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Simulations of High-Intensity, Thermionic Electron Guns for Electron Beam Thermal Processing Including Effects of Space Charge Compensation

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Abstract : Electron guns have a key function in a series of thermal processes, like EB (electron beam) melting, evaporation or welding. These techniques need a high-intensity continuous electron beam that defocuses itself due to high space charge forces. A proper beam transport throughout the magnetic focusing system can be ensured by a space charge compensation via residual gas ions. The different pressure stages in the EB gun cause various degrees of compensation. A numerical model was installed to simulate realistic charge distributions within the beam by using CST-Particle Studio code. We will present current status of beam dynamic simulations. This contribution will focus on the creation of space charge ions and their influence on beam and gun components. Furthermore, the beam transport in the gun will be shown for different beam parameters. The electron source allows to produce beams with currents of 3 A to 15 A and energies of 40 keV to 45 keV.

Keywords : beam dynamic simulation, space charge compensation, thermionic electron source, EB melting, EB thermal processing
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