

A Study on the Ion Beam Uniformity using High Current Bucket Type Ion Source

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1. Introduction

Studies from the 2000s, ion beam system was carried out actively as ion implantation, ion beam sputtering, ion beam assisted deposition, etc. However, the technology was limited in this study and mass production is in its early stages. The most important is high current and the large area ion source development to mass production of ion beam system. Thus, our research developed the high current and large area ion beam source for applying high rate etching process or ion beam sputtering, etc. The current density of ion beam and ion beam distribution for wide range were measured by one way moving electric type faraday cup. Detailed experimental results will be presented.

2. Methods and Results

2.1 High Current Bucket Type Ion Source

To develop the high current ion source, we considered the high density plasma generation, high current & large area extraction system and life time of ion source. So we developed Bucket type ion Source in which maximum current is 269mA at 20kV (theoretical data) and uniformity area is 100~150mm as Fig 1. The specs of developed bucket type ion source are as table I.

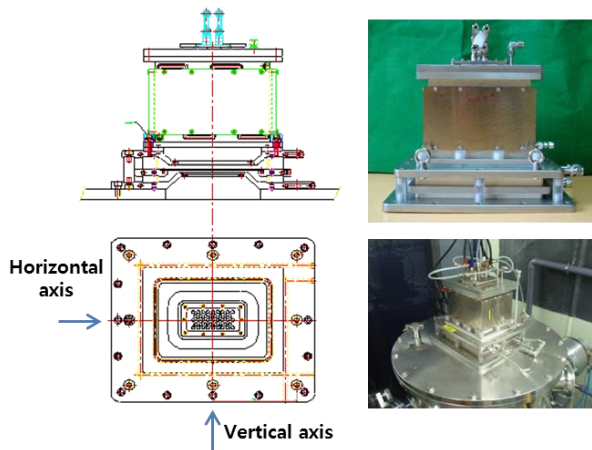


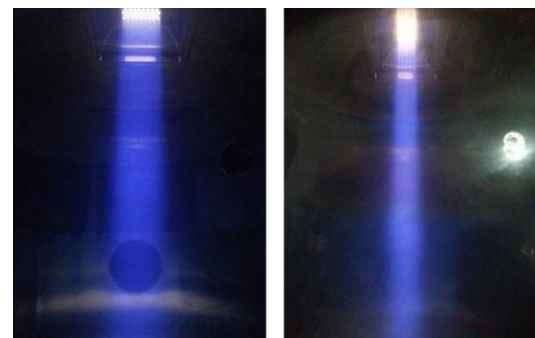
Fig. 1 High Current Bucket Type Ion Source

Table I: Bucket Type Ion Source Spec.

Max. Extraction Voltage	20kV
Max. Beam Current	200mA
Beam Width	100~150mm
Electron Source	Filament
Beam Shape	rectangular

2.2 Beam extraction

The shape of the argon ion beam extraction (at 20keV, 160mA) is shown Fig 2. The ion beam width of the horizontal axis (a) is wider than vertical axis (b) as grid designed.



(a) horizontal axis (b) vertical axis
Fig. 2. Beam extraction shape

2.3 Modified Faraday Cup

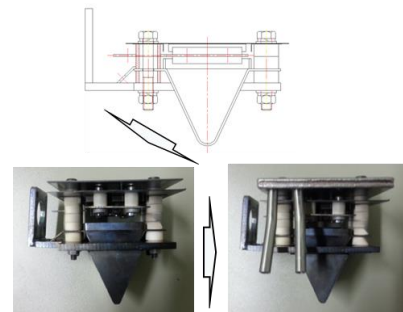


Fig. 3. Modified faraday cup for high current ion beam

To use in high-current ion beam, faraday cup was modified. Suppression electrode was installed to prevent secondary electron for accurate measurement of ion

beam current. And the cooling plate was installed on the upper part of the faraday cup to prevent the heating by high current ion beam. (Fig. 3)

2.4 Extraction Beam Profile

Extraction ion beam current measured in the horizontal direction, and the result is shown in Fig 4. Ion beam current density was increased from 1.5 to 4.5 mA/cm², the beam current was increased from 80mA to 140mA. But, increasing from 140mA to 160mA, the width of the beam was increased without increasing the beam current density. When the filament is heated above a certain temperature, is heated bucket wall. So the extraction ion beam is spread by the hot electron emission from the heated wall.

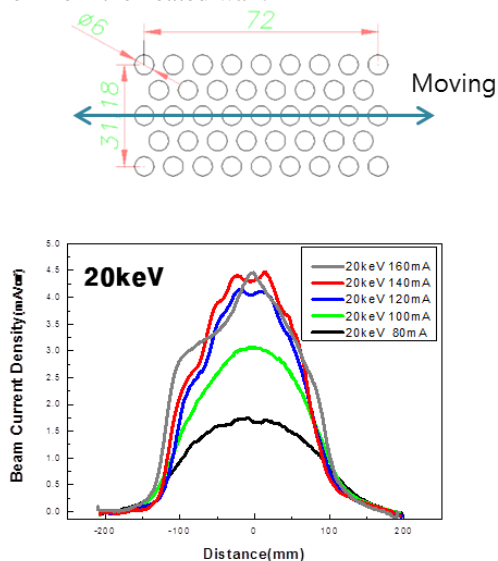


Fig. 4. Beam profile at horizontal axis

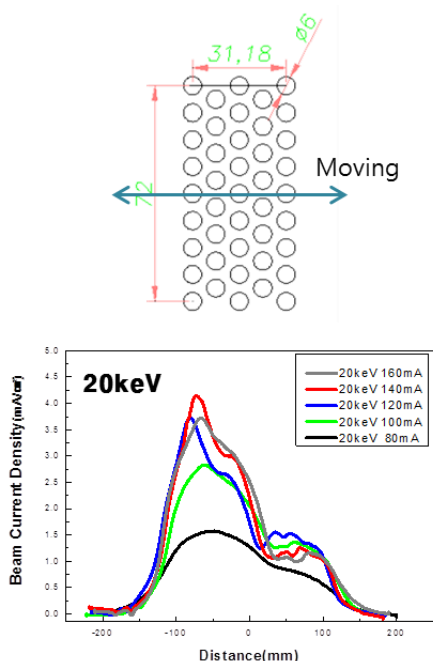


Fig. 5. Beam profile at vertical axis

Ion beam current density measurement results at vertical axis shown in Fig 5. The ion beam current density was increased gradually up to 140mA. But ion beam current density at 160mA did not increase anymore like the horizontal axis results. The deviation of the beam profile of horizontal axis was expected that two filaments and are under study.

3. Conclusions

We developed the bucket ion source for high current ion beam. Modified the faraday cup for the high current and ion beam uniformity was measured. According to the measurement results, the beam current density without increasing the beam width increases in more than a constant current. The reason is thought to be the cause of the hot electron emission from the heated wall and is under study. We have plan that develop the large area bucket ion source based on the research result of bucket ion source for high current ion beam.

ACKNOWLEDGMENTS

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