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EXPERIMENTAL INVESTIGATION OF PLASMA FLOW CHARACTERISTICS OF A QUASI-STATIONARY HIGH-CURRENT PLASMA ACCELERATOR *)

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One of the promising areas of application of QSPA-type installations is the development of powerful electric-reactive plasma rocket engines based on it [1]. As part of the work in this area, the tasks of efficient use of plasma-forming gas and energy invested in the discharge, as well as reducing erosion of the electrode system of the plasma accelerator, are relevant. The study of the spatiotemporal characteristics of the discharge and plasma flow generated by the QSPA will optimize the geometry and operating modes of the QSPA in order to form more homogeneous plasma flows, ensure stable operation and reduce the role of dissipative processes.

Experimental studies were carried out on a quasi-stationary high-current plasma accelerator generating a supersign flow of hydrogen plasma with an energy content of 125 kJ and a duration of 1 ms. The spatiotemporal structure of discharge radiation was obtained using high-speed video recording for the first time. During the plasma pulse, the length of the glow region in the discharge gap ranges from 2 to 7 cm.

It is shown that a radial inhomogeneity of the plasma flux glow is observed at the end of the accelerator electrode system. There is a divertor glow area measuring 8.5 cm in the longitudinal direction and 2.7 cm in the radial direction. It is shown that this region is characterized by the presence of impurities in the materials of the electrode system and increased values of electron density. The maximum value of the electron concentration in this region, obtained based on the measurement of the Stark broadening of the H_β line, is $(4 \pm 0.7) \cdot 10^{16} cm^{-3}$. This value is 4 times higher than the value of $n_e = (1 \pm 0.2) \cdot 10^{16}\ cm^{-3}$ obtained outside this area using the same method.

In [2], based on high-speed video recording, it was shown that the plasma flow outside the region of radial inhomogeneity in the longitudinal direction represents dark and light regions alternating in time. In this paper, it is shown that these periodic changes are associated with the directional movement of the plasma flow.

The time dependences of the electron concentration were measured simultaneously using two independent methods. The first one is based on the measurement of the Stark broadening of H_β. As the second, heterodyne interferometry was used. From a comparison of the concentration values obtained using these methods, it follows that the values of n_e of the plasma flow at a distance of 90 cm from the output of the electrode system lie in the range from $3 \cdot 10^{15}$ to $7 \cdot 10^{15}\ cm^{-3}$.

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