electrical conductivity of contacts with direct conductance without tunneling or semiconducting barriers obeyed Ohm's law Nonlinearities of the current voltage characteristics were explained by joule heating of the metal in the region of the contact However studies of the current voltage characteristics of metallic point contacts at low liquid helium temperatures 142 showed that heating effects were negligible in many cases and the nonlinear characteristics under these conditions were observed to take the form of the energy dependent probability of inelastic electron scattering induced by various mechanisms **Solid State**

**Physics** S. L. Chaplot, 2002 This volume covers the proceedings of the 44th Department of Atomic Engineering DAE Solid State Physics Symposium With contributions of papers from institutions from around the world Contains 316 research articles including 28 invited papers on a wide range of topics of current interest in solid state physics comprising the following categories Phase Transitions Phonons Soft condensed Matter Electronic Structure Novel Materials Superconductivity Experimental Techniques and Instrumentation Magnetism Liquids Glasses and Amorphous Systems Transport Properties Relaxation Studies Semiconductor Physics Surface Science Key Features Recent developments in Synchrotron Research Photo electron Spectroscopy Newly emerging superconductors **Spintronics Handbook, Second**

**Edition: Spin Transport and Magnetism** Evgeny Y. Tsymbal, Igor Žutić, 2019-06-26 Spintronics Handbook Second Edition offers an update on the single most comprehensive survey of the two intertwined fields of spintronics and magnetism covering the diverse array of materials and structures including silicon organic semiconductors carbon nanotubes graphene and engineered nanostructures It focuses on seminal pioneering work together with the latest in cutting edge advances notably extended discussion of two dimensional materials beyond graphene topological insulators skyrmions and molecular spintronics The main sections cover physical phenomena spin dependent tunneling control of spin and magnetism in semiconductors and spin based applications Features Presents the most comprehensive reference text for the overlapping fields of spintronics spin transport and magnetism Covers the full spectrum of materials and structures from silicon and organic semiconductors to carbon nanotubes graphene and engineered nanostructures Extends coverage of two dimensional materials beyond graphene including molybdenum disulfide and study of their spin relaxation mechanisms Includes new dedicated chapters on cutting edge topics such as spin orbit torques topological insulators half metals complex oxide materials and skyrmions Discusses important emerging areas of spintronics with superconductors spin wave spintronics benchmarking of spintronics devices and theory and experimental approaches to molecular spintronics Evgeny Tsymbal's research is focused on computational materials science aiming at the understanding of fundamental properties of advanced ferromagnetic and ferroelectric nanostructures and materials relevant to nanoelectronics and spintronics He is a George Holmes University Distinguished Professor at the Department of Physics and Astronomy of the University of Nebraska Lincoln UNL Director of the UNL's Materials Research Science and Engineering Center MRSEC and Director of the multi institutional Center for NanoFerroic Devices CNFD Igor Žutić received his Ph D in theoretical physics at the University of Minnesota His work spans a range of topics from high temperature superconductors and ferromagnetism that can get stronger as the temperature is increased to prediction of various spin based devices He is a recipient of 2006 National Science Foundation CAREER Award 2005 National Research Council American Society for Engineering Education Postdoctoral Research Award and the National Research Council Fellowship 2003 2005 His research is supported by the National Science Foundation the Office of Naval Research the Department of Energy and the Airforce Office of Scientific Research

Unconventional Superconductors Gernot Goll, 2006 This book offers a comprehensive summary of experiments that are especially suited to reveal the order parameter symmetry of unconventional superconductors It briefly introduces readers to the basic theoretical concepts and terms of unconventional superconductivity followed by a detailed overview of experimental techniques and results investigating the superconducting energy gap and phase plus the pairing symmetry This review includes measurements of specific heat thermal conductivity penetration depth and nuclear magnetic resonance and muon spin rotation experiments Further point contact and tunnelling spectroscopy and Josephson experiments are addressed Current understanding is reviewed from the experimental point of view With an appendix offering five tables with almost 200

references that summarize the present results from ambient pressure heavy fermion and noncopper oxide superconductors the monograph provides a valuable resource for further studies in this field Magnetic And Superconducting Materials (In 2 Vols): Procs Of The First Regional Conference M Akhavan,Jens Jensen,K Kitazawa,2000-09-27 The great breakthroughs in the science and technology of superconducting and magnetic materials in recent years promoted many outstanding representatives of various scientific disciplines physics chemistry and materials science to present their latest findings in a scientific atmosphere of the highest standard at the MSM 99 conference Over 200 eminent scientists from 50 countries gathered to discuss the physics materials science and application of magnetic and superconducting materials and to foster research and development collaborations between the scientists and technologists of the regional countries and also with the international scientific community The main topics of this book are the physics materials science and application of magnetic and superconducting materials having a close relationship between the strong correlated electron system and magnetism

**Mesoscopic Electron Transport** Lydia L. Sohn,Leo P. Kouwenhoven,Gerd Schön,2013-06-29 Ongoing developments in nanofabrication technology and the availability of novel materials have led to the emergence and evolution of new topics for mesoscopic research including scanning tunnelling microscopic studies of few atom metallic clusters discrete energy level spectroscopy the prediction of Kondo type physics in the transport properties of quantum dots time dependent effects and the properties of interacting systems e g of Luttinger liquids The overall understanding of each of these areas is still incomplete nevertheless with the foundations laid by studies in the more traditional systems there is no doubt that these new areas will advance mesoscopic electron transport to a new phenomenological level both experimentally and theoretically Mesoscopic Electron Transport highlights selected areas in the field provides a comprehensive review of such systems and also serves as an introduction to the new and developing areas of mesoscopic electron transport *Superconductivity and Magnetism in Skutterudites* Ctirad Uher,2022-01-13 Superconductivity and Magnetism in Skutterudites discusses superconducting and magnetic properties of a class of materials called skutterudites With a brief introduction of the fundamental structural features of skutterudites the book then provides a detailed assessment of the superconducting and magnetic properties focusing particularly on the rare earth filled skutterudites where a plethora of fascinating properties and ground states is realized due to interactions of the filler species with the framework ions Such interactions underpin the exciting forms of superconductivity and magnetism most notably realized in the exotic heavy fermion superconductor of composition  $\text{PrOs}_4\text{Sb}_{12}$  The two main topics of superconductivity and magnetism are provided with a concise introduction of superconducting and magnetic properties so that a reader can appreciate and understand the main arguments in the text This book would appeal to graduate students postdoctoral students and anyone interested in superconducting and magnetic properties of a large family of minerals called skutterudites Key Features Gives a thorough account of the superconducting and magnetic properties of skutterudites Each topic is accompanied by introductory sections to assist in the understanding of

the text Supported by numerous figures and all key references      Scanning Tunneling Microscopy and Related Methods R.J. Behm, N. García, H. Rohrer, 2013-03-09 Proceedings of the NATO Advanced Study Institute on Basic Concepts and Applications of Scanning Tunneling Microscopy Erice Italy April 17-29 1989      **Strongly Correlated Systems** Adolfo Avella, Ferdinando Mancini, 2014-10-01 The continuous evolution and development of experimental techniques is at the basis of any fundamental achievement in modern physics Strongly correlated systems SCS more than any other need to be investigated through the greatest variety of experimental techniques in order to unveil and crosscheck the numerous and puzzling anomalous behaviors characterizing them The study of SCS fostered the improvement of many old experimental techniques but also the advent of many new ones just invented in order to analyze the complex behaviors of these systems Many novel materials with functional properties emerging from macroscopic quantum behaviors at the frontier of modern research in physics chemistry and materials science belong to this class of systems The volume presents a representative collection of the modern experimental techniques specifically tailored for the analysis of strongly correlated systems Any technique is presented in great detail by its own inventor or by one of the world wide recognized main contributors The exposition has a clear pedagogical cut and fully reports on the most relevant case study where the specific technique showed to be very successful in describing and enlightening the puzzling physics of a particular strongly correlated system The book is intended for advanced graduate students and post docs in the field as textbook and or main reference but also for any other researcher in the field who appreciates consulting a single but comprehensive source or wishes to get acquainted in a as painless as possible way with the working details of a specific technique      **Iron-Based Superconducting Thin Films** Silvia Haindl, 2021-06-27 This book provides a modern introduction to the growth characterization and physics of iron based superconducting thin films Iron pnictide and iron chalcogenide compounds have become intensively studied key materials in condensed matter physics due to their potential for high temperature superconductivity With maximum critical temperatures of around 60 K the new superconductors rank first after the celebrated cuprates and the latest announcements on ultrathin films promise even more Thin film synthesis of these superconductors began in 2008 immediately after their discovery and this growing research area has seen remarkable progress up to the present day especially with regard to the iron chalcogenides FeSe and FeSe<sub>1-x</sub>Te<sub>x</sub> the iron pnictide BaFe<sub>2</sub>(As<sub>1-x</sub>P<sub>x</sub>)<sub>2</sub> and iron oxyarsenides This essential volume provides comprehensive state of the art coverage of iron based superconducting thin films in topical chapters with detailed information on thin film synthesis and growth analytical film characterization interfaces and various aspects on physics and materials properties Current efforts towards technological applications and functional films are outlined and discussed The development and latest results for monolayer FeSe films are also presented This book serves as a key reference for students lecturers industry engineers and academic researchers who would like to gain an overview of this complex and growing research area      **Single-Molecule Electronics** Manabu Kiguchi, 2016-05-23 This book presents a multidisciplinary

approach to single molecule electronics It includes a complete overview of the field from the synthesis and design of molecular candidates to the prevalent experimental techniques complemented by a detailed theoretical description This all inclusive strategy provides the reader with the much needed perspective to fully understand the far reaching ramifications of single molecule electronics In addition a number of state of the art topics are discussed including single molecule spectro electrical methods electrochemical DNA sequencing technology and single molecule chemical reactions As a result of this integrative effort this publication may be used as an introductory textbook to both graduate and advanced undergraduate students as well as researchers with interests in single molecule electronics organic electronics surface science and nanoscience

*Anomalous Rare Earths and Actinides* J.X. Boucherle,J. Flouquet,C. Lacroix,2013-09-17 *Anomalous Rare Earths and Actinides* Valence Fluctuation and Heavy Fermions focuses on the characteristics reactions transformations technologies and processes involved in the study of anomalous rare earths and actinides The selection first offers information on lanthanides and actinides and electronic structures in cerium monpnictides Topics include rare earth metals with fluctuating valencies normal rare earth metals and band calculation and Fermi surface The text then elaborates on neutron scattering studies of anomalous rare earth compounds including magnetic neutron scattering measurements stability and localization of magnetic moments and condensed state The manuscript examines the transport properties of cerium monochalcogenides and pressure volume relationships of cerium monochalcogenides and monpnictides The text also ponders on the theory of anisotropic magnetic behavior in hybridizing actinide systems band hybridization effects on indirect magnetic coupling of localized moments and neutron scattering from transuranium materials The selection is a dependable reference for readers interested in the research on anomalous rare earths and actinides

**Rare Earth Transition Metal Borocarbides (Nitrides)** Karl-Hartmut Müller,Vladimir Narozhnyi,2012-12-06 This volume contains most of the contributions presented at the NATO Advanced Research Workshop on Rare Earth Transition Metal Borocarbides Nitrides Superconducting Magnetic and Normal State Properties held in Dresden Germany at 13 18 June 2000 The Workshop was chaired by K H Muller and V N Narozhnyi This was the first meeting specially focused on the quaternary rare earth transition metal borocarbides and nitrides a new class of magnetic superconductors discovered in 1994 The motivation for organizing this workshop was to bring together scientists both experimentalists and theoreticians actively working in this field in different countries using different methods to exchange their points of view on the properties of these materials and to recognize the directions for future research Totally 48 participants from 17 countries of Europe the United States Brazil India Israel and Japan took part in this meeting In addition about 15 observers mainly from Germany attended The scientific Programme of the Workshop was composed of 7 sections The section Introduction and Overview was followed by the Electronic Structure and Properties and Phonon Spectra Magnetic Properties and CEF Effects Interplay between Superconductivity and Magnetism Vortex Lattice Thin Films Nature of the Superconducting State in Borocarbides sections



Totally 50 presentations were given 45 of them in oral form Considerable attention was devoted to the characterization of the particular place of borocarbides amongst the other magnetic and superconducting systems and especially magnetic superconductors

Terahertz (THz), Mid Infrared (MIR) and Near Infrared (NIR) Technologies for Protection of Critical Infrastructures Against Explosives and CBRN Mauro Fernandes Pereira, Apostolos Apostolakis, 2021-04-30 Critical infrastructures are targets for terrorism and deliver a valuable vector through which the proliferation of CBRN and explosive precursors can be detected Recent technological breakthroughs notably in the field of near infrared NIR mid infrared MIR Terahertz THz and Gigahertz GHz sources and detectors have led to rugged commercial devices capable of standoff sensing a range of these dangerous substances However at the same time criminal and terrorist organizations have also benefited from the availability of technologies to increase the threat they pose to the security of citizens and a concerted effort is needed to improve early detection measures to identify activities such as the production of homemade explosives or CBRN that can be potentially dangerous to society The key global technological bottleneck to be overcome is the current lack of integration and networking of mature detection technology into early warning systems for critical infrastructures Thus this book brings together complementary information connecting the research of leading teams working on critical Infrastructure protection with academic developers and industrial producers of state of the art sensors

Handbook of Spin Transport and Magnetism Evgeny Y. Tsymbal, Igor Zutic, 2016-04-19 In the past several decades the research on spin transport and magnetism has led to remarkable scientific and technological breakthroughs including Albert Fert and Peter Grunberg's Nobel Prize winning discovery of giant magnetoresistance GMR in magnetic metallic multilayers Handbook of Spin Transport and Magnetism provides a comprehensive balance

*Quantum Mesoscopic Phenomena and Mesoscopic Devices in Microelectronics* Igor O. Kulik, Recai Ellialtiogamalu, 2012-12-06 Quantum mechanical laws are well documented at the level of a single or a few atoms and are here extended to systems containing 10<sup>2</sup> to 10<sup>10</sup> electrons still much smaller than the usual macroscopic objects but behaving in a manner similar to a single atom Besides the purely theoretical interest such systems pose a challenge to the achievement of the ultimate microelectronic applications The present volume presents an up to date account of the physics technology and expected applications of quantum effects in solid state mesoscopic structures Physical phenomena include the Aharonov Bohm effect persistent currents Coulomb blockade and Coulomb oscillations in single electron devices Andreev reflections and the Josephson effect in superconductor normal superconductor systems shot noise suppression in microcontacts and contact resistance quantisation and overall quantum coherence in mesoscopic and nanoscopic structures related to the emerging physics of quantum computation in the solid state environment

**Handbook of Superconductivity** David A. Cardwell, David C. Larbalestier, Aleksander Braginski, 2022-07-05 This is the first of three volumes of the extensively revised and updated second edition of the Handbook of Superconductivity The past twenty years have seen rapid progress in superconducting materials which exhibit one of the most remarkable physical states of matter

ever to be discovered Superconductivity brings quantum mechanics to the scale of the everyday world where a single coherent quantum state may extend over a distance of metres or even kilometres depending on the size of a coil or length of superconducting wire Viable applications of superconductors rely fundamentally on an understanding of this intriguing phenomena and the availability of a range of materials with bespoke properties to meet practical needs This first volume covers the fundamentals of superconductivity and the various classes of superconducting materials which sets the context and background for Volumes 2 and 3 Key Features Covers the depth and breadth of the field Includes contributions from leading academics and industry professionals across the world Provides hands on guidance to the manufacturing and processing technologies A comprehensive reference this handbook is suitable for both graduate students and practitioners in experimental physics materials science and multiple engineering disciplines including electronic and electrical chemical mechanical metallurgy and others

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