Assignment of the Master's Thesis in the Program NanoEngineering (NE)

Topic: Development of InP-Based Layer Stacks for DHBTs Based on a Low-Temperature MOVPE Process

Task:

In the BHE field, InP-based double heterojunction bipolar transistors (DHBTs) for high-frequency applications are being studied based on a metal-organic vapor phase epitaxy (MOVPE) process. The performance of the DHBTs is significantly dependent on the chosen layer structure of the semiconductor stack. High n- and p-doping is required to achieve low contact resistances and transfer lengths, sharp material interfaces at the hetero- and pn-junctions, as well as precise control of the composition and layer thicknesses of the grown layers. Particularly, the growth of highly p-doped layers poses a significant challenge due to the low growth temperatures required and the sensitivity of the grown layer to subsequent growth steps.

The objective of this work is to investigate highly doped p-InGaAs base layers within a complete DHBT layer stack. In this context, the epitaxy parameters of the p-InGaAs layer itself are to be optimized, while also reducing the epitaxy temperature of the subsequent emitter and emitter-cap layers, all while maintaining a low n-contact resistance at the emitter. The grown layers will be investigated using HRXRD and atomic force microscopy. Furthermore, individual grown layers will be characterized using Hall and TLM methods, and complete HBT layer stacks will be further processed into large-area test transistors, optimizing for current gain and other electrical parameters such as contact resistance and leakage and recombination currents.