THE APPLICATION OF SHADOW METHOD FOR ELECTRON CONCENTRATION MEASUREMENTS IN COLLIDING FLOWS OF EROSION PLASMA

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ABSTRACT: The purpose of this work is research of qausi-stationary plasma formations with high energy content for practical applications in high thermal physics and diagnostic of materials under extreme conditions.

Investigated interaction process is based on high-current discharges of plasma accelerators of erosion type in vacuum. An end erosion plasma accelerator is a system of two coaxial copper electrodes separated by a caprolone insulator. An outer copper electrode is shaped as a convergent nozzle. The accelerator was mounted in a vacuum chamber by means of copper co-axial current supply. Visualization, photography and shadow investigation were made through special vacuum chamber optical windows. Each accelerator was put into operation by discharging a capacitor battery.

Shadowgraphs of colliding plasma flows were made using knife and slit method. As a light source a specially made argon flash lamp was used. A lamp operating voltage is 20 kV, light pulse duration is 3 μs. Averaged electron concentration in the interaction area was calculated from intensity distribution in shadowgraphs. In order to perform a correct shadow display a contribution of plasma intrinsic emission to the shadow pattern must be eliminated. To this effect a light filter system with transmission peak at 547 nm was mounted before the CCD-camera. At this wavelength the relative intensity in plasma spectrum is low while in argon lamp spectrum it is near-maximum.

A shadow pictures data processing revealed that the localized stable spherical plasma structure forms in a collision zone by 15 μs from accelerators operation start. An electron concentration inside this structure reaches a maximum value $8{,}4 \cdot 10^{16}$ cm^{-3} between 15 and 20 μs from accelerators operation start, at this moment a discharge current tops. After 20 μs electron concentration decreases and plasma structure downsizing occurs. The results of electron concentration calculation are in good agreement with data obtained by spectral method.

References

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