

### W波段多种槽加载折叠波导行波管的研究

彭博\*<sup>①②</sup> 何俊<sup>①</sup> 黄明光<sup>①</sup> 郝保良<sup>①</sup> 刘濮鲲<sup>①\*</sup>

<sup>①</sup>(中国科学院电子学研究所高功率微波技术国防科技创新实验室 北京 100190)

<sup>②</sup>(中国科学院研究生院 北京 100190)

### Investigation of W-band Diverse-shaped Groove-loaded Folded Waveguide Traveling-wave Tubes

Peng Bo<sup>①②</sup> He Jun<sup>①</sup> Huang Ming-guang<sup>①</sup> Hao Bao-liang<sup>①</sup> Liu Pu-kun<sup>①\*</sup>

<sup>①</sup>(Key Laboratory of Science and Technology Innovation for High Power Microwave, Institute of Electronics, Chinese Academy of Sciences, Beijing 100190, China)

<sup>②</sup>(Graduate University of Chinese Academy of Sciences, Beijing 100190, China)

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**摘要** 该文提出了3种槽加载折叠波导行波管慢波结构: 三角形、梯形和燕尾形槽加载折叠波导。分析比较了不同槽形状对慢波结构的色散特性和耦合阻抗的影响。利用粒子模拟的方法对W波段4种槽加载折叠波导行波管的非线性注-波相互作用进行了研究; 在相同的电子注参数和输入功率的条件下, 对输出功率、电子效率和增益等参量进行了比较。在多种槽加载结构中, 梯形槽加载折叠波导输出功率(255 W)和增益(37.1 dB)最大, 电子效率最高(10.7%); 燕尾形槽加载折叠波导达到饱和所需要的相互作用电路最短(64.2 mm); 三角形槽加载折叠波导的3 dB带宽最宽。

**关键词:** 行波管 槽加载折叠波导 高频特性 注-波相互作用 粒子模拟

**Abstract:** Three novel groove-loaded Folded Waveguide Slow-Wave Structures (FWSWS), which include triangle groove-loaded, trapezoid groove-loaded and swallow-tailed groove-loaded FWSWS, are analyzed for the purpose of improving beam-wave interaction. The high-frequency characteristics, including dispersion properties and interaction impedance, are investigated by numerical simulation, and the nonlinear large-signal performances of these Traveling Wave Tubes (TWTs), including output power, gain and electron efficiency, are also analyzed and compared by a 3-D particle-in-cell code MAGIC3D. Within the same beam parameters and input power, it is concluded from the comparison that: among these FWSWSs, the trapezoid groove-loaded FWSWS has the highest output power (255 W), saturated gain (37.1 dB), and electron efficiency (10.7%); The swallow-tailed groove-loaded FWSWS owns the shortest circuit length to obtain the saturated gain of which is 64.2 mm; the triangle groove-loaded FWSWS has the widest bandwidth.

**Keywords:** Traveling Wave Tube (TWT) Groove-loaded folded waveguide High frequency characteristics Beam-wave interaction Particle-in-cell simulation

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通讯作者: 彭博 Email: amazingpbcjf@126.com

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