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Joule heating of an emitter on the cathode surface by field electron emission current with account of the non-isolation of the vertex

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The physical nature of the high-voltage breakdown in vacuum that can occur in particle accelerators, particularly in the CLIC (Compact LInear Collider, CERN), is quite complex and, despite numerous studies, a complete theory of the process does not yet exist.

The emission of electrons from the cathode surface is usually local, due to the existence of tips on the surface. Increasing the voltage in the vacuum gap leads to an increase in the density of the field emission current and, accordingly, to the heating of the emitter due to Joule energy dissipation. It is usually assumed that heating the local area leads to breakdown. In this paper, we use the hypothesis that the breakdown occurs due to the heating of the cathode tips by the field electron emission current.

Therefore, we consider the nonstationary problem of the thermal conductivity of a nanoemitter on the surface of a massive metal cathode when the field emission current passes through it. The cases of different values of the applied electric field strength are considered, the influence of temperature and dimensional effects, as well as the sublimation process are considered.

Topic

Field Emission

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