Contribution ID: **1079**

Type: **Oral**

Experimental, analytical and computational studies of electron gun grid heating

Monday, 24 June 2019 16:30 (15 minutes)

Electron guns are at the heart of various vacuum tubes used for applications that include communications, RF accelerators, industrial nondestructive inspection and medical imaging. An electron gun is typically comprised of the electron emitter and electrodes/electron gun elements used for beam extraction, control and focusing. A critical component of an electron gun for linear vacuum tubes is the mesh grid, which is typically placed at a certain distance from the emitting surface for beam extraction and control. For microwave tubes, the grid electrode serves the important function of beam pre-bunching. A linear microwave tube benefits from having a pre-bunched beam before entering the microwave circuit by having increased interaction efficiency, considerable reduction in vacuum tube length, and enhanced output power. Modulating the voltage on the grid electrode with a hundred microns of the emitting surface pre-bunches the electron beam and intercepts a fraction of the incident electron beam. Grid deformation, grid heating, secondary emission from the grid, and precise control of grid position and placement during electron gun assembly when designing a mesh grid-based electron gun.

Understanding and avoiding mesh grid overheating in electron guns is critical since it may critically impact electron beam optics. This work uses experiments, analytic calculations from first principles and 3D finite element (FE) simulations to assess electron gun mesh grid heating. Analytic and FE studies recover the experimental trends; in experiments, we have determined electron beam mesh grid intercepted power that causes grid destruction using a dispenser cathode as the electron emitter and a Mo grid placed 250 microns away. 3D FE simulations accounting for temperature-dependent material properties and the analytic theory predict mesh grid heating in reasonable agreement with experimental results.

Primary authors: CROSS, Andrew (GE Global Research); FRUTSCHY, Kristopher (GE Global Research); GARNER, Allen (Purdue University); NECULAES, Vasile (GE)

Presenter: GARNER, Allen (Purdue University)

Session Classification: 3.1 Plasma, Ion, and Electron Sources I

Track Classification: 3.1 Plasma, Ion and Electron Sources