Annular Electron Beam Generation Using a Ferroelectric Cathode

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***Abstract*—In this paper, we report on the emission of electrons from a ferroelectric cathode in a coaxial gun geometry. The electrons are emitted from the inner conductor of the coaxial system and are accelerated radially. An axial magnetic field causes the formation of an azimuthal annular electron flow. The electrostatic potential distribution then leads to the ejection of the annular beam from the anode–cathode region into the drift space. A beam energy of up to 50 keV and an electron current of up to 250 A is typical in this proof of principle experiment. The Hull cutoff condition is found to considerably underestimate the magnetic field required to insulate the radial electron current flow in the diode. The results obtained are consistent with earlier data showing that the behavior of the ferroelectric is closely coupled to the changing state of the ferroelectric.**

***Index Terms*—Ferroelectric cathode, magnetron.**

the polarization fields of the medium from the vacuum of the gun, and field emission from the triple points at the junction between grids on the ceramic surface, the ceramic itself, and the vacuum region. Both processes are, however, controlled by a rapidly changing submicrosecond voltage pulse applied across the ferroelectric as opposed, for example, to the usual field emission, which is controlled by the voltage applied to the anode of the gun, i.e., the electron dynamics are closely coupled to the domain dynamics and internal fields of the ferroelectric sample. During the electron emission pulse, it is expected that the high current densities obtained by emission from triple points will lead to material volatalization, ionization, and, finally, plasma closure within the gun. These processes were described many years ago by Bugaev *et al.* [6] and an extension of that paper applied more recently to ferro-