C3NiT Newsletter: Winter 2021

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Swedish Center for III-Nitride Technology

Next Board Meeting June 4th, 2021 in Teams

PROJECT UPDATES

Epitaxial growth development:
Initial test runs of GaN and AlN growth are performed in the MBE system at Chalmers, and technical/process details are under optimization. At LiU, graded AlGaN/GaN structures for highly linear HEMTs are grown and investigated. N-polar GaN with low surface roughness is optimized for implementation in HEMT structures.

HEMT technology:
A new batch with HEMTs has been finalized on a series of different epitaxially grown wafers. Compared to the material used in the current MMIC run, these are more downscaled. The split regards the doping profile in the buffer. Characterization in order to evaluate the high-frequency- and output power has yet to be completed.

Vertical GaN power devices:
Interview with PhD student Rosalia Delgado Carrascon, LiU

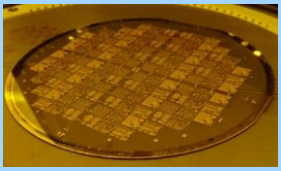
Hi Rosalia, tell us a bit about your work!

Hi! I work on growth and characterization of materials for vertical power devices. Recently we had great results on GaN-on-GaN, with smooth surfaces and a threading dislocation density of 10^6 cm^{-2}. A 1 µm thick GaN layer was successfully grown, enabling truly vertical power device structures!

What would be the next step?

The next step would be to grow truly vertical device structures on GaN bulk substrates and hopefully perform the growth of n-$Al_xGa_{1-x}N$ on GaN bulk substrates. I am looking forward to seeing how n-$Al_xGa_{1-x}N$ works as an active material for device purposes!

GaN MMIC:



MMIC process: After repeated interruption, the MMIC processing is now proceeding! The frontside is finalized and the wafer has been thinned down. The remaining steps are via-hole etching backside metallization. Completion is expected by the end of March!

Multilayer integration of passive structures using BCB:
After the first successful batch the process has been updated by a few modifications in order to improve the adhesion and reduce losses. The next step will be to repeat the process with three layers, and also include thin film resistors.

Developing the next generation high-power β-Ga_2O_3 material:
New SiC coated susceptor is implemented in the hot MOCVD reactor to enable high-purity material and reduce C incorporation. Growth of single orientation heteroepitaxial GO layers with the new susceptor has been demonstrated. Current efforts include increasing growth rate and Si doping optimization for GO drift layers.

Hexagem joins C3NiT!

Lund-based epitaxial growth company Hexagem has joined the center! Hexagem specializes in the growth of low-density-dislocation GaN and will be involved in the projects Advanced epitaxial growth and Vertical GaN power devices.

Hexagem

Mikael Björk
CEO

RESEARCH HIGHLIGHTS

Disclosures: C3NiT presents latest research at Compound Semiconductor Week CSW2021:

R. D. Carrascon et al.: "*Hot-wall MOCVD growth of low Al content, high electron mobility n-type $Al_xGa_{1-x}N$ layers*" and "*Homoepitaxial growth of GaN by hot-wall MOCVD: thermal stability and effect of H_2*"
D. Q. Tran et al.: "*Thermal conductivity of wide-bandgap semiconductors beyond the Debye approximation*"
M. Ghezellou et al.: "*Hot-wall MOCVD epitaxial growth of β-Ga_2O_3 on sapphire*"
P. Kühne et al.: "*2DEG in AlN/Al0.78Ga0.22N High Electron Mobility Transistor Structure Detected by THz Optical Hall Effect*"
A. Papamichail et al.: "*Low resistivity p-GaN grown by hot-wall MOCVD*"
H. Zhang et al.: "*Polarity determination and inversion in nitrogen-polar group III-nitride Films*"
J. Ul Hassan et al.: "*CVD growth and properties of β-Ga_2O_3 epitaxial layers*", *Invited talk*

Master thesis: Laurenz Geihofer (Linköping University and Graz University of Technology), **"**Epitaxial growth and basic material characterization of β-Ga_2O_3"