Assignment of the Bachelor's Thesis in the Program Electrical and Information Engineering

Topic: Investigation in THz RTD Oscillator Array and Concepts

Task:

In the terahertz (THz) range between 300 GHz and 4 THz, many novel applications are currently being developed: contactless material detection and characterization, ultrafast wireless data transmission of several Tbit/s, and detection of hidden objects in robotics and security applications. For these application areas, compact signal sources and detectors are needed that can efficiently provide high output power, detect with high sensitivity and low noise, and be produced in a compact, robust, and cost-effective manner.

In the Collaborative Research Center/Transregio 196 (SFB/TRR196) MARIE, we investigate the resonant tunneling diode (RTD), a device based on the quantum mechanical tunneling effect, capable of generating signals up to 2 THz to date. By improving the vertical structure of the semiconductor, the manufacturing processes of the devices, and their integration into arrays, we aim to enhance the performance of these THz components. A significant problem with these THz emitters is the use of a stabilization resistor, which considerably limits the achievable efficiencies.

In the context of this work, an oscillator array system will be developed based on existing single-oscillator designs. The coupling of the individual array elements will be investigated using 3D electromagnetic field simulation, and the array will be optimally designed concerning the spacing of the individual elements.

Optionally, the conditions for electronic beam steering will be examined. Once the conditions are sufficiently analyzed, initial design iterations for extending the oscillator chip can also be undertaken to enable electronic beam steering.