STUDIES ON HIGH-POWER MILLIMETER-BAND TRAVELING WAVE TUBE AMPLIFIERS WITH MULTIPLE SHEET ELECTRON BEAMS

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ABSTRACT

Many applications, such as advanced telecommunication and radar systems, spectroscopy, biomedical research etc. require high-power, compact sources of sub-THz (0.1-0.3 THz) radiation. To improve output performance of vacuum-tube sub-THz amplifiers and oscillators, using of high-aspect-ratio sheet electron beam is very promising [1]. Multiple sheet beam offers an opportunity of further increase of the power level. Several multiple-sheet-beam traveling-wave tubes (TWTs) have been proposed [2]-[5]. In this paper, the results of design and development of two TWTs of such a kind are presented.

The first one is the TWT with multiple-tunnel meander-line slow-wave structure (SWS) and vertically arranged sheet beams [4]. The V-band SWS is designed and simulated. The TWT is driven by a 200-mA, 18-kV double sheet beam. Over 250 W average output power and 25-30-dB small-signal gain can be attained with 1-2 W input power at 68 GHz. The second one is the G-band TWT with a horizontally arranged multiple sheet beam interacting with a higher-order transverse mode of a staggered dual-grating SWS. An electron gun with three elliptic sheet beams is designed, simulated, and fabricated. Beam transportation in a solenoidal magnetic field is simulated and experimentally studied. The results of 3-D PIC modeling of beam-wave interaction are presented showing nearly 100-W output power and over 25-dB gain. Technology for microfabrication of the multiple-tunnel SWS is discussed.

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