بسم الله الرحمن الرحيم

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وَكَانَ فضلُ اللهِ عليكَ عَظيماً

صَدَقَ اللهُ العَظيم

سورة النساء "آية ١١٣"

بسم الله الرحمن الرحيم

Ain Shams University
Faculty of Science
Department of Physics

STUDY OF PLASMA CHARACTERISTICS USING R.F ION SOURCE

Thesis

Submitted For The Partial Fulfillment Of
The Requirements For The Degree Of Master
In Plasma Physics

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Abstract

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Study of plasma characteristics using R.F ion source.

The main interest of this work is to study the plasma parameters of axial constricted R.F ion source beside the optimization of the R.F. ion source.

The plasma has been generated by a 50 MC R.F., 200 watt oscillator which is inductively coupled to the plasma by R.F coil wound round the constricted Pyrex glass chamber. Argon and Nitrogen gases have been used as working gases in the pressure range 3-80 m torr.

Electric probe measurements showed that for Nitrogen gas at a pressure of 40 m torr., the plasma electron temperature increases linearly with the increase of R.F power without using extraction voltage in the ion source. The electron temperature was 7eV for 25 watt R.F power and 20 eV for 90 watt R.F power. At constant R.F power and gas pressure the plasma electron temperature increased with the increase of the extraction voltage.

The electron density has been estimated within the R.F discharge vessel for Nitrogen gas at a pressure of 40 m torr. The density varies between 4.5×10^{15} m^{-3} and 7.5×10^{15} m^{-3} at R.F power = 77 watt, for extraction voltage 500 and 1250 V respectively.

It has been found that the ion current density extracted increases with the increase of the electron density in the R.F discharge vessel.

The study of the extracted ion beam showed that the beam divergence decreases with the increase of the initial gas pressure which may be due to the recombination processes.

The increase of the ion beam divergence with perveance increase can be attributed to residual charge forces as well as the increase of the electron temperature. For Nitrogen gas at a pressure of 3 m torr. the perveance was found to be 0.243 x 10^{-8} A/$V^{3/2}$ while for Argon gas at the same pressure it reached 0.122 x 10^{-8} A/$V^{3/2}$ where the angular divergences were 10.3° and 7.2° respectively. For Nitrogen gas at a pressure of 25 m torr., the perveance was found to be 0.03 x 10^{-8} A/$V^{3/2}$ while for Argon gas at the same pressure was 0.023 x 10^{-8} A/$V^{3/2}$ where the angular divergences were 1.2° and 3.2° respectively.

The performance of the constricted R.F ion source showed that it can be used to draw higher current where the plasma temperature and density within the source play an important role.

Comparing the results obtained using our axial constricted R.F ion source with the conventional axial R.F source, it was found that the beam current increases by about 40% in case of our ion source.

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