CHAPTER 6

CONCLUSION

An in-waveguide microwave plasma source has been constructed and studied. The microwave plasma source provides electron current of up to 250 mA at a bias of -50 V. It was electrically isolated from the rest of the waveguide which allows an arbitrary potential to be biased. For any working condition electron current from the source can be controlled by changing the bias potential of the source. The source was used as an ion beam neutralizer. Ion beam was generated by FEEFS which was first designed by using KOBRA-INP3 computer software. Then it was constructed and tested. The current provided by the FEEFS was in the milliampere range at the beam energy of 10 keV. The extracted current could be enhanced by using a accel-decel electrode configuration which allows higher extraction potential.

Numerical studies of the source have been done using a 3-dimensional simulation software which assumes a frequency-depending complex permittivity which allows a satisfactory understanding and optimization of the plasma source under investigation. Simulation is far more efficient than changing the source geometry and performing experimental measurements. In the presented work we proposed an improved source where the dimensions of the waveguide structure were optimized. The plunger position should be 47-50 mm from the center of the source to obtain a high electric field for plasma ignition. The distance R_1 was suggested to be about 270 mm. The distance R_1+R_2 should be optimized for the plasma phase at 648 mm. The reduced height of the tapered waveguide was optimized at 20 mm. The simulation predicted a better transformation of the complex plasma impedance to the matching area of the 3-stub tuner. Consequently, the electric field available for the ignition phase was doubled, thus reducing the necessary input power. In plasma-on phase the source could be operated with as low reflected power as 10 percent. We conclude that the modern state-of the-art simulation tools can significantly speed up and improve the development of complex plasma sources.

The optimization of the microwave plasma source which was suggested by the simulation should be done experimentally. The results obtained from the simulation and the experiments should be compared. This source can be applied to other kinds of ion beam, where low contamination is needed.