High-Power Microwave Generation Using A Ferroelectric Cathode Electron Gun

Yasushi Hayashi, *Member, IEEE*, X. Song, J. D. Ivers, Donald D. Flechtner, *Member, IEEE*, J. A. Nation, *Fellow, IEEE*, and Levi Schächter, *Senior Member, IEEE*

***Abstract*—A two-stage 500 kV 200-A ferroelectric electron gun has been designed, fabricated, tested, and used in a high power microwave amplifier experiment. We report on the operational characteristics of the gun including measurements of the beam dynamics. The optimum conditions for application of the trigger and its timing are also reported. Faraday cup measurement shows that the beam radius is 4.1 mm in good agreement with simulation. The gun is designed for use in traveling-wave tube amplifiers, and testing of an X-band amplifier driven by the gun is reported. A peak output power of 5.9 MW has been observed from a single stage amplifier driven by a 100 A, 450 kV beam. This corresponds to energy converging efficiency of 13.1% and is the first observation of high power ($\sim$MW) microwave generation using the beam generated from a ferroelectric cathode.**

***Index Terms*—Electron beams, electron guns, ferroelectric cathodes, microwave amplification, traveling-wave tubes.**

A single stage X-band traveling-wave tube amplifier has been designed and constructed for use with the gun. In these experiments, microwave amplification of order 30 dB has been achieved and output powers of several megawatts have been observed. This is the first observation of high-power microwave generation from a beam generated using a ferroelectric cathode.

In the following sections, we present results extending our previously reported study of ferroelectric emission in a diode to electron beam generation at beam energies of up to 550 keV [5], and demonstrate its use in a high power microwave (HPM) amplifier experiment. The beam quality has been determined by measurements of the beam emittance and confirmed by the observation of microwave amplification in X-band.