C3NIT NEWSLETTER

Swedish Center for III-Nitride Technology

Fall 2023

UPCOMING EVENTS

C3NiT day 2023

Annual C3NiT meeting and workshop

Thursday 23rd of November 2023

Lund University

PhD defense Dat Tran:
"Thermal Conductivity of Wide and Ultra-Wide Bandgap Semiconductors"

10:00 – Friday 6th of October 2023

LiU, IFM, Nobel, zoom link (request PW)

PhD defense Alexis Papamichail:
"Hot-wall MOCVD for advanced GaN HEMT structures and improved p-type doping"

10:00 – Thursday 5th of October 2023

LiU, IFM, Nobel, zoom link (request PW)

PUBLICATIONS

D. Y. Chen, et al., "*Structural investigation of ultra-low-resistance Ohmic contacts for AlGaN/GaN HEMTs based on Ti/Al/Ti-metallization*", Semicond. Sci. Technol. **38**, 105006 (2023). Link

P. Gribisch, et al., "*Capacitance and mobility evaluation for normally-off fully-vertical GaN FinFETs*", IEEE Trans. Electron. Dev. **70**, 4101 (2023). link

V. Stanishev, et al., "*Low Al-content n-type AlGaN layers with a high-electron-mobility grown by hot-wall metalorganic chemical vapor deposition*", Vacuum **217**, 112481 (2023). link

D.Q. Tran, et al., "*On the thermal conductivity anisotropy in GaN*", AIP Adv. **13**, 095009 (2023). Link

A. R. Persson, et al., "*Correlating cathodoluminescence and transmission electron microscopy for InGaN platelet nano-LEDs*", Appl. Phys. Lett. **123**, 022103 (2023). link

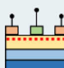
C3NIT in the NEWS

"Från materialforskning till system" *Elektroniktidningen* September 2023 (link)

PROJECT UPDATES

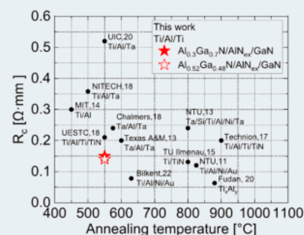
Linear E/W band HEMTs and MMICs

An advanced nonlinear test-bed for intermodulation distortion measurements is being built at Chalmers. It extends the capabilities with accurate measurement of the impedance levels at all intermodulation products as well as higher order harmonics. Next steps include verification of nonlinear models in microwave CAD software to enable the design of highly linear LNA MMICs.

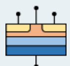


High voltage HEMTs and circuits for power and microwave applications

Novel approach to forming low-resistance ohmic contacts for AlGaN/GaN HEMTs has been developed. The optimized contacts exhibit an outstanding contact resistance of approximately 0.15 Ω·mm. This is achieved by firstly recessing the barrier of the heterostructure to a depth beyond the channel and the annealing process is performed at a low temperature of 550 ◦C.

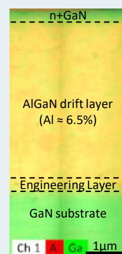


The impact of [C] (1×10^{17} to 5×10^{17} cm^{-3}) in the $Al_{0.06}Ga_{0.94}N$ back-barrier (BB) and GaN buffer is established. It is demonstrated that the BB effectively shields from buffer-related trapping for VDS ≤ 30 V. The lowest [C] enables the highest P_{out} (~1.8 W/mm), whereas the 3×10^{17} cm^{-3} doping provides the highest PAE >40%.



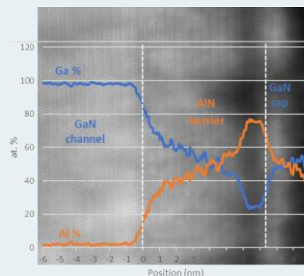
Vertical devices for power application

5µm AlGaN drift layers with reduced reverse leakage current with 2 orders of magnitude and 6% improvement of break-down voltage with respect to GaN are demonstrated. A buffer layer has been introduced to engineer the strain and bandgap between the thick AlGaN drift layer and GaN substrate. The device fabrication process is underway to demonstrate the first AlGaN-based vertical FinFETs.



Advanced epitaxial concepts for cost reduction

Substantial progress is made in the epitaxy of material technology for the purposes of high frequency (> 100 GHz) HEMT devices. MOCVD growth of AlGaN/GaN HEMT structures with 80% of Al in the barrier layer have been developed and MBE growth of AlN/GaN HEMTs with mobility up to 1650 cm^2/ V s demonstrated. Next steps include device fabrication and testing.



Next Board Meeting November 24th 2023 at Lund University

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