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Title:Sheet Electron-Beam Transport Analysis Through Closed Short PCM for Vacuum Subterahertz Devices

Authors:Panda, P.C. (1); Srivastava, V. (1); Vohra, A. (2)

Author affiliation:(1) Central Electron. Eng. Res. Inst., Council of Sci. & Ind. Res. (CSIR), Pilani, India; (2) Dept. of Electron. Sci., Kurukshetra Univ., Kurukshetra, India

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Abstract:Closed short periodic cusped magnets consisting of miniature permanent magnets of material NdFeB 35H have been designed for transporting the sheet electron beam suitable for vacuum subterahertz devices. The aspect ratio of the magnetic tunnel is selected as 2 to provide proper focusing force in both horizontal and vertical directions. Numerical analysis performed by CST Particle Studio shows that both the peak value of the magnetic field and the nature of variation of the transverse components of the magnetic field along their respective transverse directions depend on the transverse thickness of the magnets. The peak value of the magnetic field increases by increasing the transverse thickness of the magnets. When the magnetic period, axial thickness, and transverse thickness of the magnets are 3.4, 1.3, and 8 mm, respectively, the simulated peak value of the magnetic field is 0.131 T. Under the tunnel of the aforementioned structure, the sheet electron beam of size 3 mm (width) &times; 0.15 mm (height), current density 100 A/cm<sup>2</sup>, and kinetic energy 20 keV transports up to a 60-mm distance without any significant instability through the drift tube of tunnel size 5 mm (width) &times; 0.3 mm (height). When the magnetic period, axial thickness, and transverse thickness of the magnets are 2.8, 1, and 8 mm, respectively, the simulated peak value of the magnetic field is 0.181 T. Under the tunnel of this structure, the sheet electron beam of size 2 mm (width) &times; 0.1 mm (height), current density 120 A/cm<sup>2</sup>, and kinetic energy 20 keV transports up to a 60-mm distance without any significant instability through the drift tube of tunnel size 3 mm (width) &times; 0.2 mm (height).

Number of references:12

Controlled terms:beam handling equipment - boron alloys - current density - electron beams - electron optics - ferromagnetic materials - iron alloys - neodymium alloys - numerical analysis - permanent magnets - terahertz wave devices

Uncontrolled terms:sheet electron beam transport analysis - closed short PCM - vacuum

subterahertz device - closed short periodic cusped magnet - miniature permanent magnet - magnetic tunnel - numerical analysis - CST Particle Studio - magnetic field transverse component - magnet transverse thickness - current density - kinetic energy - tunnel size - NdFeB 35H - size 3.4 mm - size 1.3 mm - size 8 mm - electron volt energy 20 keV - magnetic flux density 0.181 T - NdFeB

Classification codes:A0777 Particle beam production and handling; targets - A4180D Electron beams and electron optics - B7410B Particle beam handling and diagnostics - B3110C Ferromagnetic materials - B3120E Permanent magnets - B5150 Moving charges in electric and magnetic fields

Numerical data indexing:size 3.4E-03 m;size 1.3E-03 m;size 8.0E-03 m;electron volt energy 2.0E+04 eV;magnetic flux density 1.81E-01 T

Chemical indexing:NdFeB/ss Fe/ss Nd/ss B/ss

Treatment:Practical (PRA); Experimental (EXP)

Discipline:Physics (A); Electrical/Electronic engineering (B)

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