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Characterization of Sheet Plasma Device with a 2.45 GHz Microwave Cathode Source

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1. Introduction

A sheet plasma can be used as a good sputtering device. With a thickness of not more than 1 cm, its density is relatively high since the ions are compressed into a very tight space. One way to produce a sheet plasma is to suspend a hot cathode filament in a linear magnetic field. This type of plasma is mostly used for sputter deposition due to its high electron temperature and high electron density, which are both needed to produce better thin films. In the case where the plasma sheet is produced using a tungsten filament, it was found that both electron temperature and density were highly inhomogeneous [1].

2. Previous work done

A duoplasmatron type plasma cathode, shown in Fig.1, which produces a seed plasma by a hot cathode, is employed and characterized using a Langmuir probe. The main discharge current and the extraction current or the current flows from the plasma cathode and the anode are plotted as functions of discharge voltage. As discharge voltage is increased more than 50 V, a secondary discharge between the plasma cathode and the sheet plasma anode is produced and we have more secondary discharge current than the plasma cathode discharge current. The observed T_e and N_e were 2.0 eV and 2.3 x 10^{-11} respectively and this reinforces the argument that sheet plasma is a good sputtering device.

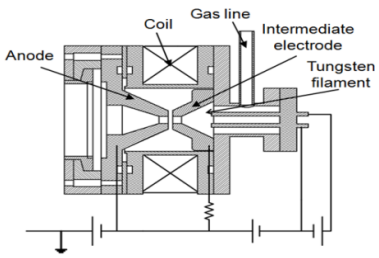

Fig.1. Schematic diagram of the duoplasmatron device

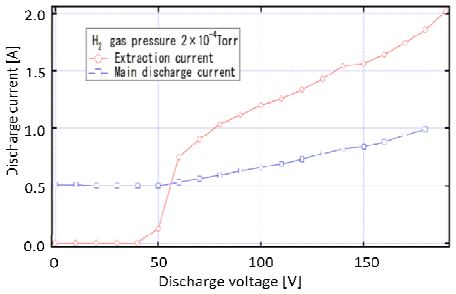

Fig. 1. I-V curve of the plasma cathode

3. Sheet plasma device using a microwave source

Shown in Fig.2 is the schematic diagram of the microwave excited sheet plasma device. A 300 mm by 300 mm by 300 mm stainless steel chamber is connected to a reducer waveguide that is connected to an E x B tuner which is then connected to a 2.45 GHz microwave power supply. The power supply delivers 3 kW CW microwave power to the plasma. The reducer waveguide is used to limit the size of the plasma production region as thin as 8 mm while the width of the waveguide is 109.22 mm. A total of six coils are placed on both sides of the chamber to confine plasma in a linear magnetic field inside the chamber. A profile of the magnetic field calculation gives the result that the field realized mirror ratio of 2.

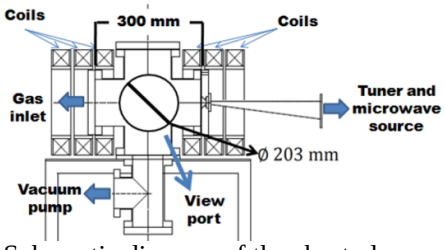

Fig. 2. Schematic diagram of the sheet plasma device with a microwave cathode source

References:

[1]J. Uramoto: Institute of Plasma Physics, Nagoya, University Report 876 (1988).