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亚太赫兹过模同轴切伦科夫发生器模式控制研究

摘要

在本文中，我们提出了一种亚太赫兹同轴过模切伦科夫产生器，其工作频率在 340 GHz 左右，器件过模比（直径与波长比值）约为 6.74。该器件设计的工作模式为准 TEM 模，由于较大的过模比，工作模式与相邻的角向非对称模式谐振特性接近，因而极易可能激励出角向非对称模式从而造成模式竞争，这会使得器件工作状态不够稳定。简要分析了模式竞争的产生原因，利用刻槽慢波结构显著改变了不同模式的谐振特性，并通过三维仿真验证了这种方法抑制模式竞争的有效性。在磁场约 6 T，二极管电压约 300 kV，二极管电流约 1.4 kA 的仿真条件下，器件最终产生了频率约 337 GHz，功率约 62 MW 的太赫兹波。

关键词

切伦科夫产生器、模式竞争、太赫兹

Abstract

This paper presents a sub-terahertz coaxial overmoded Cherenkov generator operating at approximately 340 GHz, with an overmoded ratio (diameter-to-wavelength ratio, D/λ) of about 6.74. The designed operating mode of the device is the quasi-TEM mode. Due to the large overmoded ratio, the resonant characteristics of the operating mode are close to those of the asymmetric modes, making it highly likely to excite the angular asymmetric modes and induces significant mode competition, which can lead to operational instability. By implementing a slotted slow-wave structure (SWS), the resonant characteristics of different modes are substantially altered. The effectiveness of this approach in suppressing mode competition is verified through 3D PIC simulations.Under the simulation conditions of a magnetic field of approximately 6 T, a diode voltage of about 300 kV, and a diode current of approximately 1.4 kA, the device ultimately generated terahertz waves with a frequency of about 337 GHz and a power of approximately 62 MW.

Keywords

Cherenkov generator, mode competition, terahertz

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