DISTRIBUTION OF THE ENERGY DENSITY OF A PULSED ION BEAM

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The paper investigates distribution of the energy density over the cross section of a pulsed ion beam formed by a diode with passive anode in magnetically insulation mode.

Studies of three types of diodes, in a mode of external magnetic insulation (BIPPAB-450 accelerator, 400 kV, 80 ns) and self-insulation (TEMP-4M accelerator, 250 kV, 120 ns) have been performed. Studied diodes utilize different methods for anode plasma formation: dielectric surface breakdown followed by ionization by accelerated electrons (BIPPAB-450 accelerator, a barrel diode), and explosive electron emission (strip planar and spiral diodes in TEMP-4M accelerator). To analyze the energy density of the ion beam we used infrared imaging diagnostics with a spatial resolution of 1–2 mm.

The calculation of the energy density using the 1-D Child-Langmuir equation was performed. We observed effective formation of plasma layer on the working surface of the anode for all investigated diodes. It was found that the magnetic induction in the A-C gap of the barrel diode is much higher than the critical value and the experimental values of energy density coincide with the calculation for carbon ions and the energy density distribution is uniform over the cross section. By reducing the magnetic induction in the A-C gap to a value close to the critical, the ion beam energy density is 3–6 times higher than the calculated by 1-D Child-Langmuir limit and the energy density of the ion beam is non-uniform.

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