

Swedish Center for III-Nitride Technology

Next Board Meeting 5 February, 2020 in Ericsson, Gothenburg

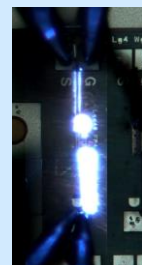
PROJECT UPDATES

Epitaxial growth development: Thanks to the efforts of SweGaN, the new quartz-free reactor for growth of GaN - Gandalf is now operational. Transfer of growth process recipes from Solaris and growth optimization for N-polar epitaxy is under way. Structural arrangement and origin of polarity inversion in N-polar AlN is established. In a collaboration with Epiluvac a flow-modulation growth is implemented to minimize formation of structural defects.

Vertical GaN power devices: Muhammad Nawaz (ABB & LiU) is appointed project leader. Material for GaN-on-SiC SBDs has been grown and processed for mesa diodes. Mg implantation for p-type doping of GaN has been performed and temperature profile for RTA being optimized. A new set-up for characterization of power devices up to 3 kV and 40 A (parameter-analyzer, probe-station, and a black-box) has been installed at Chalmers.

Developing next generation high-power β -Ga₂O₃ material: LiU together with Epiluvac and SweGaN has built a unique hot-wall MOCVD reactor for growth of β -Ga₂O₃, and related alloys.

HEMT technology: ON Semi, SweGaN, LiU and Chalmers are jointly exploring the high voltage capability of SweGaN's Quanfine™-structure with improved leakage and breakdown properties. Isolation implantation and optimization of dielectrics is underway. The maximum breakdown voltage is above 1800 V for an L_{gd} of 50 μ m.



GaN MMIC: The new design-kit needed for the in-house MMIC-process is finalized and a tape-out is planned for the beginning of 2020. The processing of the multi-layer circuits in BCB designed by Saab is being finalized and circuits will be delivered in January 2020. The strategy for aggressive gate scaling is revised to define 25-30 nm gate recesses in the SiN_x-passivation layer using a single resist and dry-etch with CF₄-plasma.

Education and outreach: We organized a *study visit* of the Graduate School Agora Materiae to the Motor lab, Collaborative robot lab and Digital High Voltage Lab at ABB on 28th of May.



Philipp Kühne gave a lecture on the Challenges for Autonomous driving, High frequency Electronics and Renewable Energies at **Pint of Science** in May. *Peter Raad* (Southern Methodist University, USA) gave a mini-course on **Computation Fluid Dynamics** at LiU in June.

The optical phonon mode order and the appearance of the reststrahlen bands for β -Ga₂O₃ have been determined. The longitudinal-phonon-plasmon coupling in β -Ga₂O₃ is established and it is found that the modes polarized in the monoclinic plane change their direction as a function of free electron concentration.

C3NiT Day with more than 60 participants from 7 countries was held on 12 November 2019

RESEARCH HIGHLIGHTS

Recent Publications

T. Huang, S. An, J. Bergsten, S. He, and N. Rorsman, "A power detector based on GaN high-electron-mobility transistors for a gigabit-on-off keying demodulator at 90 GHz", *Ipn. J. Appl. Phys.* 58, 3C55D19, 2019.

A. Malmros, Jr-Tai Chen, H. Hjelmgren, J. Lu, L. Hultman, O. Kordina, E. Ö. Sveinbjörnsson, H. Zirath, and N. Rorsman, "Enhanced Mobility in InAlN/AlN/GaN HEMTs using a GaN interlayer", *IEEE Transactions on Electron Devices*, 66, 2910, 2019.

M. Schubert, A. Mock, R. Korlacki, S. Knight, Z. Galazka, G. Wagner, V. Wheeler, M. Tadjer, K. Goto, V. Darakchieva, "Longitudinal Phonon Plasmon Mode Coupling in β -Ga₂O₃", *Appl. Phys. Lett.* 114, 102102, 2019.

M. Schubert, A. Mock, R. Korlacki, V. Darakchieva, "Phonon Order and Reststrahlen Bands of Polar Vibrations in Crystals with Monoclinic Symmetry", *Phys. Rev. B* 99, 041201, 2019.

A. Mock, R. Korlacki, S. Knight, M. Stokey, A. Fritz, V. Darakchieva, and M. Schubert, "Lattice dynamics of orthorhombic NdGaO₃", *Phys. Rev. B* 99, 184302 (2019).

PhD Thesis: Anna Malmros – "Advanced III-Nitride Technology for mm-Wave Applications", Chalmers, 10th of June 2019