

MOLECULAR ELECTRONIC DEVICES

- Monomolecular film devices(diodes, switches, memory).
- Single molecule FET
- Organic light emitting diode(OLED).

Molecular Electronic Devices

Senthil Arun Rajagopal



Molecular Electronic Devices:

Molecular Electronics and Molecular Electronic Devices Kristof Sienicki, 1993-03-25 *Molecular Electronics and Molecular Electronic Devices* is a book that provides a comprehensive review of current problems and information regarding all aspects of molecular electronics and molecular electronic devices Experimental and theoretical aspects of molecular electronics and molecular electronic devices are reviewed by distinguished researchers working in chemistry physics computer science and various areas of biology These books are excellent references for physicists chemists electronics engineers materials scientists and researchers interested in molecular electronics and molecular electronic devices

Molecular-Scale Electronics Xuefeng Guo, Dong Xiang, Yu Li, 2020-07-15 Provides in depth knowledge on molecular electronics and emphasizes the techniques for designing molecular junctions with controlled functionalities This comprehensive book covers the major advances with the most general applicability in the field of molecular electronic devices It emphasizes new insights into the development of efficient platform methodologies for building such reliable devices with desired functionalities through the combination of programmed bottom up self assembly and sophisticated top down device fabrication It also helps to develop an understanding of the device fabrication processes and the characteristics of the resulting electrode molecule interface Beginning with an introduction to the subject *Molecular Scale Electronics Concept Fabrication and Applications* offers full chapter coverage on topics such as Metal Electrodes for Molecular Electronics Carbon Electrodes for Molecular Electronics Other Electrodes for Molecular Electronics Novel Phenomena in Single Molecule Junctions and Supramolecular Interactions in Single Molecule Junctions Other chapters discuss Theoretical Aspects for Electron Transport through Molecular Junctions Characterization Techniques for Molecular Electronics and Integrating Molecular Functionalities into Electrical Circuits The book finishes with a summary of the primary challenges facing the field and offers an outlook at its future Summarizes a number of different approaches for forming molecular scale junctions and discusses various experimental techniques for examining these nanoscale circuits in detail Gives overview of characterization techniques and theoretical simulations for molecular electronics Highlights the major contributions and new concepts of integrating molecular functionalities into electrical circuits Provides a critical discussion of limitations and main challenges that still exist for the development of molecular electronics Suited for readers studying or doing research in the broad fields of Nano molecular electronics and other device related fields *Molecular Scale Electronics* is an excellent book for materials scientists electrochemists electronics engineers physical chemists polymer chemists and solid state chemists It will also benefit physicists semiconductor physicists engineering scientists and surface chemists

Molecular Electronics and Molecular Electronic Devices Kristof Sienicki, 1994 *Molecular Electronics and Molecular Electronic Devices* Kristof Sienicki, 1993-09-27 *Molecular Electronics and Molecular Electronic Devices* is a book that provides a comprehensive review of current problems and information regarding aspects of molecular electronics and molecular electronic devices Experimental and theoretical

aspects of molecular electronics and molecular electronic devices are reviewed by distinguished researchers working in chemistry physics computer science and various areas of biology These books will be an excellent reference for physicists chemists electronics engineers and researchers interested in molecular electronics and molecular electronic devices

Molecular Electronics Juan Carlos Cuevas, Elke Scheer, 2010

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Single Molecule Electronics and Nanofabrication of Molecular Electronic Devices Senthil Arun Rajagopal, 2006 Molecular electronics is an emerging field that

makes it possible to build electronic devices with single molecules as their active element The conductivity of single molecules can be manipulated to perform functions similar to present day bulk electronic devices These single molecules with a size of few nano meters can be designed and chemically synthesized with tailored electronic structures This thesis focuses on the design fabrication and measurement of nanogap electronic devices The enabling device to study the conductivity of dimetal paddlewheel inorganic complexes using electrode pairs with nanometer separation is fabricated A study of these inorganic complexes would provide more versatile opportunities for tailoring electron transport properties The molecular complex and its electron transport mechanism are discussed and a detailed description of the fabrication of the nano gap electrode with a controlled gap size is provided Electron beam lithography fabrication techniques are discussed in detail A reliable method to fabricate a controlled nanogap with electrodeposition and electromigration is demonstrated The results of I V curves of gaps are used to estimate the nanogap dimensions via comparison to tunneling current theory

Molecular Electronics and Molecular Electronic Devices Kristof Sienicki,1994-03-22 Molecular Electronics and Molecular Electronic Devices is a new book series that reflects the state of the art in the science and technology of molecular electronic devices It provides a comprehensive review of current problems and the latest information regarding all aspects of molecular electronics and molecular electronic devices Experimental and theoretical aspects of molecular electronics and molecular electronic devices are reviewed by distinguished researchers working in chemistry physics computer science and various areas of biology Molecular Electronics Ioan Baldea,2015-11-30 Molecular electronics an emerging research field at the border of physics chemistry and material sciences has attracted great interest in the last decade To achieve the ultimate goal of designing molecular electronic devices with the desired functionality and experimental manipulation at the single molecule level theoretical understanding of electron transport at the nanoscale is an important prerequisite This book a multi authored volume comprising reviews written by leading scientists discusses recent advances in the field It emphasizes the need for studies beyond the low bias regime a fact on which the scientific community became aware in the last years To make the book useful for scientists of various disciplines interested in learning by doing each chapter is written in a science tutorial hybrid style with its own introduction presenting fundamental concepts and frameworks The content reflects the strong transdisciplinary efforts needed for substantial progress **Molecular Electronics** ,1983 Molecular Electronics Michael C. Petty,2007-12-26 This consistent and comprehensive text provides an informed insight into molecular electronics by contrasting the prospects for molecular scale electronics with the continuing development of the inorganic semiconductor industry **Molecular-Scale Electronics** Xuefeng Guo,2018-12-06 The series Topics in Current Chemistry Collections presents critical reviews from the journal Topics in Current Chemistry organized in topical volumes The scope of coverage is all areas of chemical science including the interfaces with related disciplines such as biology medicine and materials science The goal of each thematic volume is to give the non specialist reader whether in academia or industry a

comprehensive insight into an area where new research is emerging which is of interest to a larger scientific audience Each review within the volume critically surveys one aspect of that topic and places it within the context of the volume as a whole The most significant developments of the last 5 to 10 years are presented using selected examples to illustrate the principles discussed The coverage is not intended to be an exhaustive summary of the field or include large quantities of data but should rather be conceptual concentrating on the methodological thinking that will allow the non specialist reader to understand the information presented Contributions also offer an outlook on potential future developments in the field

Building Molecular Electronic Devices from the Bottom Up Julia Del Re, 2016 Ever since Aviram and Ratner's revolutionary paper in 1974 that proposed that molecules could conduct electrical current molecular electronics has attracted a great deal of interest as a potential replacement for silicon technology Using molecules in electronic devices offers many advantages including high device density due to their small size and the ability to integrate new functions into devices with well designed synthesis One such example is sensing as the conduction in a molecular wire has been shown to be incredibly sensitive to its local environment Proof of concept experiments have demonstrated that the conduction of oligophenylene vinylene OPV a well studied molecular wire is sensitive to nitroaromatic molecules In order to be able use molecules in molecular electronic devices though it is necessary to be able to control their switching between the on and off state Preliminary work has attempted to understand how voltage induced switching works in bipyridyl dinitro oligophenylene ethynylene dithiol BPDN The subsequent step is to look at integrating these molecules into functional devices One proposed way for integrating conducting molecules into functional devices is to form networks of densely packed gold nanoparticles and molecular wires between metal electrodes on insulating substrates This design requires that nanoparticles be spaced closely enough together otherwise molecular wires will fail to bind between neighbouring nanoparticles thus decreasing device efficiency Biomolecules have proven to be excellent templates for self assembly and offer the advantage of being able to work under mild aqueous conditions Two examples are peptides and viruses Peptides are known to provide excellent control over the size shape and assembly of inorganic materials Their activity can further be enhanced by fusing two different functional domains together to form a fusion peptide which is multifunctional in nature Viruses are highly desirable templates for self assembly for a variety of reasons including their monodispersity and well defined shapes The tobacco mosaic virus is one such example and its coat protein is capable of forming different assemblies depending on pH and ionic strength One assembly of interest is the 20S disk which is 18 nm in diameter In this work the Flg A3 peptide was first used to form gold nanoparticles which can form stable aggregates upon interaction with metal ions These aggregates are then bound in high density to silicon dioxide surfaces using the A3 QBP1 peptides The Flg A3 gold nanoparticles were also covalently bound to tobacco mosaic virus disks with the hopes of eventually being able to increase the size of the aggregates that it forms The gold nanoparticles were covalently bound to the N terminus of this structure which is located on the

circumference of the disk for further studies of their aggregation properties The final step focused on making functional devices from oligophenylene vinylene and these gold nanoparticle networks formed using fusion peptides The nanoparticle networks were plated on silicon dioxide substrates with lithographically defined gold electrodes They were treated with ultraviolet ozone cleaning in order to remove the peptide prior to using these films for electrical measurements with oligophenylene vinylene

Molecular Electronics Ari Aviram, Mark A. Ratner, 1998 This volume explores the resurgence of interest in the field of molecular electronics in view of recent advances in such areas as molecular wires molecular components fabrication and assemblies of molecular scale devices and their wiring on surfaces It shows how molecular electronics offer scientists an opportunity to study and understand a new class of materials on the molecular level and in isolation while offering to engineers a new microelectronics technology

Molecular Electronic Devices Forrest L. Carter, 1982

Quantum Chemistry Studies of Molecular Electronic Devices Liu Yang, 2010 Detailed control of electrical current through a single molecule plays an important role in the development of molecular electronic devices Precise modeling of charge transfer through molecular junctions calls for combining the theory of quantum transport with ab initio electronic structure calculations In this thesis first principles simulations of Scanning Tunneling Microscopy and Spectroscopy have been used to characterize organic molecules on semiconductor surfaces Theories behind these quantum theoretical treatments have been presented and several applications have been discussed and compared with experiments Cases studied in this work include various types of organic molecules on silicon surfaces with different crystal faces Successful explanation of experimental measurements and extraction of novel information indicate that simulations provide a powerful tool for molecular identifications Additionally some novel experiments have been proposed to enhance the contrast among different adsorbates

Molecular Electronic Devices II Carter, 1987-08-28

Spectroscopy, Fabrication, and Electronic Characterization of Molecular Electronic Devices Andrew Paul Bonifas, 2011 Abstract Molecular electronics is the study of charge transport through single molecules or molecular ensembles Molecular electronic junctions consist of single molecules or an ensemble of molecules positioned between two conducting contacts To fabricate and measure the electronic properties of molecular junctions several techniques have been employed such as scanning tunneling microscopy conducting probe atomic force microscopy and vapor deposition of top contacts Charge transport observed through molecular junctions has been shown to exhibit technologically important phenomena such as rectification conductance switching and orbital gating The primary focus of the field of molecular electronics is to understand the effect of molecular properties such as structure and molecular orbitals on charge transport mechanisms through molecular junctions In this dissertation the various techniques to fabricate and characterize molecular junctions are discussed along with an introduction to charge transport mechanisms expected to control transport through molecular junctions More specifically this dissertation is primarily focused on the fabrication and characterization of molecular junctions fabricated through the

formation of an electronic contact on a molecular layer through physical vapor deposition. A common problem with this technique is structural damage to the molecular layer or metal penetration through the molecular layer during the contact formation. To overcome these limitations, a novel fabrication technique was developed and employed to fabricate reproducible molecular junctions through a physical vapor deposition technique without molecular damage or metal penetration. Termed surface diffusion mediated deposition (SDMD), the technique remotely deposits a metallic contact adjacent to and about 10–100 nm away from the molecular layer. Surface diffusion causes the metallic contact to migrate towards and onto the molecular layer to form an electronic contact. With SDMD, single molecule and many molecule junctions are fabricated and electronically characterized. To probe electronic states and molecular structure in molecule/oxide junctions, an in situ optical absorbance spectroscopy technique was developed and employed to monitor bias induced molecular redox events in solid state molecular junctions. Correlation of the observed spectral changes with molecular redox events allows characterization of the electronic properties of molecules which are critical in understanding charge transport through molecules. In a related application, the developed in situ optical absorbance spectroscopy technique was used to probe doping events in polypyrrole oxide junctions. Doping reactions in polypyrrole are shown to strongly depend on the surrounding environment. For application to both molecular and conjugated polymer junctions, in situ absorbance spectroscopy is shown to be a useful analytical tool to determine charge transport mechanisms. Finally, a thermal oxidation technique is introduced to increase the resolution of nanoimprint lithography to fabricate nanogap electrodes for molecular junctions. The advantage of this technique is the ability to use a simple, fast, and reliable oxidation process to increase the resolution of standard nanofabrication techniques. *Molecular Electronic Devices*, International Symposium on Molecular Electronics, 1988.

Molecular Electronics, Michael C. Petty, 2008-03-11. This consistent and comprehensive text is unique in providing an informed insight into molecular electronics by contrasting the prospects for molecular scale electronics with the continuing development of the inorganic semiconductor industry. Providing a wealth of information on the subject from background material to possible applications, *Molecular Electronics* contains all the need to know information in one easily accessible place. Speculation about future developments has also been included to give the whole picture of this increasingly popular and important topic. Theoretical Considerations and Computational Strategies for Molecular Electronic Device Design, Janna Domenico, 2019. The key feature of electronic devices is the interface through which electrons or holes flow. The behavior of such a device is therefore dependent upon how energetically favorable this charge injection process is. The energetics of the system can be computed using quantum chemical methods and the charge injection barrier can be inferred from these results. The efficiency of one type of electronic device, the dye sensitized solar cell (DSSC), is strongly influenced by dye molecule orientation and interactions with the substrate. Understanding the factors controlling the surface orientation of sensitizing organic molecules and being able to study them using electronic structure calculations will aid in the

improvement of both traditional DSSCs and other devices that integrate molecular linkers at interfaces Chapter 3 first presents a general approach to understand relative dye substrate orientation and analytical expressions predicting orientation are provided The effects of substrate solvent and protonation state on dye molecule orientation are considered A two part analytical model is developed that predicts the binding energy of a molecule and quantifies the dye solvation energy for two solvents This affords the rapid prediction of dye molecule and MOF linker binding preference on the basis of the size of the adsorbing molecule identity of the surface and the solvent environment Once binding orientation is predicted the charge injection barrier between the materials that constitute the interface can be computed This computation and its challenges are discussed in Chapter 4 Finally with the rapid advancement of the field of interface materials it is surprising that materials science topics are currently underrepresented in the chemistry curriculum Chapter 5 describes student activities that were developed in order to introduce concepts surrounding the electronic structure of materials to upper level undergraduate and introductory graduate level chemistry students

Unveiling the Energy of Verbal Beauty: An Emotional Sojourn through **Molecular Electronic Devices**

In some sort of inundated with screens and the cacophony of instantaneous transmission, the profound energy and psychological resonance of verbal art frequently fade into obscurity, eclipsed by the constant barrage of noise and distractions. However, located within the musical pages of **Molecular Electronic Devices**, a captivating work of literary splendor that pulses with natural feelings, lies an remarkable journey waiting to be embarked upon. Written by way of a virtuoso wordsmith, that exciting opus instructions viewers on a psychological odyssey, delicately revealing the latent possible and profound impact stuck within the complicated web of language. Within the heart-wrenching expanse of this evocative evaluation, we can embark upon an introspective exploration of the book is key subjects, dissect their captivating publishing fashion, and immerse ourselves in the indelible impact it leaves upon the depths of readers souls.

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Molecular Electronic Devices Introduction

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