P24

# LOW-PRESSURE MICRO PLASMA GENERATION USING MICROWAVE IN A MIRROR MAGNETIC FIELD

A. Yukishige[1], T. Nakatani[1, 2], M. Shinohara[3] and H. Fujiyama[1]

[1]*Graduate school of science and technology, Nagasaki University, 1-14 bunkyo Nagasaki,852-8521, Japan*

[2]*Toyo Advanced Technologies Co., Ltd.,5-3-38 Ujina-higashi Ninami-ku Hiroshima, 734-8501, Japan.*

[3]*Department of Electrical and Electronic Engineering, Nagasaki University,*

*e-mail:d707240k@cc.nagasaki-u.ac.jp

**Abstract**

Microsize plasma sources have not been developed for the condition of low-pressure range less than 0.1Torr in the present technology. In this article we investigate a 2.45GHz microwave discharge operated at the ECR and the 2nd harmonic ECR, by mirror magnetic field.

**Keywords:** microplasma, 2nd harmonic ECR, low pressure plasma generation

## Introduction

Low-pressure microplasma generation has been attempted to perform the inner coating of the narrow tube by the sputtering process. We are developing the low-pressure microplasma to realize the inner coating of narrow tube by the sputter processing.

In the present paper, we will report on the results of measurement of the plasma parameter for the low-pressure short gap length plasma which we developed previously.

## Experiments

Figure 1 shows the experimental setup. The Microwave source of 2.45GHz is emitted in the TEM mode, so that the microwave can propagate through metallic tube of any size.

The diameter of an inner electrode is 5mm, and the gap length has been kept by outer electrode of 12mm of diameter. And the plasma generation point is located about 25mm from the edge of the electrodes. It is located in the center of the mirror magnetic coil. A ceramics is inserted other than the portion of the plasma generation.

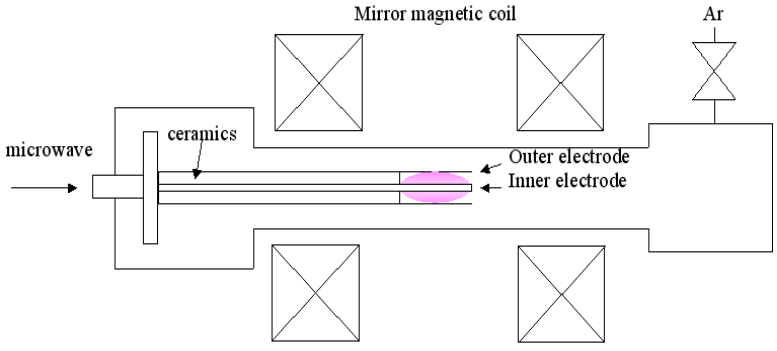


Fig1 experimental setup

## Results and Discussions

As a result of experiment, we succeeded the low-pressure microplasma generation. The plasma has been mainly generated in the condition of 2nd Harmonic ECR condition. ($\omega_c/\omega = 0.5$) Probe measurements have been performed in the condition of the Ar pressure of 0.03 Torr, gap length of 3.5mm and incident microwave power of 30W. Figure 3 shows that the probe system. The tungsten rod (diameter 0.15mm) was used as the probe and it was inserted in the plasma generated in the coaxial electrode. (From the edge of the electrodes to 25mm) The top surface of the probe was insulated. This is because preventing inflow of the particle of a direction perpendicular to a line of magnetic force.

Figure 2 shows the magnetic field dependence of the electron density. According to the probe measurement, high electron density and low electron temperature plasma generation has been confirmed at the 2nd Harmonic ECR condition. [1] We already confirmed the electron orbit of the gap space is very small on 2nd Harmonic ECR condition, by our previous calculation.

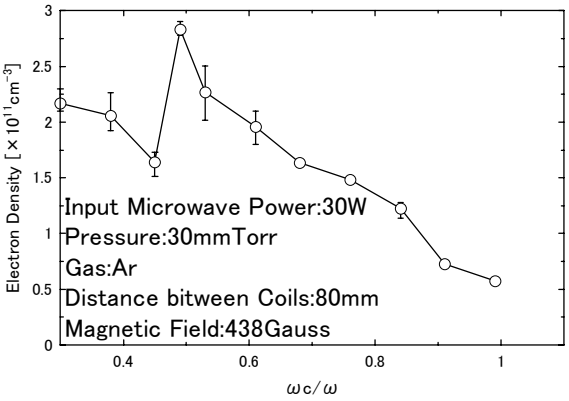


Fig.2. Dependence of magnetic flux density on
Electron Density (mirror magnetic field)

## Conclusions

The purpose of this research is the low-pressure micro plasma generation for the inner coating of narrow tubes. As a result of the probe measurement, for the gap length of 3.5mm, high electron density and low electron temperature plasma generation has been confirmed at 2nd Harmonic ECR condition

References

[1] M. Saigoh, N. Ohno, and H. Fujiyama, Materials Science & Engineering, A139 (1991)307-31