power Absorption and wave structure OBSERVED IN THE INDUCTIVE RF PLASMA SOURCE WITH EXTERNAL MAGNETIC FIELD

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The present work is dedicated to the studying of efficiency of RF power absorption by plasma and the structure of the exited waves in inductive RF plasma sources (PS) with diameter 20 cm and length 20, 32 and 52 cm with the external magnetic field 10–65 G. It is possible to generate helicons and Trivelpice-Gould waves at these indicated values of magnetic fields. The measurements were carried out in argon within the range of pressure 0.1–2.3 mTorr and RF generator power 200‑800 W.

The experiments have shown that the RF power input efficiency depends non-monotonic on the induction of external magnetic field B at the values of pressure less than 1 mTorr, more exactly there is local maximum at the magnetic fields values В\* 10–30 G. The growth of RF generator power and the increase of argon pressure are accompanied by the broadening of local maximum and its shift in the B area, located beyond the limits of considered range of external magnetic field. The RF power input in PS with length 20 cm is sufficiently higher at low values of external magnetic field. The pressure growth is accompanied by increase of RF power input efficiency in the absence of magnetic field. The partly standing waves appear in the presence of external magnetic field in the PS with lengths 20, 32, 52 cm. In the case with PS length 32 cm the most extensive structure is formed at the RF generator power 800W. The number of local maxima of axial RF magnetic field Bz on the axis increases with external magnetic field induction growth from 20 to 36 G at the pressure 0.6 mTorr in the PS 32 cm. The power absorption efficiency maximum is observed at the value 36 Gs, this point corresponds to appearance of three local maximum of Bz. Further increase of magnetic field leads to reduction of local maxima number. The higher the pressure the higher B is necessary for obtaining three-maxima structure in the PS. The amplitude of azimuthal component RF magnetic field Bϕ also non-monotonic changes with the increase of coordinate z. The position of local maxima of axial and azimuthal components of RF fields are shifted relatively to each other, moreover the shifting value depends on external magnetic field. In the case when the exited wave is mostly close to a standing wave, the z value of Bz maximum corresponds to the conditions of Bϕ minimum, and vice versa. In PS with different lengths at the same magnetic field 36 G the distance between local maxima and local minima of wave structure coincides and is close to 8 cm, it means that the exited wave length is close to 16 cm in the all cases. The amplitude of axial RF magnetic field component reaches the maximum on the PS axis at the magnetic field induction more than 20 G. The larger the external magnetic field, the smaller the area near the axis where Bz is localized. With the approach to the bottom flange the dependence Bz(r) become more complicated, the RF field amplitude maximum is shifted to the middle of the radius. The field doesn’t penetrate into plasma near antenna in all investigated cases.