CHAPTER 12

ELECTRONIC SCIENCE

Doctoral Theses

114. CHAUJAR (Rishu)
Analytical Modeling and Simulation of Gate Electrode Workfunction and Dielectric Engineered Recessed Channel Mosfet in Sub-100 NM Regime.
Supervisors : Dr. Mridula Gupta and Prof. R. S. Gupta
Th 15834

Abstract

Describes in detail, a two-dimentional analytical sub-threshold drain current model for the proposed MLaG-RC MOSFET design that greatly abridges the device characteristics assesment and allows the formulation of potential, electric field, threshold voltage, DIBL, sub-threshold slope and sub-threshold drain current in an encompassing way down to a gate length of 40nm, hence, presenting it as an attractive solution for the ongoing integration process in analog and digital design technology. Presents a two-dimensional analytical drain current model for the proposed GEWE-RC MOSFET design.

Contents

1. Introduction. 2. Two-Dimensional analytical sub-threshold model & design optimization of multi-layered gate-dielectric recessed channel (MLaG-RC) mosfet. 3. Design Considerations and Two-dimensional analytical model for gate elecrode workfunction engineered (GEWE) recessed channel (RC) nanoscale mosfet. 4. Hot carrier reliability and linearity-distortion evaluation of GEWE-MOSFET. 5. On state and switching behaviour of GEWE_RC MOSFET for High-speed logic and RF application. 6. Conclusion, perspectives & future research. 7. Bibliography.

115. HARSUPREET KAUR
Modeling and Simulation of Channel and Gate Oxide Engineered Cylindrical/Surrounding Gate MOSFETs for ULSI Applications.
Supervisors : Prof. R. S. Gupta and Dr. Subhasis Haldar
Th 15680

Abstract

Focuses on overcoming the limitations of planar MOSFETs. All issues have been cirtically examined and some novel device architectures are also proposed. A attempts to analyze and study the device characteristics of channel engineered and gate oxide engineered surrounding gate MOSFETs. The device performance of these device designs has been studied and compared with the conventional structures using analytical modeling and numerical simultation studies. The work will address some of the issues such as short channel effects, hot carrier degradation, reduction n current drivability and gate leakage currents due to excessive thinning of the gate dielectric layer and will also show new viewpoints for future ULSIs with surrounding gate MOSFETs.

Contents

116. JAIN (Anubha)
Fabrication, Characterization and Analysis of n-ZnO/p-Si Heterostructure for Photodiode Application.
Supervisor : Prof. R. M. Mehra
Th 15686

Abstract

Concernes with the development of n-ZnO/p-Si heterostructures for photodiode applications. Concentrates on the development and characterisation of n-ZnO/p-Si heterostructures fabricated with sol-gel grown ZnO films. The heterostructures are stydied

for the photodiode applications. The ZnO films have been grown on corning glass for studying optical properties and on Si for studying electrical properties. the structure of the ZnO films has been characterised using XRD, SEM and AFM techniques.

Contents

1. Introduction. 2. Deposition, characterization and measurement techniques. 3. Effect of the thickness on the properties of ZnO films. 4. Analysis and modeling of carrier transport in n-ZnO/ p-Si. 5. Study of ZnO/p-Si heterostructure for use as photodiode. 6. Conclusion. 7. Bibliography.

117. KASTURI (Poonam)
Two Dimentsional Physics Based Analytical Modeling and Simulation of Silicon-on-Nothing (SON) MOSFET.
Supervisor : Prof. R. S. Gupta
Th 15679

Abstract

Analytical model have been developed to study the effect of high-k gate dielectrics on the performance of SON MOSFET. analytical data is validated by simulation results achieved from ATLAS: 2D device simulator. A wide range of various technological parameters are considered to establish design guidelines aiming at reduced SCEs and higher performance engineering along with gate stack is presented through comprehensie simulation study of the properties of various dual metal MOSFETs.

Contents

1. Introduction. 2. Modeling and simulation of STacked Gate Oxide (STGO) Architecture in Silicon-on-Nothing (SON) MOSFET. 3. Two Dimensional subthreshold analysis of nanoscale SON MOSFET with gate stack architecture. 4. Dual material double layer gate stack SON MOSFET. 5. Summary, conclusion and future research. 6. Bibliography.

118. MITTAL (Ashok)
Finline PIN Diode Switches and Modulators for Millimeter Wave Applications.
Supervisor : Prof. Asok De
Th 15682

Abstract

Studies and analyses various existing configurations of switches. Suggest the use of asymmetric unilateral finline for better performance of the switching components and better power handling capability. Design of Broad Band Transition from Rectangular Wave guide to Finline structure with minimum loss is necessary for characterisation purpose and for connecting to system. Detailed Analysis has been done and presented duly taking into account the variation of the propagation constant over the incremental length.

Contents

119. PANDEY (Praveen Kant)
Studies of Semiconductor Nanostructures.
Supervisor : Prof. P. K. Bhatnagar
Th 15676

Abstract

Investigates the growth methods of CdSe and CdTe quantum dots embedded in glass matrix and their properties. It is shown that the quantum dots grown have smaller average size and reduced size dispersion as compared to the quantum dots grown by various other research groups. It was verified that the size of the semiconductor quantum does varies directly with the square root of annealing duration as predicted by theoretical analysis. An improved two-step annealign method for the growth of semiconductor quantum dots in glass matrix is presented. Differential Thermal analysis (DTA) sutdies of CdSe doped glass smaples was performed and Glass transition temperature (T_g) was found to be 480°C. A hyperbolic heat conduction model has been developed to estimate the temperature profile of a laser irradiated quantum dot embedded in glass matrix. the results were compared with the results of conventional parabolic heat conduction model. Hyperbolic model also showed that there is an instantaneious rise in the quantum dot surface temperature.

Contents

120. PANWAR (Varij)
Study of Electrical Dielectric and Mechanical Properties of Conducting Polymer Composites.
Supervisor : Prof. R. M. Mehra
Th 15683

Abstract

Studies fabrication and characterization of conducting polymer composites with high conductivity at minimum conducting filler loadings. Four different conductive polymer composites are fabricated using insulating polymers (Low density polyethylene (LDPE), high density polyethylene (HDPE) and styrene-acrylonitrile (SAN) and two different conducting filler i.e. graphite in the form of micron size and nanographite sheets (NGS) by hot-compression modling and in-situ polymerization techniques. For the characterization of conducting polymer composites, Scanning Electron Microscopy (SEM) was carried out in order to estimate the distribution of conducting filler in polymer matrix. To understand the crystalline and amorphous nature of nanographite sheets, polymers and conducting polymer composites, X-ray diffraction measurements were performed. The possible change in the chemical structure of polymer was studied by FTIR spectrometer. The study of shore-D hardness versus filler concentration was carried out to understand as to what extent the mechanical strength of the polymer is scarified due to the addition of the conducting filler.

Contents

121. PARVESH

Polarization Dependent Analysis and Characterization of AlGaN/GaN HEMT.

Supervisors : Dr. Mridula Gupta and Dr. Subhasis Haldar
Th 15790

Abstract

Focuses on developing physics based models for device structure optimization and performance prediction of $Al_mGa_{1-m}N$/GaN high electron mobility transistors, with the special emphasis on the role of piezoelectric and spontaneous polarization eeffects, a sriking feature of AlGaN/GaN material system that distinguishes it from other material parameters and provides a deep insight into device physics.

Contents

122. RAIT (Sukhbinder Singh)

Development of Conjugated Polymer Films for Device Applications.

Supervisor : Prof. P. K. Bhatnagar
Th 15822

Abstract

Deals with the development of conjugated polymer photovoltaic device for P3HT (poly (3-hexylthiophene) and C_{60} (Buckminsterfullerence) based bulk heterojunction photovoltaic devices. Experimental investigations were performed on donoracceptor type P3HT:C_{60} devices performance and maximised power conversion efficiency.

Contents

123. SAMINA KHAN
Synthesis Characterization and Field Emission Properties of Multi-walled Carbon Nanotubes (MWNTs).
Supervisor : Prof. K. N. Tripathi
Th 15685

Abstract

Focusses on the synthesis, characterization and field emission properties of $Ni_{95}Ti_5$, $Fe_{70}Pd_{30}$ and $Fe_{70}Pt_{30}$ catalyzed nanocrystalline films, using LPCVD and ECR-CVD methods. to study field emission properties, various field emission parameters viz., turn-on field (E_{to}), field enhancement factor (β), current density (j/J) were calculated from the F-N plot and were studied as function of growth time, working distance (d_0) and radius of apex curvature (r) respectively.

Contents

124. SINGH (RASHMI)
Design Considerations for Long Period Gratings in Erbium Doped Fiber and Other Applications.
Supervisor : Prof. Enakshi K. Sharma
Th 15815

Abstract

Aims to design considerations of long period gratings written in an erbium doped fiber (EDF), which in addition to gain equalization; give an overall gain enhancement as well as amplified spontaneous emission (ASE) noise suppression and also develop an understanding of the aspects related to EDFA gain in WDM optical communication systems and to develop more efficient in-line mechanisms for gain equalization using long period gratings.

Contents

6. Gain flattering by long period gratings in erbium doped fibers. 7. Long period gratings with attenuation control. 8. propagation characteristics of single mode optical fiber with arbitrary complex index profiles : a direct numerical approach. 9. Bibliography.

125. SINGH (Udaibir)
Theoretical Modeling and Experimental Investigation of Surface Roughness of Thin Films Using Light Scattering.
Supervisor : Prof. Avinashi Kapoor
Th 15677

Abstract

Deals with the theoretical modeling of rough surface of thin film for normal and oblique incidence and its experimental verification. It is well known that surface and interfaces are very important for the physical properties of any optical thin film. For the thin films, used in thin film optics and micrielectronics, the influence of surface/interface properties became crucial as the material volume reduces dramatically in comparison to the surface area. Explores various aspects of surface roughness on optical properties of thin film in various applications. Concepts of surface roughness, scattering theory and polarization have been discussed.

Contents

1. Introduction. 2. Review of existing optical theories and models of surface roughness. 3. Identical double layer homogeneous model for surface roughness. 4. Polarized light scattering through rough surface for single layer homogeneous model. 5. Transmittance property of palladium thin film using single layer model with oblique incidence. 6. Conclusion.

126. TIWARI (Manoj K.)
Theoretical and Experimental Photonic Bandgap Studies in Periodic Structures for Electronic Materials.
Supervisor : Prof. K. K. Gupta
Th 15681

Abstract

Studies the photonic bandgap structures experimentally and theoretically. The experimental study has been carried out for different periodic structures in one and two dimensions. for one dimensional study fabricated the rectangular periodic hole struc-

tures in 18 micron thick Aluminum foil. The bandgap for these metallic structures in microwave region has been experimentally determined. Variation of period, dimensions of rectangular hole, dielectric constant and width of defect in periodic structures has been studied and effect of these factors on PBG has been discussed and analyzed. Role played by the Geometrical factor, dielectric constant of the substrate and the wave impedance in the formation of PBG has been established. It has also been discussed how the wave impedance and dielectric constant or refractive index effects the formation and variation PBG. The preparation of magnetic Ni-Zn Ferrite susbtrate by use of citrate procursor methods has been discussed. Fabrication of two dimensional circular periodic structures on copper claded on two sides of duroid substrates has been discussed.

Contents

1. Introduction. 2. Materials design, fabrication and measurement techniques. 3. One dimensional photonic bandgap structures. 4. One dimensional photonic bandgap structures on magnetic substrate. 5. Two dimensional photonic pandgap structures. 6. One dimensional graded periodic dielectric structure. 7. Conclusion and scope for future work. 8. Bibliography.

127. VERMA (Preeti)
Growth and Characterization of Carbon Nanotubes for Device Applications.
Supervisors : Prof. P. K. Bhatnagar and Dr. Harsh
Th 15684

Abstract

Focusses on the development of a new generation of devices such as quantum wire interconnects, field emission devices, composites, chemical sensors, biological sensors, detectors etc. Carbon Nanotubes can, in principle play the same role as silicon does in electronic circuits, but at the molecular scale where silicon and other standard semiconductor cease to work and an overview of growth techniques, purification techniques of CNTs and the working principle of various tools like SEM, TEM, HRTEM, Raman, STM and AFM etc has been elaborated.

Contents

1. Introduction to nanotechnology. 2. Overview of CNT growth, characterization and their purification technique. 3. Experimental

details and characterization of growth of CNTs via CVD and PECVD techdnique. 4. Purification and characterization of carbon nanotubes. 5. Field emission studies of carbon nano tubes. 6. Current and degradation mechanism in CNT based emitters obtained via CVD and PECVD technique. 7. Conclusion and future plans. 8. Bibliography.