Features of maintaining resonance microwave discharge in the forvacuum pressure range [[1]](#footnote-1)\*)

DOI: 10.34854/ICPAF.2020.47.1.110

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Microwave resonance discharge in the magnetoactive plasma find wide applications in the different vacuum-plasma technologies. Well-known method of effective heating of plasma in low-pressure range, about 10–5 Torr–10–4 Torr, is classical electron cyclotron resonant (ECR). Meanwhile, when the pressure increases, that was shown earlier [1], the plasma density becomes over-dense, which leads to the creation of a dense, highly nonequilibrium plasma with a high degree of ionization. Such plasma is of interest from the point of view of creation of radiation sources with different character of a spectrum in wide spectral ranges on the basis of use of atomic and molecular spectra of various substances and their compounds.

Experimental studies were carried out on the set-up where the plasma was formed in a quartz cylindrical volume coaxial with a microwave resonator (2.45 GHz, TE111, input power from 50 to 250 W) placed in a magnetic field of a mirror trap configuration of permanent magnets (SmCo5, 875 G in the geometric center of the trap) with a magnetic closure system. Set-up worked on pulse operation mode with variable duration and frequency of repetition rate. The background pressure in volume was about 1·10–5 Torr, the working gas - Argon.

Probe measurements showed that at a pressure of 5·10-2 Torr, the plasma density achieved over-dense range (~1·1011 cm-3) for the operating frequency and an electron temperature of ~5 eV [2]. It was noted that absorbed power is rapidly increase from 75-80% (pressure-10-5 Torr-10-4 Torr ) to 90-95% (pressure 10-3 Torr-10 Torr) and there is also a corresponding increase in the luminous flux generated by the discharge from ~10 lx to 400-500 lx at an input power of 250 W. In addition, regime of discharge with over-dense plasma is also characterized by decrease of the breakdown time from 12 microseconds to 1 microsecond [3]. The skin depth for plasma of such regime. is of ~3.3 cm, which is comparable with the height of the volume that provides effective heating of the plasma.

It’s need to point out, that at pressures 1·10-2-1·10-1 Torr was observed the hysteresis behavior of photometric characteristics of the discharge and the magnitude of the absorbed microwave power. The intensity of radiation generated by the discharge plasma is greater when the gas is injected than when it is pumped out. A similar behavior is observed when analyzing the level of absorbed power in the discharge. At the same time, there were no discrepancies in these characteristics outside the transition range of pressure values.

Work is done with financial support of RFBR grant № 18-29-21041.

References

1. В.В. Андреев, И.А. Волдинер, М.А. Корнеева // Прикладная физика – 2016, №2, 42-47
2. Andreev V.V., Vasileska I., Korneeva M.A.// Plasma Phys. Rep. – 2016, Vol. 42, №.7, 699-702
3. Асанина С.Г., Андреев В.В., Василеска И, Корнеева М.А.//Современные проблемы физики и технологий. VII-я Международная научная школа-конференция – НИЯУ МИФИ, 2018 – 48-49.
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/Lt/ru/EL-Asanina.docx) [↑](#footnote-ref-1)