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Department of Semiconductor Processing for Photonics

Amber/Green Emitters Targeting High Temperature Applications AGETHA IST-1999-10292

COORDINATOR

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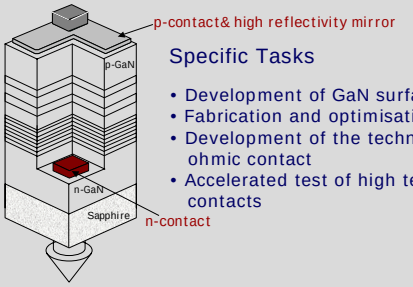
- The Provost Fellows and Scholars of the College of the Holy and Undivided Trinity of Queen Elizabeth near Dublin, Dublin, Ireland
- The University of Surrey, Surrey, United Kingdom
- Infineon Technologies AG, Muenchen, Germany
- BAE Systems (Operations) Limited, Farnbough, United Kingdom
- Institute of Electron Technology, Warsaw, Poland

OUR ROLE IN THE PROJECT

Development of Ohmic Contacts to Nitride-based Resonant Cavity Light Emitting Diodes and Resonant Cavity Detectors



Specific Tasks

- Development of GaN surface treatment
- Fabrication and optimisation of n-type ohmic contact
- Development of the technology of highly reflective p-type ohmic contact
- Accelerated test of high temperature stability of ohmic contacts

PROJECT DESCRIPTION

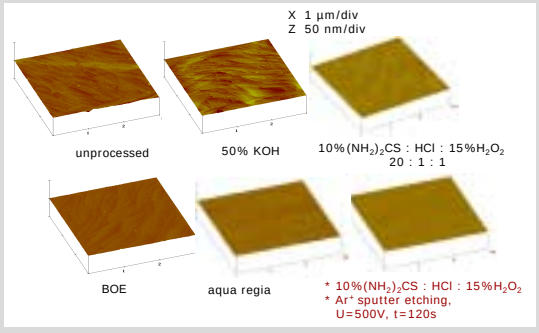
In modern cars, trucks, buses, trains, ships and aircraft, digital equipment (on-board navigation, collision avoidance and active noise cancellation systems as well as a raft of audio and video entertainment equipment) is used for control, safety, communication and entertainment applications. To date electrical data buses have been used to interconnect the various electronic components within a car at an operating speed of up to 10 Mbs^{-1}. Plastic optical fibres (POF) have recently become a highly competitive alternative to copper buses both in terms of cost and performance.

The fundamental objective of the AGETHA project is to develop high-speed emitters and detectors compatible with second-generation plastic optical fibre (POF) networks, able to operate to temperatures as high as 120ºC and at data rates of up to 500 Mbs^{-1}. Amber and green (570 nm and 510 nm) resonant cavity light emitting diodes (RCLED) and complementary resonant cavity detectors (RCD) are fabricated from the AlGaN/GaN/InGaN material system. These wide band-gap semiconductors are ideal for matching the low loss windows of polymethylmethacrylate (PMMA) based POF that occur at 570 and 510 nm. An important advantage of the InGaN quantum wells is the superior tolerance to high temperature of their spontaneous emission when compared with non-nitride structures which is attributed to the quantum dot nature of the active layers.

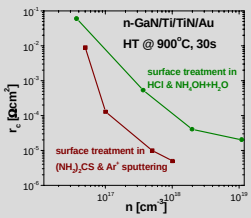
RCLED's in comparison with more conventional surface emitting LED's also have several features that make them attractive devices for use in POF networks including higher quantum and fibre coupling efficiencies. In addition the resonant cavity both narrows and fixes the emission wavelength and hence improves the stability of the emission wavelength as a function of temperature. A novel feature of the project is to also research and develop RCD's fabricated from the same epitaxial material as that grown for the RCLED's. These resonant detectors will by virtue of being nitride based have good temperature stability.

RESULTS

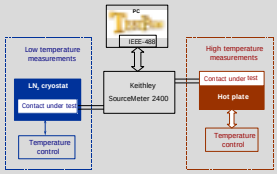
GaN surface treatment



Ohmic contacts to n-GaN

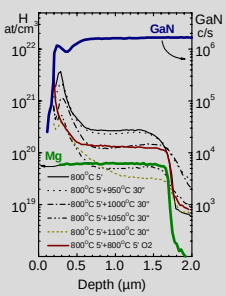


experimental set-up for evaluation of electrical properties of metal/semiconductor contacts (purchase supported by grant AGETHA)



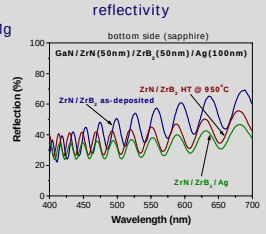
Ohmic contacts to p-GaN

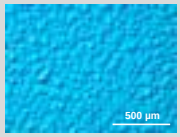
ohmic contact to p-GaN by enhanced activation of Mg



HT@T>900ºC 30s ohmic minimum r_c=6-8x10^{-5} Ωcm^2

reflectivity





bottom view

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