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ELECTROSTATIC CUMULATION: A CONVINIENT RESEARCH INSTRUMENT TO OBTAIN MBAR PRESSURES IN SOLIDS

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Magnetic cumulation is not the sole phenomenon capable to produce high-dense electron beams in relativistic vacuum diodes. Electrostatic cumulation phenomenon also exists and reveals at much lower accelerating voltages in relativistic diodes with a ring-type cathode [1, 2]. A distinctive feature of electrostatic cumulation is quite low spread of electron energies in the produced high-dense beam. These circumstances give advantages to electrostatic cumulation phenomenon if the latter is considered as a convenient research instrument for high energy density physics.

Electrostatic cumulation was revealed during modeling of high-current accelerators [3] and confirmed experimentally [2]. The qualitative picture of electrostatic cumulation can be described as follows. In a relativistic vacuum diode, electron emission is most intense from the cathode's edges (Fig. 1). Let us consider electrons emitted from the inner edge. The Coulomb repulsion causes the charged particles to rush to the region free from the beam. As a result, the accelerated motion of electrons toward the anode comes alongside the radial motion to the cathode's symmetry axis. As a result, the high-current beam density increases multifold on the axis as compared to the average current density in the cathode-anode gap.

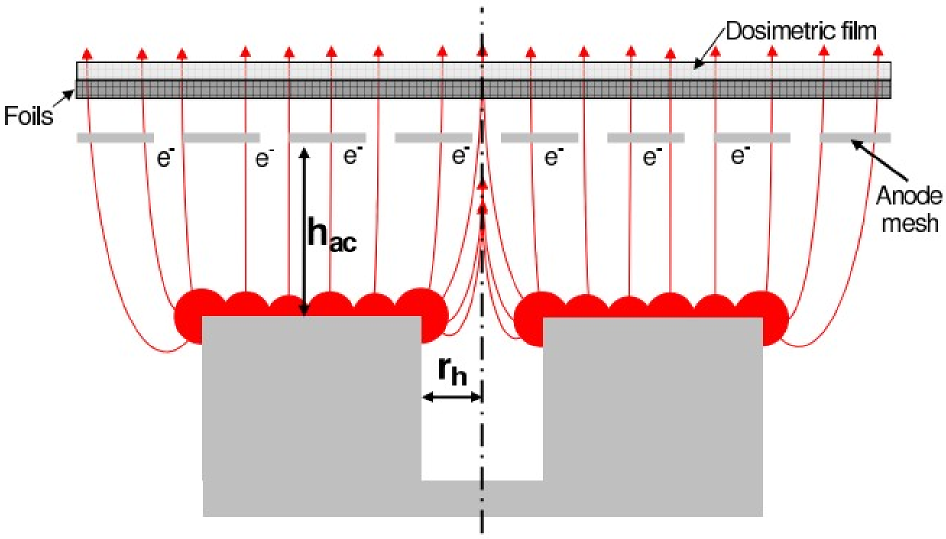

Fig.1. Electrostatic cumulation.

Electrostatically cumulated electron beam with an energy of 400 keV and a cross section of $3\cdot10^{-4}$ cm^2 is capable of delivering of 25 kJ/cm^3 of specific energy to a tungsten plate [4]. An increase in the accelerating potential up to several megavolts makes it possible to rise delivered specific energy by 1–2 orders of magnitude.

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