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PHYSICS OF SUBMICRON DEVICES



DAVID K. FERRY
AND
ROBERT O. GROUNDIN

Physics Of Submicron Devices

**Harold L. Grubin, David K. Ferry, C.
Jacoboni**



Physics Of Submicron Devices:

Physics of Submicron Devices David K. Ferry, Robert O. Grondin, 2012-12-06 The purposes of this book are many First we must point out that it is not a device book as a proper treatment of the range of important devices would require a much larger volume even without treating the important physics for submicron devices Rather the book is written principally to pull together and present in a single place and in a hopefully uniform treatment much of the understanding on relevant physics for submicron devices Indeed the understanding that we are trying to convey through this work has existed in the literature for quite some time but has not been brought to the full attention of those whose business is the making of submicron devices It should be remarked that much of the important physics that is discussed here may not be found readily in devices at the 10 nm level but will be found to be dominant at the 0.1 nm level The range between these two is rapidly being covered as technology moves from the 256K RAM to the 16M RAM chips

The Physics of Submicron Semiconductor Devices Harold L. Grubin, David K. Ferry, C. Jacoboni, 2013-11-11 The papers contained in the volume represent lectures delivered as a 1983 NATO ASI held at Urbino Italy The lecture series was designed to identify the key submicron and ultrasubmicron device physics transport materials and contact issues Nonequilibrium transport quantum transport interfacial and size constraints issues were also highlighted The ASI was supported by NATO and the European Research Office H L Grubin D K Ferry C Jacoboni v CONTENTS MODELLING OF SUB MICRON DEVICES 1 E Constant BOLTZMANN TRANSPORT EQUATION 33 K Hess TRANSPORT AND MATERIAL CONSIDERATIONS FOR SUBMICRON DEVICES 45 H L Grubin EPITAXIAL GROWTH FOR SUB MICRON STRUCTURES 179 C E C Wood INSULATOR SEMICONDUCTOR INTERFACES 195 C W Wilms en THEORY OF THE ELECTRONIC STRUCTURE OF SEMICONDUCTOR SURFACES AND INTERFACES 223 C Calandra DEEP LEVELS AT COMPOUND SEMICONDUCTOR INTERFACES 253 W Monch ENSEMBLE MONTE CARLO TECHNIQUES 289 C Jacoboni NOISE AND DIFFUSION IN SUBMICRON STRUCTURES 323 L Reggiani SUPERLATTICES 361 K Hess SUBMICRON LITHOGRAPHY 373 C D W Wilkinson and S P Beaumont QUANTUM EFFECTS IN DEVICE STRUCTURES DUE TO SUBMICRON CONFINEMENT IN ONE DIMENSION 401 B D McCombe vii viii CONTENTS PHYSICS OF HETEROSTRUCTURES AND HETEROSTRUCTURE DEVICES 445 P J Price CORRELATION EFFECTS IN SHORT TIME NONSTATIONARY TRANSPORT 477 J J Niez DEVICE DEVICE INTERACTIONS 503 D K Ferry QUANTUM TRANSPORT AND THE WIGNER FUNCTION 521 G J Iafrate FAR INFRARED MEASUREMENTS OF VELOCITY OVERSHOOT AND HOT ELECTRON DYNAMICS IN SEMICONDUCTOR DEVICES 577 S J Allen Jr Physics of Submicron Devices David K Ferry, Robert O Grondin, 1991-11-01 **The Physics of Submicron Lithography** Kamil A. Valiev, 2012-09-27 This book is devoted to the physics of electron beam ion beam optical and x ray lithography The need for this book results from the following considerations The astonishing achievements in microelectronics are in large part connected with successfully applying the relatively new technology of processing changing the properties of a material into a

device whose component dimensions are submicron called photolithography In this method the device is imaged as a pattern on a metal film that has been deposited onto a transparent substrate and by means of a broad stream of light is transferred to a semiconductor wafer within which the physical structure of the devices and the integrated circuit connections are formed layer by layer The smallest dimensions of the device components are limited by the diffraction of the light when the pattern is transferred and are approximately the same as the wavelength of the light Photolithography by light having a wavelength of $0.4 \mu\text{m}$ has made it possible to serially produce integrated circuits having devices whose minimal size is $2.3 \mu\text{m}$ in the pattern and having 10 105 transistors per circuit The Physics of Submicron Semiconductor Devices Harold L.

Grubin, David Ferry, C Jacoboni, 2014-01-15

Physics Of Submicron Devices D.K. Ferry,

Quantum Transport in Submicron Devices Wim Magnus, Wim Schoenmaker, 2002-06-12 The aim of this book is to resolve the problem of electron and hole transport with a coherent and consistent theory that is relevant to the understanding of transport phenomena in submicron devices Along the road readers encounter landmarks in theoretical physics as the authors guide them through the strong and weak aspects of various hypotheses **The Physics of Submicron Structures** Harold L. Grubin, 2012-12-06

Research on electronic transport in ultra small dimensions has been highly stimulated by the sensational developments in silicon technology and very large scale integration The papers in this volume however have been influenced to no lesser extent by the advent of molecular beam epitaxy and metal organic chemical vapor deposition which has made possible the control of semiconductor boundaries on a quantum level This new control of boundary conditions in ultra small electronic research is the mathematical reason for a whole set of innovative ideas For the first time in the history of semiconductors it is possible to design device functions from physical considerations involving nanoscale dimensions At the time the meeting was held July 1982 it was one of the first strong signals of the powerful developments in this area During the meeting important questions have been answered concerning ballistic transport Monte Carlo simulations of high field transport and other developments pertinent to new device concepts and the understanding of small devices from physics to function The committee members want to express their deep appreciation to the speakers who have made the meeting a success The USER project of DOD has been a vital stimulus and thanks go to the Army Research Office and the Office of Naval Research for financial support Urbana January 1984 K Hess Conference Chairman J R Brews L R Cooper Ex Officio D K Ferry H L Grubin G J Iafrate M I Nathan A F

Proceedings of the NATO Advanced Study Institute on Physics of Submicron Semiconductor Devices Held in San Miniato, Italy on July 10-23, 1983. The Physics of Submicron Semiconductor Devices. (NATO ASI Series B: Physics, Volume 180). Harold L. Grubin, David K. Ferry, C. Jacoboni, MODENA UNIV (Italy), 1983 Contents Modelling of Sub Micron Devices Boltzmann Transport Equation Transport and Material Considerations for Submicron Devices Epitaxial Growth for Sub Micron Structures Insulator Semiconductor Interfaces Theory of the Electronic Structure of Semiconductor Surfaces and Interfaces Deep Levels at Compound Semiconductor Interfaces

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 Techniques JHD *High-Speed Heterostructure Devices* Patrick Roblin, Hans Rohdin, 2002-03-07 Fuelled by rapid growth in
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 semiconductor devices intended for both graduate students and practising engineers This book is concerned with the
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 principles of operation of other devices such as the Bloch Oscillator RITD Gunn diode quantum cascade laser and SOI and LD
 MOSFETs are also introduced Initially developed for a graduate course taught at Ohio State University the book comes with
 a complete set of homework problems and a web link to MATLAB programs supporting the lecture material **Frontiers of
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 problems 1 The increasingly monolithic or pseudo monolithic integration of complex computing functions and systems
 imposes an environment which integrates advanced principles and techniques from a broad variety of fields Researchers not
 only must confront the increased complexity of topics in their specialty field but also must develop a deeper general
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 conferences through which research results are reported Remaining familiar with recent advances in our specific fields is a
 major challenge Casually browsing through journals and conference proceedings to remain aware of developments in areas
 outside our specialization has become an even greater challenge Frontiers of Computing Systems Research has been
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Table of Contents Physics Of Submicron Devices

1. Understanding the eBook Physics Of Submicron Devices
 - The Rise of Digital Reading Physics Of Submicron Devices
 - Advantages of eBooks Over Traditional Books
2. Identifying Physics Of Submicron Devices
 - 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 Physics Of Submicron Devices
 - User-Friendly Interface
4. Exploring eBook Recommendations from Physics Of Submicron Devices
 - Personalized Recommendations
 - Physics Of Submicron Devices User Reviews and Ratings
 - Physics Of Submicron Devices and Bestseller Lists
5. Accessing Physics Of Submicron Devices Free and Paid eBooks
 - Physics Of Submicron Devices Public Domain eBooks
 - Physics Of Submicron Devices eBook Subscription Services
 - Physics Of Submicron Devices Budget-Friendly Options
6. Navigating Physics Of Submicron Devices eBook Formats
 - ePub, PDF, MOBI, and More
 - Physics Of Submicron Devices Compatibility with Devices
 - Physics Of Submicron Devices Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Physics Of Submicron Devices
 - Highlighting and Note-Taking Physics Of Submicron Devices
 - Interactive Elements Physics Of Submicron Devices
8. Staying Engaged with Physics Of Submicron Devices

- Joining Online Reading Communities
- Participating in Virtual Book Clubs
- Following Authors and Publishers Physics Of Submicron Devices
- 9. Balancing eBooks and Physical Books Physics Of Submicron Devices
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Physics Of Submicron Devices
- 10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
- 11. Cultivating a Reading Routine Physics Of Submicron Devices
 - Setting Reading Goals Physics Of Submicron Devices
 - Carving Out Dedicated Reading Time
- 12. Sourcing Reliable Information of Physics Of Submicron Devices
 - Fact-Checking eBook Content of Physics Of Submicron Devices
 - 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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