C3NiT Newsletter: Fall 2020

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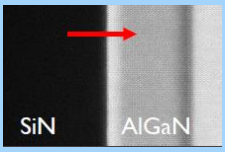
Swedish Center for III-Nitride Technology

Next Board Meeting 12 February, 2021 in Teams

PROJECT UPDATES

Epitaxial growth development: NH_3 pretreatment prior to SiNx passivation is established to minimize trapping effects and increase output power of high-frequency GaN HEMTs via reducing interface Oxygen content.



Source elements (In, Ga, Al, Si, and Mg) have been installed in the MBE system at Chalmers and the RHEED has been successfully tested.

Vertical GaN power devices: Process for homoepitaxial regrowth on GaN templates has been established and is being transferred to bulk GaN. Stable in-situ Mg doping and activation processes are developed to deliver hole concentration of 6-7 x 10^{17} cm^{-3} in GaN. Next step is the fabrication of PIN diodes and their characterization. Si doping in low-Al content AlGaN drift layers is developed.

HEMT technology: *Interview with PhD student Ragnar Ferrand Drake del Castillo*

Hi Ragnar, what's new?

Hi, the most recent progress is the development of T-gate:s with a length down to 50 nm using a three-layer resist stack. The lift-off has shown to be smoother compared with the previous two-layer resist process and therefore has improved the repeatability.

Why is downscaling of the gate length so important?

Scaling down the gate reduces the gate capacitance, which is essential for reaching higher frequencies of operation.

What's next?

The next step is to implement these T-gates on down-scaled epi, and hopefully measure a very high f_{max}.

Developing the next generation high-power β-Ga_2O_3 material: Successful growth of thick single crystalline β-Ga_2O_3 on sapphire with high growth rate of 1 µm/h. Further improvement in the growth rate and transferring to homoepitaxial growth is in progress.

GaN MMIC: Processing of the 1st GaN MMIC run is in progress and expected to be finalized by Jan 2021. Multilayer integration using BCB: Passive circuits on Si substrate fabricated. Very good agreement between simulations and measurements achieved.

C3NiT Center Day 12 Nov 2020

More than 40 C3NiT members met on-line to discuss their research progress and plan. Invited lecture on "Wide bandgap electronic devices for microwave and power applications at FBH" was presented by, Dr. Joakim Würfl.

We welcome our new C3NiT board members**: Winnie Mwangi** from Volvo Cars (left) and **Anna Malmros** from Gotmic AB (right).

Theses

Licentiate Thesis: Ding Yuan Chen – "Optimization of Ohmic Contacts and Surface Passivation for 'Buffer-Free' GaN HEMT technologies", Chalmers, December 2020.

Recent Publications

D. Q. Tran, R. D. Carrascon, J. F. Muth, T. Paskova, M. Nawaz, V. Darakchieva, P.P. Paskov, "Boundary scattering and phonon transport in AlGaN: Effect of layer thickness"; Appl. Phys. Lett. 117, 252102 (2020).

P. Gopalan, et al., "The anisotropic quasi-static permittivity of single crystal β-Ga_2O_3"; Appl. Phys. Lett. 117, 252103 (2020).

R. Korlacki, M. Stokey, S. Knight, A. Papamichail, V. Darakchieva and M. Schubert, "Strain and stress relationships for optical phonon modes in monoclinic crystals with β-Ga_2O_3 as an example"; Phys. Rev. B 102, 180101 (2020).

S. Knight, S. Schöche, P. Kühne, T. Hoffman,V. Darakchieva and M. Schubert; "Tunable cavity-enhanced terahertz frequency-domain optical Hall effect"; Rev. Sci. Instrum. 91, 083903 (2020).

M. Stokey, et al.,"Brillouin zone center phonon modes in $ZnGa_2O_4$", Appl. Phys. Lett. **117**, 052104 (2020)

Conferences

I. Angelov, G. Granström, M. Gavell, M. Ferndahl, N. Rorsman, and A. Perez, "On the delay implementation in FET Large Signal Models", INMMIC, 2020.