Terahertz Oscillators Integrated with Multiple Resonant Tunneling Diodes into Cavity Resonator

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Resonant tunneling diodes (RTDs) have shown potential as a high-power and compact terahertz (THz) source at room temperature. We achieved >1 mW at 0.6 THz using low loss cavity resonator and large RTDs. We also used a power combination method of two RTDs in cavity resonator to achieve 0.2 mW at 0.9 THz. In this work, we integrated multiple RTDs into cavity resonator and arranged into two long lines. The cavity resonator has small inductance and resistance, and then large area of RTDs can be integrated for high output power at high frequency. A large metal-insulator-metal (MIM) capacitor was integrated for the stable operation of RTDs. The top electrode on RTDs was large and thick for good heat dissipation to prevent heat destruction. The device was fabricated with a tri-layer resist process (ZEP/PMGI/PMMA) to form the three-dimension structure. We made the wet etching time of RTD mesa to be short for device uniformity, thus the total RTD size was almost decided by the RTD mesa electrodes. The oscillation spectrum proved the coherent oscillation of RTDs, and the received powers at the power meter were 0.3-0.5 mW in 0.6-0.8 THz. Cavity resonator and integration of multiple RTDs shown the expectation of high-power terahertz radiation, and high current density RTDs were intended to be used for further increase of output power.