

Plasma heating in the PLM-M device

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In the PLM-M device, research is being carried out on the interaction of stationary plasma with the surface of heat-protective materials of a thermonuclear reactor and research on the development of technology for creating a plasma engine. One of the tasks being solved is to create a plasma of high electron density and temperature (10–15 eV) in a weak magnetic field (0.03 T) and maintain it by exciting helicon waves at frequencies of 13.56 and 27.12 MHz. Plasma is generated in the process of stepwise ionization by electron impact of atoms of the plasma-forming gas (helium, hydrogen). The electron current density required for the stepwise ionization process is achieved through thermionic emission when the tantalum cathode is heated to a temperature of 2.3 kK. To heat the plasma, an rf generator with a power of up to 5 kW and a cooled antenna installed inside the vacuum chamber in the helicon heating unit at operating frequencies of 13.56 and 27.12 MHz are used. As a result, the plasma discharge is maintained for several hours (8 h or more). Comparative studies of the efficiency of rf plasma heating based on a cooled helicon antenna with plasma-forming working gases—helium and argon with a small addition of hydrogen—have been carried out. The experiments measured the efficiency of energy transfer to plasma over a wide range of densities at different magnetic field values. Plasma parameters were measured using optical emission spectroscopy and electrical probes.

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