Ion Beam Facilities Installation and Commissioning at KOMAC

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1. Introduction

Korea Multipurpose Accelerator Complex(KOMAC) had been performed metal and gaseous ion beam service such as Cr+, Fe+, Co+, Cu+, H, He, N, Ar, and Xe ions. However, it has limitation to beam service and R&D research caused by deteriorated parts such as control system, beam transport system and beam diagnostic system, vacuum system etc. It is needed that replacement and improvement of deteriorated parts and beam commissioning for efficient and reliable operation of ion beam facilities. So we started to a project to upgrade existing ion beam facilities and all the ion beam facilities will be housed in a dedicated building, so-called Beam Utilization Building, which was completed end of 2014. We transferred modify complementary ion beam facilities 1) Gaseous 2) Metal 3) Vertical 4) High current IBSD ion beam facilities to Beam Utilization Research Building and installed and commissioned. Also, it was acquired radiation safety license through equipment inspection for radiation generator from KINS (Korea Institute Nuclear Safety). In this report, we will describe upgraded ion beam facilities, successful commissioning and equipment inspection from KINS.

2. Ion beam facility

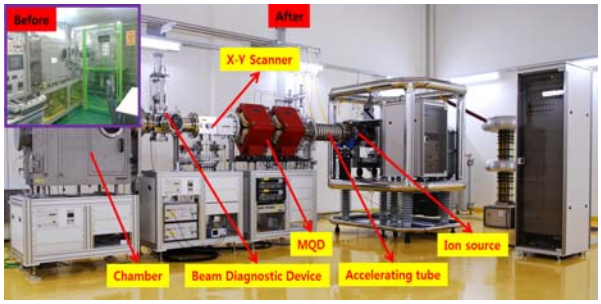
2.1. Beam Utilization Building

The Beam utilization building consists of ion beam facilities, 1) Gaseous 2) Metal 3) Vertical 4) High current IBSD Room and R&D Room for ion source & components in the 1st floor of the building. Also, 1MV ion accelerator and He RFQ accelerator is developing. These facilities are expected to cover wide range of beam energy and current for material study of beam service. Figure 1 shows The Beam utilization building.

<Figure 1. Beam Utilization Building>

2.2. Gaseous ion beam facility

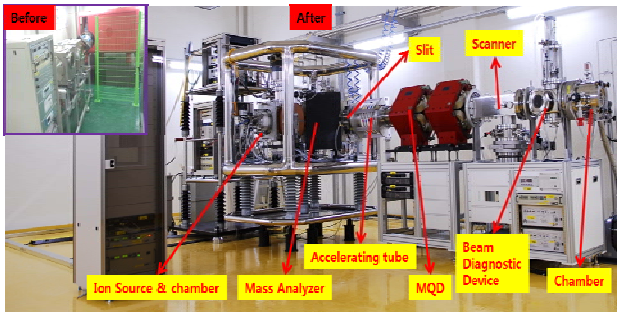
Its nominal operating condition is 20~120keV /~5mA and H, He, N, O, Ar, Kr and Xe beam was serviced. However, it is need to improve beam uniformity and increase beam energy for various R&D region and high quality beam irradiation. So we replaced deteriorate parts or adapting new parts such as control, beam transports, vacuums and so on. Beam energy is increased from 120keV/~5mA to 200keV/~5mA as replacing acceleration tube and was installed to improve beam uniformity as adapting MQD(Magnetic Quadrupole Doublet) and X-Y scanner and beam diagnostic devices such as and BPM (Beam Profile Monitoring). We are studying for irradiation area (100mm x 100mm) and uniformity (>90%). Figure 2 shows the before and after upgrade for metal ion beam facility.



<Figure 2. Gaseous Ion Beam Facility>

2.3. Metal ion beam facility

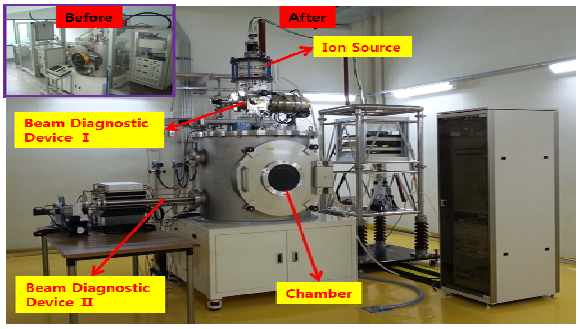
After installation and commissioning, metal ion beam facility was provided the metal ions such as Cr^+, Fe^+, Co^+, and Cu^+ metal ions to users [1, 2]. The metal ion implanter consist of a bernas type ion source, analyzer magnet, slit, acceleration tube, quadrupole magnet, electrostatic scanner, BPM and target chamber. The high voltage terminal contained power supplies for ion source, ion source chamber with anaylzer magnet, mass separation magnet, slit components. Also the desired beam shape and size adjusting electrostatic scanner and quadrupole magnet were obtained. Maximum operating voltage increased from 100keV to 150 kV. For the high quality ion beam, deteriorated components are replaced or adapting new one. Also, we will be added metal ion such as Al^+, P^+, Ti^+ and Ag^+ according to increasing user demand gradually. Figure 3 shows the before and after upgrade for metal ion beam facility.



<Figure 3. Metal Ion Beam Facility>

2.4. Vertical ion beam facility

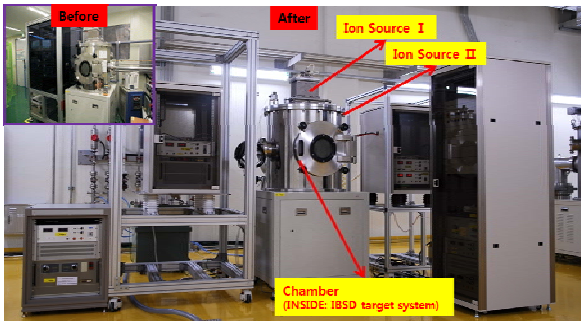
We developed a high-current ion facility with a large irradiation area, which is capable of feasibility studies of pragmatic applications of ion beams. For industrial application of non-semiconductor field, it is mainly required beam energy below 100keV because of economics and radiation safety license. So we developed 60keV/20mA ion source without acceleration tube. Figure 3 shows the before and after upgrade for metal ion beam facility.



<Figure 4. Vertical Ion Beam Facility>

2.5. High current IBSD facility

Ion beam sputtering is an attractive technology for the deposition of thin film coatings onto a broad variety of polymer and metal substrates. Energetic ions (Cr and STS) can be used to modify film density, stress, texture, grain size, structure of the interface and other related properties. This facility is consists of high current bucket-type ion source(22keV/150mA) and material of target are chromium and stainless steel 304.

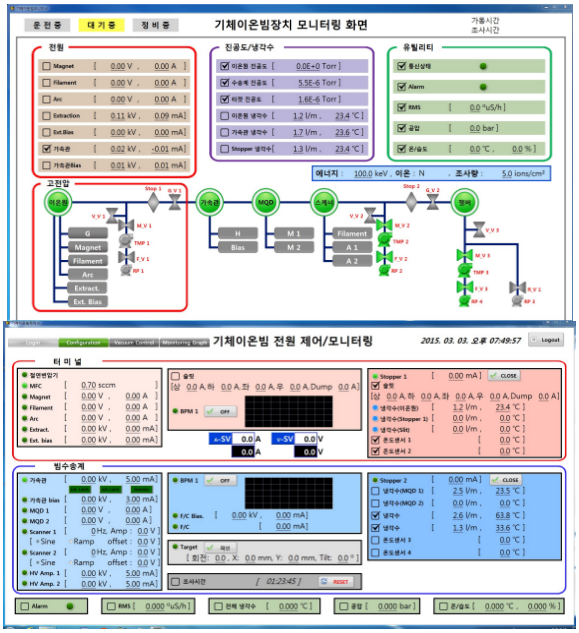


<Figure 5. High Current IBSD Facility>

It was installed DuoPIGatron ion source(30keV/20mA) additionally besides bucket ion source for hybrid procedure. Upgraded high current IBSD facility is shown in figure 5.

2.6. Control & Monitoring System

For the facility operation, the LABVEW based control system was developed to monitor and remotely control the equipment. Figure 6 shows main control & monitoring display of each facility. It also includes interlock system 1) RMS 2) Door for the personal safety systems.



<Figure 6. Control & Monitoring Display>

2.7. Acquisition of operation license

Installed ion beam facilities acquired radiation safety license from KINS (Korea Institute Nuclear Safety) and is performing beam service to beam users from March. 2015. Operation license is shown in figure 6.

<Figure 7. Operation License>

3. Conclusions

In order to meet increasing user demands for high-quality ion beams with various conditions, we started to a project to upgrade existing ion beam facilities by replacing deteriorated parts or adapting new parts, such as controls, beam transports, diagnostics, vacuums and so on. After installation and successful beam commissioning, we started user service from March, 2015. We will perform facility test, upgrade and R&D for high quality beam service continuously.

4. ACKNOWLEDGMENTS

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4. REFERENCE

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[2] I. S. Hong, H. R. Lee, T. A. Trinh and Y. S. Cho, Nuclear eng. and tech, Vol 41, No 5, 709 (2009).