Simulation Study of High Current Density Miniaturized Pseudospark Based Sheet Electron Beam Source

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Abstract

As the frequency increases, it becomes increasingly difficult (if not impossible) using conventional electron beam sources to focus and form high current density, high quality sheet electron beams through the small size interaction region of the high frequency vacuum electron devices (VEDs) [1]. This is because the sheet-electron beam exhibits disruptive diocotron instability due to E × B velocity shear effect during its propagation through a uniform axial magnetic field. Therefore, plasma based sheet-electron beams are quite useful in generating high power and high frequency microwave signals which eliminates the requirement of external magnetic field [2]. For efficient generation of high frequency microwave signals, geometrical design parameters of electron beam source play an important role. In this paper, design parameters of sheet beam plasma cathode electron gun have been optimized. The diameter (D) to length (L) ratio of hollow cathode as well as beam aspect ratio for efficient sheet electron beam generation has been analysed using COMSOL Multiphysics software in an argon gas environment. The D/L ratio has been varied from 0.1 to 10 while beam aspect ratio has been varied from 5:1 to 12:1 to analyse the beam parameter like beam accelerating potential, beam current density, etc. The results for optimized value of D/L and beam aspect ratio will be presented.

References:

[1]Intense Sheet Electron Beam Transport in a Uniform Solenoidal Magnetic Field, IEEE Trans. Elect. Dev.**56**, p 744-752, (2009)
[2] Analysis of Experimental Results on Pseudospark Discharge-Based Electron Beams with Simulation Model, IEEE Trans. Plasma Sci., **45**, p 405-411, (2017)

Paper Code:

Paper Code	CMP
Preferred mode of presentation	ORAL