

Master Thesis

Field of work:

Neue Halbleiter Devices

Focus:

- Entwicklung & Simulation
- Layout
- Charakterisierung
- Programmierung
- Hardware-Entwicklung
- Messtechnik
- Machbarkeitsstudie

Study program:

- Elektro- und Informationstechnik
- Physik
- Biologie
- Informatik
- Maschinenbau

Start:

01.06.2022

Duration:

6 Monate

Vorkenntnisse:

- digitale Schaltungstechn.
- analoge Schaltungstechn.
- SPICE Simulation
- Layout-Erfahrung
- Programmierkenntnisse
- elektr. Messtechnik

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Stand: 07.04.2022

Characterization of lateral GaN sensor structures for pressure applications

Motivation

GaN is a promising candidate to revolutionize electronics in multiple different fields of applications, the most prominent being high power and high frequency. But also sensing applications can benefit highly from GaN high electron mobility transistor (HEMT) technology. Due to the mechanically induced two-dimensional electron gas (2DEG), a high strain sensitivity is given. With appropriate placing on membranes a pressure sensor can be built featuring high output signals, high pressure sensitivity and a robustness against harsh environments. [1,2]

Scope of Work

Using a previously developed pressure test rig, the effects of pressure and stress on HEMT sensor elements on thin membranes are to be investigated. For this purpose, electrical measurements on on-wafer test structures (PCMs) are to be planned, prepared and carried out in the clean room and laboratory. With the help of a compact model [3,4] to describe the mechanical and electrical transistor properties, the measurement data will be analyzed and evaluated by simulation.

During the work, the following tasks are to be scientifically investigated and documented:

- ✓ Literature review focusing on stress and strain effects on GaN HEMTs
- ✓ Modeling of the test structures/sensor elements using Verilog-A
- ✓ Electrical Simulation of test structure behaviour
- ✓ Planning, preparation and execution of pressure experiments

References

- [1] X. Tan *et al.*: "High performance AlGaIn/GaN pressure sensor with a Wheatstone bridge circuit", in *Microelectronic Engineering* (Jan. 2020).
- [2] C. A. Chapin *et al.*: "InAlN/GaN high electron mobility micro-pressure sensors for high-temperature environments", in *Sensors and Actuators A: Physical* (Aug. 2017).
- [3] M. Moser *et al.*: "Model and Simulation of GaN-Based Pressure Sensors for High Temperature Applications - Part I: Physics Based Compact Modeling," in *IEEE Sensors Journal* (Sep. 2021).
- [4] M. Moser *et al.*: "Model and Simulation of GaN-Based Pressure Sensors for High Temperature Applications - Part II: Sensor Design and Simulation," in *IEEE Sensors Journal* (Sep. 2021).

Key Words

GaN, HEMT, Pressure, Sensors, Harsh environment, Device modelling, High sensitivity, Strain measurement.