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Investigation and optimization of electron gun beam, based on simulation and experimental results

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Abstract

Nowadays, by expanding the application of thin layers in industry and medical sciences, their fabrication methods have also received attention. One of those methods is the vaporizing material method with the help of an electron gun. The most important part in the electron gun is the electron optic, which is responsible for producing and accelerating electrons, so that it becomes possible to vaporize refractory materials in a shorter period of time by better modifying and controlling the electron beam (the shape and diameter of the electron beam) at the target location. The reduction and control of the beam diameter in this evaporation source depends on various parameters such as device geometry, magnetic field intensity, electric power, etc. Therefore, in this research, the effect of those parameters was investigated by conducting experiments and using finite element and modeling software. The simulation results revealed that the effect of the effective parameters on the beam diameter can be predicted to a good extent, so that the diameter of the electron beam decreases by changing the geometrical shape, size and displacement of the output beam components. Then, the new electron gun, compared to the existing prototype, is optimized by applying these changes in the construction of the device and conducting experiments, and its beam diameter is reduced by 40% to be more focused.

Keywords: electron gun, beam, optics, simulation.

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