STUDIES OF PLASMA PARAMETERS OF A MICROWAVE PULSED-PERIODIC RESONANT DISCHARGE

Andreev V.V., Korneeva M.A.

Peoples’ Friendship University of Russia, Moscow, Russia, [aitc@list.ru](mailto:aitc@list.ru)

The results of a study of the parameters of an argon plasma of a pulsed microwave resonance microwave discharge created in a mirror magnetic trap are presented.

The experimental setup is an axisymmetric system with a cylindrical TE111 cavity immersed in the magnetic mirror field created by permanent magnets with a closed magnetic contour. The magnetic field induction at the trap minimum was 875 G. Microwaves of a 2.45 GHz magnetron were used and launched into the cavity through a rectangular waveguide with diffractive coupling. The quality factor of the cavity with the quartz chamber reaches 600. The waveguide is equipped with Vegatel DC900/2500-15 directional couplers, which allow one to monitor the magnitude of the incident and reflected microwave powers in the working regimes. The standing wave ratio (SWR) of the designed microwave system does not exceed 2. The modulator scheme allows one to vary the duration and repetition rate of rectangular heating pulses in wide ranges; namely, the pulse duration was varied from 0.07 to 5.4 ms, while the pause, from 0.2 to 7.1 ms (the pulse ratio, from 5 to 10). The discharge is generated in a cylindrical quartz bulb aligned with the cavity axis. The background pressure in the bulb is 1 х 10–5 Torr. The gas was supplied via a CHA-2 piezoelectric leak, and argon was used as a plasma producing gas. The operating pressure was varied within the limits of 5·10–3–10 Torr.

The detection of the behavior of the integral (wavelength) light in time was carried out by a high-speed photodetector (SD3421 / 5421, 500–1100 nm, time constant 15 ns). The detector has a linear dependence of the output voltage on the radiation intensity in the region of spectral sensitivity. The detector docked to a vacuum-tight window with UV glass and recorded radiation in the direction perpendicular to the side surface of the resonator. The field of view of the detector covered almost the entire volume of the quartz bulb. The signal from the detector was fed to a digital oscilloscope. Illumination was recorded using a certified TKA-PKM C051 lux meter (380–760 nm, range from 10 to 200,000 lux, ± 8.0% error). The photometric head in the measurement process was installed similarly to a photodetector. Experimentally determined ranges of changes in the operating parameters of maintaining the discharge to ensure the effective absorption of the energy of the incident microwave wave up to 95%. The effect of a “secondary” ignition was observed, accompanied by a sharp (by two orders of magnitude) increase in the intensity of the luminous flux, and a hysteresis phenomenon was observed in the photometric characteristics in the transition pressure range.

This work was supported in part by the Russian Foundation for Basic Research (project no. 16-02-00640/16) and the Ministry of Education and Science of the Russian Federation (agreement nos.3.2223.2017)