

DESIGN AND STUDY OF THE LOW-VOLTAGE VIRCATOR UTILIZING SPENT ELECTRON BEAMS

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ABSTRACT

Spent electron beams at the exit from the interaction space of vacuum electron devices have a significant electron velocity spread and a electron beam residual grouping [1-3]. For the design and development of sources of broadband noise-like microwave oscillations with middle-power level (10-100 W) such spent electron beam could be useful. In this work we have carried out the study of the spent electron beam structure at the exit from the interaction space of TWT. The spectral (scatter of longitudinal electron velocities) and energy (current density in space-charge clusters) characteristics of spent electron beam were studied with help of dismountable vacuum setup [4]. Also an original scheme of a hybrid device consisting of a travelling wave tube (TWT) and a low-voltage vircator utilizing the spent electron beams at the exit from the interaction space of travelling-wave tube was proposed and studied. The proposed hybrid device consists of a TWT and a drift pipe located immediately after the output of energy (low-voltage vircator), with measuring probe and a collector, the potential of which can vary widely. The results of an experimental study of the parameters of broadband noise-like generation of a low-voltage vircator using a spent electron beam at the exit from the interaction space of a TWT were obtained. All elements of the hybrid device under study were placed in the same evacuation research chamber of a collapsible vacuum setup. We used a pulsed mode with pulse duration $\tau = 50 \mu\text{s}$ and duty cycle $Q = 1000$, accelerating voltage was 4.2 kV, beam current was 130 mA. The carried out experimental studies have shown that the spent electron beam based vircator has output integrated power of 60 W, electronic efficiency of 11% and operating frequency band of 1-3 GHz. So, the conducted studies have shown that utilizing of a spent electron beam with a large electron spread in longitudinal velocities leads to the generation of broadband noise-like oscillations. Also, it was shown that it is possible to implement several multifunctional systems in one hybrid device: a mono signal amplifier based on a TWT and an source of middle-power noise-like signals.

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References

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