Installation of the Ion Accelerator for the Surface Analysis

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1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) is operating several ion beam accelerators to provide various ion beams to users. Those are a 100 MeV proton linear accelerator, a 220 keV ion implanter for gaseous ion beams, a 150 keV metal ion implanter and a 20 keV high-current ion implanter. In addition to those, a 1 MV electrostatic ion accelerator for gaseous ion beams, a 1 MeV/n multi-purpose accelerator based on the radiofrequency quadrupole (RFQ) have been developed [1]. All of those are the machine for user service and it is important to qualify the results of the irradiation conditions for user service. For this reason, an electrostatic tandem accelerator, which has been operating over 25 years at Korea Institute of Geoscience and Mineral Resources (KIGAM), is moved to KOMAC in order to supply the qualified and quantified data on the irradiation species. In this paper, an introduction to the accelerator, an installation status at KOMAC and the operation plan of the accelerator are discussed.

2. Installation and Operation Plan

2.1 Accelerator

The accelerator is a pelletron with tandem type. The maximum voltage is 1.7 MV. The specification of the accelerator is shown in Table 1 [2].

Table 1: Specification

Manufacturer	NEC, USA
Model	5SDH-2
Maximum voltage	1.7 MV
Type	Tandem
Insulation	SF6 gas
HV charging method	Pelletron chain, 2 sets
Charging current	300 uA
Voltage ripple	< 500 V
H+ beam current	1.0 uA @ 0.5 MeV
H+ beam current	5.0 uA @ 3.4 MeV
He2+ beam current	2.0 uA @ 5.1 MeV

The accelerator has two ion sources, one is a SNICS (Source for Negative Ion by Cesium Sputtering) and the other is a duoplasmatron. Also it has four beam lines, a PIXE (Particle Induced X-ray Emission) beam line, a RBS (Rutherford Backscattering Spectrometry) beam line, a beam line for ion implantation and for neutron production [3]. The total length from the ion source to the beam line is 17 m. The accelerator is shown in Fig. 1 when it was installed at KIGAM.

Fig. 1. Accelerator when it was installed at KIGAM

2.2 Installation

The accelerator will be installed in the beam application building at KOMAC. It uses three rooms, one is for accelerator, another is for beam lines and the third is for neutron target. The layout of the accelerator is shown in Fig. 2. The required utilities are summarized in Table 2, all of them were prepared already. In addition to those, a SF6 storage tank and a treatment system were installed. The alignment will be done using Laser Tracker. The network system was installed in the room.

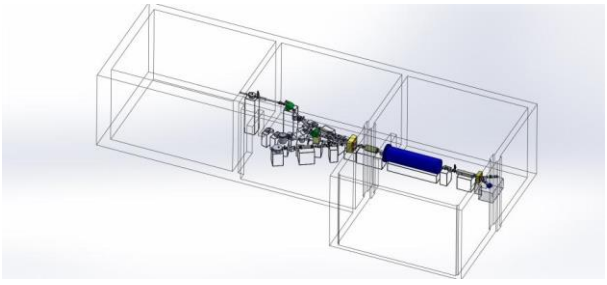

Fig. 2. Layout of the installation at KOMAC

Table 2: Required utilities

Electricity	220V, 60 Hz, 3 ϕ, 12 kVA
Cooling water	9.5 lpm at 15° ΔT < 10° ΔP > 4 bar Max. p < 5.7 bar
Compressed Air	Max. p < 5.7 bar

All the beam lines components were delivery to KOMAC already as shown in Fig. 3.

Fig. 3. Accelerator installation at KOMAC

2.2 Operation Plan

All of the four beam lines will be used. The PIXE beam line is used for the quantitative analysis of the small concentration of element in the sample. A proton beam with energy up to 3.4 MeV is used. A Si(Li) detector is used to detect the X-ray. The RBS beam line is used for the quantitative analysis of the depth profiling of the element. A helium beam with energy up to 5.1 MeV is used. A surface barrier detector located at 170° with respective to the beam direction is used to detect the energy of the backscattered incident beam. An ERD (Elastic Recoil Detection) beam line shares with the RBS beam line. The ERD beam line is used for the quantitative analysis for the light element in the sample. A high energy chromium beam is used as a probe and a time-of-flight is used to measure the energy of the forwardly scattered secondary particle. An implanter beam line is used for the MeV energy range implantation, which is now impossible at KOMAC. The neutron beam line is used for standard neutron source for nuclear data production. A 3.4 MeV proton is used to produce a nuclear with the lithium target at initial stage.

The installation of the system will be finished in September and the test of the accelerator will be started. The PIXE beam line with SNICS ion source is considered the first one to be commissioned. We are going to change the duoplasmatron ion source to RF ion source because the RF ion source is well suited for the negative helium beam production with rubidium charge exchanger. After the RF ion source is installed, the RBS beam line can be commissioned.

3. Conclusions

A pelletron, which has been used over 25 years at KIGAM, is moved and installed at KOMAC in order to supply a qualified service to ion beam users. The system will be installed in September and component tests will be carried. The operation of the system starts in 2016 after it gets operation license from Nuclear Safety and Security Commission.

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REFERENCES

[1] Y. S. Cho, Proceedings of the Linear Accelerator Conference 2014, Geneva, 1-5 September 2014, p413.
[2] Operation manual of the Pelletron (5SDH-2), NEC, 1987.
[3] H. J. Woo, et al., Development of Ion Beam Nano Structure Techniques in KIGAM, Journal of Korean Physical Society, Vol. 52, No. 93, p743~751, 2008.