

## Development of Small Size Terahertz Vacuum Sources in IECAS

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### Abstract

Terahertz frequencies are among the most under developed electromagnetic spectra, even though their potential applications are promising in biochemical sensing, imaging for medical and security applications, astrophysics and remote atmospheric monitoring, and high-bandwidth communications. Among their wide applications, the lightweight, low voltage and broadband sources of high-power coherent THz radiation are important for military radar, electronic countermeasure systems and communications. Vacuum electronic devices such as the traveling wave tube amplifier (TWTA), backward wave oscillator and extended interaction oscillator show great potential for applications at the frequency because of wide band and high power. At THz band, the most critical part of small size THz vacuum sources is the slow wave structure, which determines the output performances, such as the output power and signal band. In the millimeter and sub-millimeter wave vacuum devices, the various of SWSs including coupling cavity, disk-loaded, helix and complex CC are used. However, they are not suitable for the THz band, resulting from the difficulty of fabricating and integrating.

Folded waveguide (FW) or serpentine circuits, for example, have ~10:1 aspect ratio in the waveguide height dimension. This is much larger than the ideal for both machining, which is limited by the length of the tool shank with acceptable wobble; and photolithography, which is limited by defocusing and absorption of light as it penetrates into deep photoresist. These requirements are the topic of ongoing research in the vacuum electronics community, motivated by the continued interest in high power mm-THz sources. Consequently, there is a great interest in the study and development of FW SWS. For the satisfied with requirement of high speed communication and ViSAR, the TWT has been developed. Based on the FW, the small size THz vacuum devices are developed in China, including UESTC, IECAS CETC 12 and CAEP, etc. In this talk, we report the development of small size THz vacuum devices in IECAS.

At IECAS, three kinds THz devices have been developed, such as the 0.3THz EIO, the peak power exceeds 4W. The 0.1THz EIO generates the output power is larger than 12W. Moreover, the THz TWT has been developed through the small size electron gun, high strength focusing magnetic field and high frequency structure welding. It produces the output power exceeds 2W and the band width is larger than 5GHz. Now we are developing the continued wave TWT for the power exceeds 10W and signal band width larger than 5GHz.

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