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CORPUSCULAR AND PROBE MEASUREMENTS OF PLASMA FLOW PARAMETERS IN A MAGNETIC NOZZLE ON THE E-1 DEVICE *)

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Plasma flow parameters on the BPRD-100 experimental setup on the E- 1 device in the National Research Center “Kurchatov Institute” are currently being studied.

BPRD-100 is a laboratory prototype of an electrodeless plasma rocket engine [1] with a target high-frequency discharge power up to 100 kW. These engines can create high exhaust velocity up to 50 km/s with remarkable for electric propulsion propellant mass flow rate of 50 mg/s. The power input into the plasma flow is formed by two types of discharge [2,3]: a helicon discharge at the frequency of 13.56 MHz with 30 kW maximum power and ion-cyclotron resonant heating at the frequency of 0.5 MHz with 70 kW maximum power.

Experiments with helium plasma with a total RF power up to 35 kW in a magnetic field up to 0.2 T have already begun in order to test the technical systems of the layout.

In order to optimize the deposition of high-frequency power to the plasma flow, certain local and integral plasma flow parameters are required. Due to the high density of the power flow through the magnetized plasma channel, all measurements of mentioned parameters are carried out in the area of the diverging magnetic field, which acts as a magnetic nozzle.

Diagnostic tools such as a momentum flux sensor, Faraday probe, Mach probe, an array of flat probes and retarding potential analyzers have been developed and put into operation for these purposes. The above mentioned corpuscular diagnostic systems are installed on the positioning system of the E-1 vacuum chamber, allowing measurements of the spatial distributions of plasma parameters.

This paper gives description of developed diagnostic tools, as well as the results of processing and analysis of obtained experimental data, and the possibilities for further studies of the main engine parameters such as thrust, specific impulse, propellant utilization and efficiency of converting RF power into flow power.

References

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