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QUASISTATIONARY REGIME OF THE HELICON DISCHARGE PLASMA GENERATION *)

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Plasma-material interaction (PMI) studies are required for the development of thermonuclear reactor and researching of the appropriate materials for first wall. The first wall problem requires simulation of plasma loads in linear plasma devices (LPD). The plasma source for LPD must comply the criteria of efficiency of the input energy in relation to the generated plasma flow, stationarity of the plasma generation mode, as well as plasma purity. These criteria indicated the prospects of using high-frequency electrodeless plasma generation systems as the most effective plasma sources with the ability to create plasma with an ion flow in the range of 10^{22} - 10^{23} $m^{-2}s^{-1}$. In particular, helicon plasma sources are increasingly used in materials science facilities with high [1] and medium power flux to the target [2], [3].

A helicon source, as a rule, consists of a magnetic system, an RF excitation system including a RF generator, a matching system and an RF antenna, as well as a discharge chamber made of dielectric material and outer DC magnetic system. One of the main problems limiting the steady state regime of the helicon source is the overheating of the dielectric discharge chamber during plasma generation resulting in its erosion and sputtering of the wall material into plasma. This work is devoted to the study of the interaction of plasma with the discharge chamber walls, as well as methods for increasing the duration of plasma generation.

The studies were carried out on a helicon device developed at the Institute of Nuclear Physics SB RAS [4, 5]. The dependence of the heating of the chamber on various discharge parameters as input power (5-25 kW), magnetic field (170-600 G) and plasma pulse duration (tens of seconds) was studied. An increase in the heating temperature of the chamber was discovered with an increase in the voltage on the RF antenna, which is proportional to the input power, and temperature maxima were found located in places of the highest electric field strength of the antenna. In the experiments no influence of the magnetic force lines geometry and plasma density on the heating of the chamber was found. Various methods for reducing the overheating of the chamber were studied (Faraday internal shield, additional insulator between the antenna and the chamber). In addition, a double water-cooled wall design has been proposed.

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