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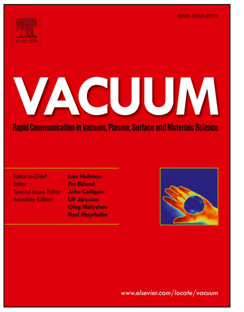

Reflection influence on the operation of a 0.42 THz second harmonic gyrotron with complex cavity

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Reflection Influence on the Operation of a 0.42 THz Second Harmonic Gyrotron with Complex Cavity[1]

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Abstract Since the average power of a 0.42 THz second harmonic gyrotron with complex cavity is small, the laser calorimeter AC2500H is adopted to measure the pulsed output power. However, the optimal spectral response of AC2500H is far from the operating frequency of the designed gyrotron. Thus the reflection on the laser calorimeter would be large, which would affect the mode competition in the designed gyrotron. In this paper, the influence of reflections from the laser calorimeter and output window is investigated by a multi-mode, time-dependent nonlinear code. From numerical simulation results, it is shown that the output power of the designed gyrotron is greatly decreased by the reflection from AC2500H although it doesn't cause excitations of competing modes. And it is found that when the reflection phase on the output window $\theta_{r,n,1}$ is $5\pi/11$, reflection magnitude on the laser calorimeter $\Gamma_{r,n,2}$ is 0.44 and the corresponding phase $\theta_{r,n,2}$ is $3\pi/7$, the variation of the calculated output power is very similar with the experimental result. Moreover, if the beam quality and Ohmic loss in the cavity wall are both considered, the calculated power can fit perfectly with the measured one.

Keywords Gyrotron・Complex Cavity・Reflections・Terahertz

1 Introduction

It is well known that gyrotron is a powerful microwave source in the millimeter to terahertz wave region, which fills a gap in the radiation spectrum between conventional microwave sources and infrared lasers [1-8]. Over the last few years, there are significant developments on the short-wave gyrotrons especially on THz gyrotrons for numerous applications such as spectroscopy, plasma diagnostics, communication and medicine [9-16]. For example, a gyrotron operating at 1.3 THz with an output power of 0.5 kW has been investigated at the Institute of Applied Physics (IAP) [17], Russia, which represents the highest frequency terahertz radiation generated by gyrotron. A 670 GHz gyrotron with record power and efficiency has been developed in the collaboration experiment of IAP and the University of Maryland [18]. Meanwhile a 388 GHz second harmonic gyrotron has been designed in Japan, which can generate about 62 kW terahertz radiation [19].

Recently, a 0.42 THz second harmonic gyrotron with complex cavity has been designed and experimentally tested in Terahertz Science and Technology Research Center (University of Electronic Science and Technology of China, UESTC) [20]. Since the average power of the designed gyrotron is small, the laser calorimeter AC2500H is experimentally adopted to measure the pulsed output power.

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