PROJECT ASSIGNMENT MPA19

IN THE MASTER'S PROGRAM NANOENGINEERING

Topic: Process development of passive RF components realized in microstrip technology

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 concealed 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.

An essential requirement for a range of applications is electronic beam steering. This can be conceptually achieved by applying an external subharmonic signal to an oscillator array. Previous antenna designs have struggled with the coupling efficiency of subharmonic signals. Novel and more complex antenna designs have already been investigated. The technological implementation of these new antenna concepts still needs to be realized. Accordingly, the work will focus on the development of the necessary passive components for RF circuits. Microstrip technology will be utilized through the use of benzocyclobutene (BCB). Previous works have covered small segments of this technology. Here, the previous developments aimed at realizing passive RF components will be consolidated and partially optimized.

This involves developing RF test and calibration structures for evaluating passive circuit elements such as capacitors and resistors. Furthermore, the technological implementation will be developed both in layout and processing. Optionally, 3D electromagnetic (EM) field simulations can be used to support and verify the design. The following specific tasks will be carried out:

- Top-down structuring (lithography, ICP-RIE, galvanics, PVD)
- Layout design
- On-wafer high-frequency measurements
- Optional: 3D EM field simulations