Electronic Materials & Thin Film Research Group

Head of Group



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Dr Mmantsae Diale





Group Members

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Research Projects

- General description of current research projects:
 - Fabrication and characterization of ohmic and Schottky contacts to semiconductors
 - Electrical characterization of semiconductors
 - UV photoresponse characterization of wide bandgap materials
 - Modification of semiconductor properties by particle irradiation
 - Defect characterization in semiconductors by deep level transient spectroscopy (DLTS and high resolution Laplace-DLTS).
- Currently we do research on the following materials: Si, Ge, GaAs, Ga(AI)N, ZnO, SiC, Cd(Zn)Te
- Computer modelling and calculations of defect structures in semiconductors.

Experimental and Modelling Facilities

- Thin Film Deposition
 - Resistive evaporation
 - Electron beam evaporation
 - DC & RF sputtering
 - Inductively coupled plasma etching
- Thermal annealing
 - Open furnace (Ar, O, N, etc. gasflow)
 - ♦ Vacuum furnace

Electrical characterization

Current-Voltage (IV) & Capacitance-Voltage (CV) measurements



Mr Matshisa Legodi

Mr Johan Janse van Rensburg

Dr Mohan Das

Research Activities

Research activities of our group can be outlined as follows :

- Cleaning and processing of semiconductor materials.
- Studies on different metals and processes for fabrication of ohmic and Schottky contacts to semiconductor materials such as Ge, Si, AlGaAs, GaN, AlGaN and ZnO.
- Electrical characterization of Schottky and ohmic contacts.
- Introduction of defects through irradiation with protons or α -particles using a van de Graaf accellerator or radioactive sources.
- Electrical characterization of radiation and process induced defects in semiconductor materials.
- UV photoresponse characterization of GaN photodetectors.

Collaboration

- International collaboration
 - Prof. Tony Peaker, University of Manchester, UK (Laplace DLTS)
 - Late Prof. Leszek Dobaczewski, Poland, (Laplace DLTS)
 - Prof. Bengt Svensson, University of Oslo, Norway (DLTS and Hall measurements) on ZnO, radiation hardnes of semiconductors)
 - Dr. Holger von Wenckstern, University of Leipzig, Germany (Laplace-DLTS of radiation induced defects in PLD grown ZnO)
 - Prof. Andre Vantomme, KUL, Leuven, Belgium (ion implantation of semiconductors)
 - Prof. Anna Cavallini, Italy, Cd(Zn)Te and AlGaN



- Deep-level transient spectroscopy (DLTS) & Laplace DLTS
- Admittance spectroscopy
- Four-point probe resistivity
- Variable temperature Hall effect
- UV & visible photoresponse characterization
- Low temperature irradiation and in situ DLTS
- Scaning Probe Microscope (CV & DLTS)
- Modelling of defects
 - Ab initio modeling of defects in semiconductors (VASP software)

Funding

- National Research Foundation
 - ♦ IFRR
 - CPRR
 - ♦ CSUR
 - ♦ Blue Skies
 - Student bursaries
- Norway-South Africa Bilateral: ZnO
- Italy South Africa: CdTe, AlGaN
- Germany South Africa: ZnO,GaN, AlGaN, Ge
- TIA: CSIR, UP, NMMU: daylight blind UV sensors: GaAIN and ZnO

Recent Publications

- "Defect introduction in Ge during inductively coupled plasma etching and Schottky barrier diode fabrication processes", Auret FD, Coelho SMM, Myburg G, van Rensburg PJJ, Meyer WE, Thin Solid Films, Vol. 518, Issue: 9, p 2485-2488, 2010.
- "Shallow levels in virgin hydrothermally grown n-type ZnO studied by thermal admittance spectroscopy", Schifano R, Monakhov EV, Svensson BG, Mtangi W, van Rensburg PJ, Auret FD, Physica B, Vol: 404, Issue: 22, p 4344-4348, 2009.
- "Lithium and electrical properties of ZnO", Vines L, Monakhov EV, Schifano R , Mtangi W, Auret FD, Svensson BG, Appl Phys, Vol: 107, Issue: 10, 103707, 2010.
- "Current-temperature measurements of a SBD evaporated onto inductively coupled plasma cleaned germanium", Coelho SMM, Auret FD, Myburg G, van Rensburg PJJ, Meyer WE, Physica B, Vol: 404, Issue 22, p 4389-4392, 2009.





- Local collaboration
 - CSIR, UP, NMMU: Daylight blind UV sensors
 - University of the Free state: XPS of semiconductors
 - Nelson Mandela Metropolitan University: DLTS of GaAs and ZnO
 - DETEK: inductively coupled plasma etching of semiconductors
- "Effects of chemical treatment on barrier height and ideality factors of Au/GaN Schottky diodes", Diale M, Auret FD, Physica B, Vol: 404, Issue: 22, p 4415-4418, 2009.
- "A comparative study of electronic properties of the defects introduced in p-Si (i) during electron beam deposition of Ti/Mo, (ii) by proton irradiation, and (iii) by electron irradiation", Das AGM, Nyamhere C, Auret FD, Hayes M, S & C Tech, Vol: 203, Issue: 17-18, p 2628-2631, 2009.

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