DESIGN AND ELECTROMAGNETIC ANALYSIS OF AN INPUT CAVITY FOR 648 MHz INDUCTIVE OUTPUT TUBES

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ABSTRACT

Inductive Output Tubes (IOTs) are widely used high-power RF amplifiers for accelerator and broadcast systems, where the input cavity must provide efficient electron bunching and stable RF coupling. This work presents the design and electromagnetic analysis of a 648 MHz input cavity with the anode attached to the shell, as shown in Fig. 1. The cavity incorporates key components including a loop coupler for input excitation, a 5 mm Al_2O_3 insulator, cathode, Window, focus electrode, and Grid, optimized using CST Studio Suite simulations.
The cavity was simulated under a cathode potential of -70 kV and a grid bias of 350 V, with a sinusoidal excitation at 648 MHz. Electromagnetic simulations reveal excellent impedance matching with a reflection coefficient S_{11} of -30.11 dB precisely at 648 MHz, indicating low return loss and effective power transfer into the cavity. Voltage monitors positioned at the cavity centre and 5 mm offset record peak values of 54.83 V and 59.02 V, respectively, suggesting a usable RF field distribution for beam modulation. Particle trajectory tracking in Fig. 3 shows current collision on the anode and grid. These results demonstrate the cavity's suitability for IOT applications, achieving high Q-factor potential and coupling efficiency suitable for multi-kW operation. Future work will integrate this input section with the output cavity for full device validation [1-2]. This work was Supported by National natural science foundation of China (Grant No.62527804).

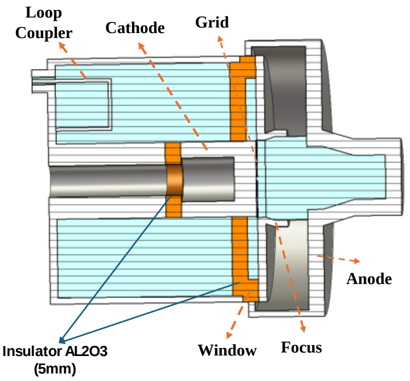

Fig.1. Proposed input cavity

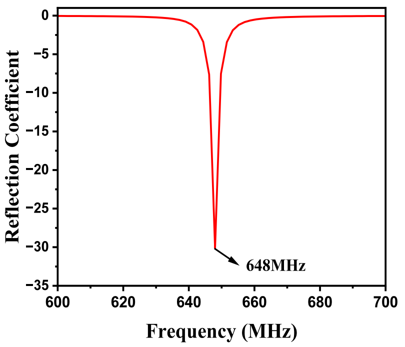

Fig.2. Reflection Coefficient at 648MHz

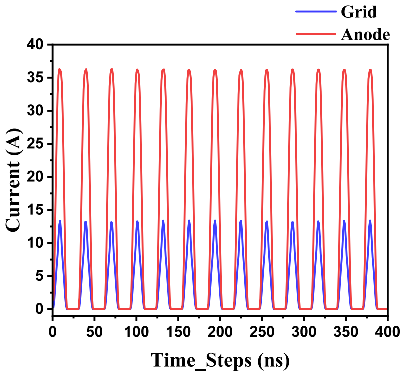

Fig.3. Current Collision on Anode & grid

References

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