P02

Dual Planar Inverted-F Antenna Resonant-Tunneling-Diode Oscillator

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Resonant-tunneling diodes (RTDs) are among the fastest electronic devices capable of generating electromagnetic radiation up to 2 THz [1,2]. Operating at room temperature, RTDs enable truly compact THz sources with significant potential for bringing THz technology into real-world applications [3,4].

Compact RTD oscillators that radiate above the semiconductor substrate are particularly advantageous, as they do not require bulky Si lenses (which are large relative to the oscillator itself) thereby enabling integration of THz sources into larger systems. While lenses can improve beam collimation, a comparable effect can be achieved through the use of RTD oscillator arrays.

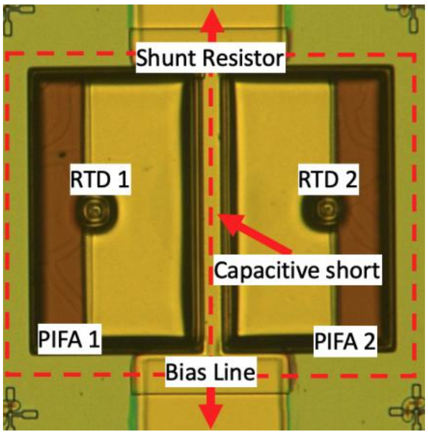

Fig. 1 Micrograph of the dual PIFA RTD oscillator.

We present a novel RTD oscillator geometry that achieves above-substrate radiation based on a planar inverted-F antenna (PIFA). PIFAs inherently exhibit tilted radiation patterns; however, by introducing a second RTD oscillator mirrored across the (capacitive) PIFA short, the combined radiation pattern becomes symmetrical above the substrate. This geometry is closely related to the double-RTD patch antenna [5], with the key distinction that the central section of the patch has a narrow dip, bringing it close to the ground plane. This effectively acts as a capacitive short circuit at high frequencies, transforming the structure into two back-to-back PIFAs. As with double-RTD patch antennas, two resonant modes can exist in this structure: a symmetric mode and an antisymmetric mode. The poorly radiating symmetric mode is shifted to lower frequencies by the capacitive short and suppressed by connecting a resistive shunt at the patch center, making the desired antisymmetric mode dominant. The resulting structure is shown in Fig. 1.

We fabricated and characterized these devices. The RTD oscillators operated at approximately 700 GHz with an output power of ~30 μW. Their emission spectra were free of parasitic spectral lines, confirming single-mode operation. The radiated power pattern was symmetric, with a maximum directed perpendicularly to the substrate. These devices represent a promising foundation for compact RTD oscillator arrays, enabling large-scale integration of THz sources.

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