

CHAPTER 13

ELECTRONIC SCIENCE

Doctoral Theses

121. AMIT KUMAR
Optical and Electrical Characterization of Electroluminescent Conjugated Polymer- MEHPPV and Development of its Light Emitting Devices.
Supervisor : Prof. P. K. Bhatnagar
Th 14714

Abstract

Studies light emitting devices based on MEHPPV and then performed electrical characterization over these. It has been found that light emitting efficiency of basic PLED viz. ITO/MEHPPV/Al can be improved if added a buffer layer of LiF in between polymer and Al. This increased efficiency can be attributed to the lowering of potential barrier at Al cathode due to the presence of LiF buffer layer. The device performance is also found to get improved by replacing monolayer of MEHPPV by bilayer of MEHPPV/Alq3. These improved characteristics can be attributed to balanced charge recombination caused at MEHPPV/Alq3 interface.

Contents

1.Introduction. 2. Details of experimental techniques used. 3. Absorption and photoluminescence studies. 4. Current injection mechanism in monolayer devices. 5. Temperature and electric field dependences of hole mobility. 6. Carrier conduction mechanism. 7. Fabrication and operation of light emitting devices. 8. Major conclusions and Bibliography.

122. GAUR (Shiv Shankar)
Fabrication and Characterization of Dyedoped Polmeric waveGuides for Optoelectronics and Sensing Applications.
Supervisors : Prof. K. N. Tripathi and Dr. V. K. Sharma
Th 14718

Abstract

Describes the definition of optical waveguide, classification of optical waveguide, basic three-layer optical waveguide structure

physical optic approach of the optical waveguide and ray optic approach, eigen value equation for the TE mode and TM mode. Electric field distribution in three-layer, selection of waveguide materials, different types of substrate materials, substrate cleaning etc have been discussed. Optimizes the various optical parameter such as refractive index, thickness, birefringes, transmission and absorbance spectra. The effect of the dye doping in the polymeric films have been studied. The mode filtration properties in four layer dye doped polymeric structures have been studied. The sensing properties in polymeric waveguides have been studied using methyl red doped with polystyrene and bromocresol purple doped with SAN films. The various waveguiding parameters of three different negative photoresist materials, namely-HNR80, HNR120 and 450 were optimized.

Contents

1. Waveguides in integrated optics. 2. Optical waveguide theory and experimental techniques. 3. Dye doped polymeric waveguide 4. Fabrication and characterization of dye-doped polymeric mode filter 5. Planar optical waveguides as pH sensors. 6. Photoresist based waveguides. 7. Conclusion and Bibliography.

123. GUPTA (Manoj Kumar)
Non-linear Laser Plasma Interactions at Intense Relativistic Laser Powers.
 Supervisor : Dr. V. L. Gupta
 Th 14717

Abstract

Studies the nonlinear propagation of two laser beams; beat wave excitation and particle acceleration when relativistic and ponderomotive nonlinearities are operative. The effect of a relativistically intense gaussian laser pulse, on the propagation of electron plasma wave is studied. Derives the dynamical equation for the pump laser beam when these two nonlinearities are operative. The solution of pump laser beam has been obtained within the paraxial ray approximation. Filamentary structures of the laser beam are observed. On account of VXB force, the generation of plasma wave at second harmonic frequency has been studied in these filamentary structures. Generation of localized electron plasma wave structures at pump wave frequency and the second harmonic electromagnetic field emission in these filamentary structures

are studied. Investigated the effect of ultra intense laser beam filaments on stimulated raman scattering (SRS) in unmagnetised plasma when relativistic and ponderomotive nonlinearities are operative.

Contents

1. Introduction. 2. Cross focusing of two laser beams and plasma wave excitation. 3. Effect of ultra intense laser pulse on the propagation of electron plasma wave in relativistic and ponderomotive regime and particle acceleration. 4. Generation of plasma wave and third harmonic generation at ultra relativistic laser power. 5. Generation of plasma wave at pump wave frequency and second harmonic generation at ultra relativistic laser power. 6. Effect of relativistic and ponderomotive nonlinearities on stimulated raman scattering in laser plasma interaction. 7. Conclusion and Bibliography.

124. JAIN (Amit)

Theoretical Investigation of Parameters of Real Solar Cells Using Lambert W-function.

Supervisor : Dr. Avinashi Kapoor

Th 14716

Abstract

Deals with the theoretical investigation of current-voltage characteristics of inorganic and organic solar cells. The I-V equation of a solar cell is transcendental in nature i.e., I and V cannot be separated or it is not possible to present I in terms of V explicitly and vice versa. Till now several numerical and iterative techniques have been used to extract various parameters of solar cell. The parameters thus extracted are not accurate and needs comparatively more computational time. In present work a lesser known but very useful function called lambert w- function is used to separate current and voltage in solar cell equation. Parameters thus extracted using lambert w-function (w-function) are accurate and needs less computational time.

Contents

1.Introduction. 2. Lambert w-function and review of extraction of solar cell parameters. 3. Extraction of various parameters of solar cell using lambert w-function. 4. Study of parameters of organic solar cell. 5. Solar cell array parameters. 6. Conclusion and Bibliography.

125. KAUSHIK (Navneet)
Modeling and Simulation of 6H-SiC MOSFETs for High Power and High Temperature Applications.
 Supervisors : Prof. R. S. Gupta and Dr. Subhasis Haldar
 Th 14713

Abstract

Describes the need of invention of silicon based power MOSFETs and then how it appears unsuitable for harsh environment operated industries. A unique operating mode, called “Quasi-saturation”, present in vertical DMOSFET is described. An analytical model of 6H-SiC inversion channel MOSFET is developed incorporating the fermi-dirac statistics and influence of incomplete dopant ionization. The charge sheet approach is used to evaluate the surface potential, drain current, transconductance and drain conductance. An explicit analytical expression is also developed which relate the transconductance with interface trap density. It is observed that interface state density has an effect of lowering the transconductance. The effects of interface trap density on other device characteristics have also been discussed. The charge sheet model developed has been extended for non-uniformly doped channel 6H-SiC MOSFET. A temperature dependent analytical model of 6H-SiC inversion channel MOSFET is developed. The developed model incorporates the effect of temperature variation and continuous interface trap distribution, which increases toward the edge of the conduction band. The model is based on an analytical solution of poisson’s equation including incomplete ionization of dopant impurities, continuous interface trap distribution and fermi-dirac statistics. The expressions developed for surface potential and threshold voltage include the presence of increasing interface trap density (D_{it}) towards the edge of the conduction band. The effect of body leakage current and the drain/source contact region resistances also included beside the improved charge sheet approach.

Contents

1. Introduction 2. An extraction technique for characterization of electric field distribution and drain current in VDMOS power transistor 3. Analytical model of 6H-SiC mosfet 4. Numerical modeling and simulation of nonuniformly doped channel 6H-SiC mosfet. 5. Interface traps distribution and temperature dependent 6H-SiC mosfet analysis. 6. Conclusion and Bibliography.

126. SAXENA (Manoj)
Physics Based Analytical Modeling and Simulation of Dual-material Gate (DMG) MOSFET.
 Supervisor : Prof. R. S. Gupta
 Th 14712

Abstract

Deals with modeling and simulation of transport enhanced mosfet structures, i.e those structures for which increased transistor drive current for improved circuit performance can be achieved by enhancing the average velocity of carriers in the channel. Various analytical models have been developed to study the effect of (a) gate electrode workfunction engineering (GEWF) i.e dual material gate (DMG) mosfet on conventional bulk silicon mosfet and double gate mosfet and (b) gate oxide engineering (GOE) i.e. Asymmetric gate stack (ASYMGAS) mosfet on bulk silicon mosfet. The work also relates the device performance to several technological parameters like metal work function, dielectric constant of the upper gate oxide and channel length. Thus the results of the present research will make it possible to clear device designs of DMG mosfet and show new viewpoints for future applications.

Contents

1.Introduction. 2. Two dimensional analytical modeling and simulation of potential and electric field distribution in dual material gate (DMG)- mosfet. 3. Physics based modeling and simulation of dual material gate stack (DUMGAS) mosfet and asymmetric gate stack (ASYMGAS) mosfet. 4. Physics based analytical modeling and simulation of hetero material double gate (HEM-DG) mosfet and effect of stacked gate oxide. 5. Conclusion and Bibliography.

127. SEHGAL (Amit)
Poly-crystalline Silicon Thin Film Transistors : Modeling, Simulation and Characterization.
 Supervisors : Prof. R. S. Gupta and Dr. Mridula Gupta
 Th 14715

Abstract

Poly-crystalline silicon thin film transistors (poly-si TFTs) are upcoming devices in the field of device and integrated circuit (IC) applicaitons, due to easy fabrication and low cost production.

This has led to inclination of research interest towards improving its performance. In poly-Si-TFTs, evaluation of the properties of grain boundary trap states is of major importance for its development. The current trend towards downscaling of device geometry has proved to be vital for this device; as the effect of grain boundaries (such as high threshold voltage, low field effect mobility etc.) present in the poly si film has been reduced. On the other hand, the appearance and the effect of grain boundaries becomes distinct and thus cannot be worked out by simply using uniform distributed trap states as considered in the case of amorphous si. With this theory, together with the small geometry effects, this thesis effectively modeled the poly-si TFT characteristics for better understanding of its performance on various geometries and bias parameters.

Contents

1. Introduction 2. Quasi two dimensional modeling of tft. 3. The kink effect analysis in post saturation. 4. Two dimensional potential distribution analysis. 5. Threshold voltage optimization 6. Improved gate transport device: Multi material gate analysis 7. Conclusion and Bibliography.