Fabrication and Characterisation of RTDs and RTD-based Microwave Oscillators

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Introduction
Resonant Tunnelling Diode (RTD) is one type of negative resistance oscillators and is considered as a unique semiconductor device which exhibits negative differential resistance (NDR) up to terahertz (THz) frequencies. RTD has been widely studied because of its importance in nano-electronic science and technology and its potential applications in very high speed devices and circuits [1]. The very high switching speeds provided by RTD have also allowed for a variety of applications in wide-band secure communications systems and high-resolution radar and imaging systems for low visibility environments [2]. However, the RTD-based oscillator has a significant problem that is low output power which is due to the fact that the NDR exists from dc to THz range. To rectify these problems the area of the RTD, and hence, the output power are restricted [3].

Main Fabrication Steps For RTD

(1) Metal contact
Emitter
spacer
RTD
Collector
Buffer
Si: InP Substrate

(2) Metal contact
Emitter
RTD
Collector
Buffer
Si: InP Substrate

(3) Metal contact
Emitter
RTD
Collector
Buffer
Si: InP Substrate

(4) Metal contact
Emitter
RTD
Collector
Buffer
Si: InP Substrate

Schematic Circuit of the RTD Oscillator

Results

IV Characteristics of a (4x4) µm² RTD

Measured Output Spectrum of an RTD Oscillator

Conclusion

- Device characterisation has been made on a MMIC RTD oscillator with mesa size of (4x4) µm².
- The simulation result of this device has shown that the measured frequency was 33.2 GHz.
- The maximum output power for this device has been calculated to be 0.935 mW. Hence, having two RTDs combined will double this output power.

References: