DESIGN AND SIMULATION OF A 434 MHz INDUCTIVE OUTPUT TUBE

Dingyu Gu[1,2], Jiaqiu Tian[1,2], Hirwa Sakindi Alain [1,2], Shaomeng Wang[1,2], Zhanliang Wang[1,2], Qingying Yi[1,2], Yubin Gong[1,2]
[1] National Key Laboratory of Science and Technology on Vacuum Electronics, [2] Terahertz Radiation and Application Key Laboratory of Sichuan Province, Universityof Electronic Science and Technology of China, China
E-mail of corresponding author: ybgong@uestc.edu.cn
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ABSTRACT

The inductive output tube (IOT) is a linear-beam amplifier in which an RF grid-controlled electron gun directly bunches the beam, thereby enabling high-efficiency and high-linearity amplification [1]. This paper presents the design and simulation of the input cavity, electron gun, and output cavity of a 434 MHz IOT.
In this tube, electrons are emitted from a spherical cathode heated by an internal heater. A spoke-grid structure is employed, and the grid is placed in close proximity to the cathode, with a cathode–grid spacing of 0.7 mm. The RF signal is applied directly between the cathode and the grid, so that beam density modulation is established in the electron-gun region [2]. The grid is connected to the grounded cavity housing, and insulating ceramic spacers electrically isolate the housing from both the cathode and the grid.

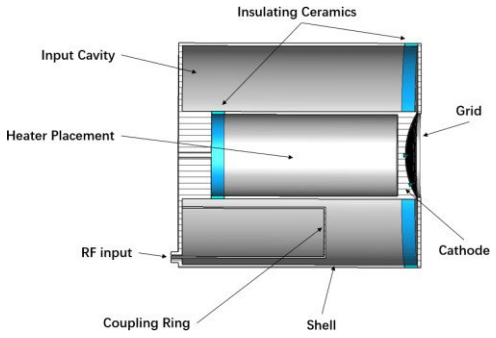

Fig. 1 Cross-section of the input cavity

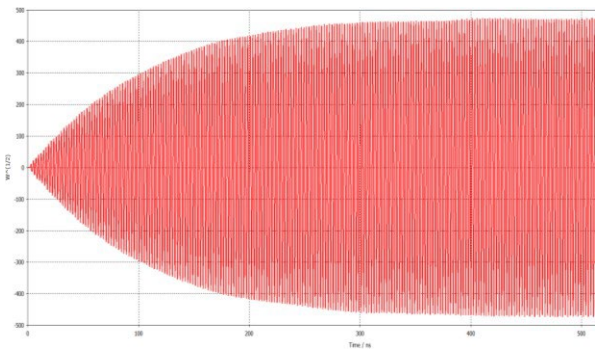

Fig. 2 RF output power

The device is simulated in CST Studio Suite 2024. Under operating conditions, with an input RF power of 1500 W, the peak cathode-to-grid RF voltage reaches 770 V, and the maximum beam current is 16 A. The cathode is biased at −60 kV, while the grid bias relative to the cathode is −300 V. In the absence of RF drive, the dc beam current is approximately 0.23 A. The density-modulated electron beam then passes through the grounded anode aperture and enters the output section. The output cavity adopts a re-entrant resonant-cavity structure, and the overall efficiency reaches 47%, with a peak output power of up to 227 kW.
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References

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