A 4.7-THz GaAs Schottky barrier diode mixer

Divya Jayasankar[1], Jan Stake[1]
[1] Chalmers University of Technology

There is a need to develop efficient frequency converters that can operate at frequencies close to 5 THz without any cryogenic cooling. In particular, missions with terahertz heterodyne instruments are planned to measure water and hydroxyl at 2.5 THz and atomic oxygen transitions at 4.7 THz. A high spectral resolution, stability, and low receiver noise are essential in detecting molecular transitions for scientific space and atmosphere exploration. For this purpose, GaAs Schottky diodes are the key elements for millimeter and submillimeter wave heterodyne receiver systems, especially when room temperature operation is desired.

Typical, state-of-the-art GaAs Schottky diode mixers exhibit a noise temperature (sensitivity) of 50 times the quantum limit (hf/k). However, beyond 2 THz, high-frequency loss and insufficient coupling of the radiation at supra-terahertz frequencies becomes exceptionally challenging, leaving a gap in the frequency range (2-5 THz) where further research is essential to solve the lack of efficient, room-temperature heterodyne mixers. In this work, submicron-size Schottky barrier diodes are integrated with matching circuits on an ultra-thin membrane (< 2 μm) to address these challenges, forming a low-loss suspended stripline circuit. Still, there are many challenges regarding the coupling of electromagnetic radiation and the assembly of such circuits. We have demonstrated efficient harmonic mixers at 3.5 THz and are exploring fundamental mixers at 3.5 and 4.7 THz. Progress toward demonstrating integrated semiconductor electronics for science applications up to 5 THz will be presented.