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# Performance Results for Building the 1 MV Electrostatic Accelerator at KOMAC

*Dae-Il Kim[a#], Hyeok-Jung Kwon[a], Sae-Hoon Park[a], Yong-Sub Cho [a]*
*[a]Korea Atomic Energy Research Institute, KOrea Multi-purpose Accelerator Complex*
*181 Mirae-ro, Geoncheon-eup, Gyeongju-si 780-904*
**Corresponding author: dikim@kaeri.re.kr*

## 1. Introduction

1 MV electrostatic accelerator of KOrea Multi-purpose Accelerator Complex (KOMAC) is being developed to satisfy the needs from the users, especially for the applications with a MeV range ion beam implantation. Table 1 shows specifications of the 1MV electrostatic accelerator [1].

Table 1. Specifications of the 1 MV electrostatic accelerator

| | |
|---|---|
| Beam Current Max. | >1mA |
| Operating Voltage | 0.2 – 1.0MV |
| Energy Stability | ±0.5% |
| Ions | Gaseous (Proton, O, N, etc.) |
| Power for Ion Source | <1kW |
| Life Time of Ion Source | >2,000 hrs |

The accelerator consists of ion source, beam transport system and target chamber. The ion source and accelerating column are installed inside the pressure vessel of high voltage power supply. The layout of the system is shown in Fig. 1 [2].

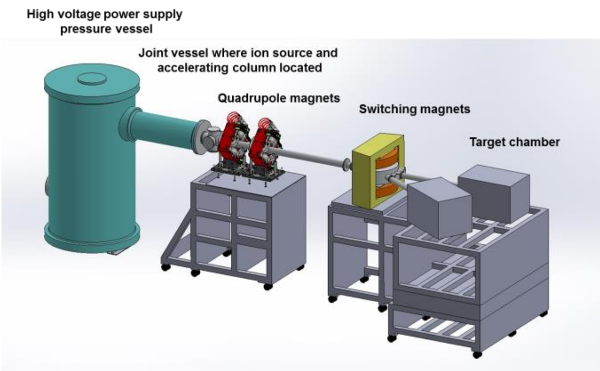


Fig. 1. Layout of the 1 MV electrostatic accelerator.

A thonemann type RF ion source operated by 200 MHz was selected for long-time operation without maintenance. High voltage power supply is electron transformer rectifier (ELV) type which was developed in Nuclear Physics Institute (Novosibirsk) for industrial electron accelerators [2].

High voltage power supply fabricated by domestic company was confirmed at KOMAC site. Equally, the RF ion source was installed in the 300 kV test-stand. In this paper, test results in the 300 kV test-stand are reported and its performance processes are presented.

## 2. 300 kV Test-stand

300 kV test-stand located in KOMAC site is shown in Fig. 1. The test-stand consists of a 300 kV high voltage terminal, a battery of the ion source power, a 60 Hz inverter, a 200 MHz RF power, a 5 kV extraction power supply, a 300 kV accelerating tube, and a vacuum system including the beam current measurement system.

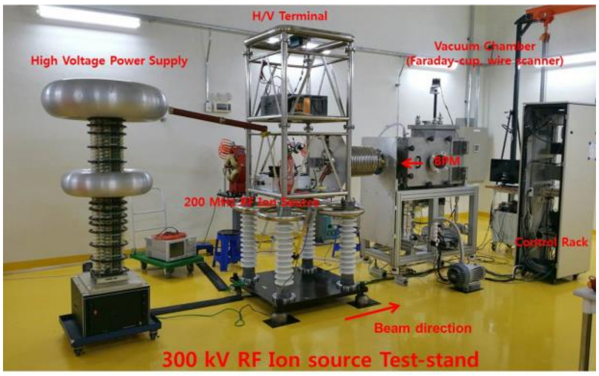


Fig. 2. Layout of the 1 MV electrostatic accelerator.

### *2.1 200 MHz RF Ion Source*

A 200-MHz RF ion source consists of an air variable capacitor comprising a loading and tuning capacitor, a 1-turn coil, a permanent magnet, a shielding box, and an electrode. The extraction power supply on high voltage potential is manually controlled from 0 to 5 kV. Cockcroft-Walton which can be applied high voltage on the high voltage terminal is operated from 0 to 300 kV [2]. Fig. 3 shows the operating plasma generated by its matching circuit.

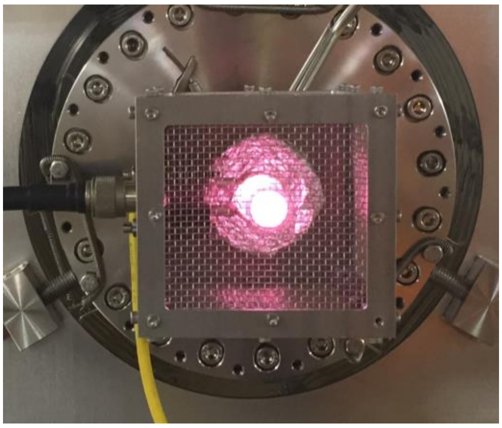

Fig. 3. Plasma generated by its matching circuit.

### *2.2 Beam Current Measurement*

The beam current in 300 kV test-stand is measured by water-cooled faraday-cup at the end of chamber. The beam current was monitored by the beam monitoring system produced LabView through PLC and the current preamplifier. The beam profile monitor measured for beam shape and position was installed at the downstream from the accelerating tube. The wire scanner was located at the end of the chamber. Its motion and data acquisition system was made by LabView.

## 3. Test Results

The result of beam current depending on hydrogen gas and extraction voltage is shown in Fig. 4. A target chamber pressure was used to replace the hydrogen gas because a mass flow controller is not installed. The beam current increases depending on the rising chamber pressure and also rising extraction voltage, and is saturated up to 600 uA above the pressure of 1E-5 Torr.

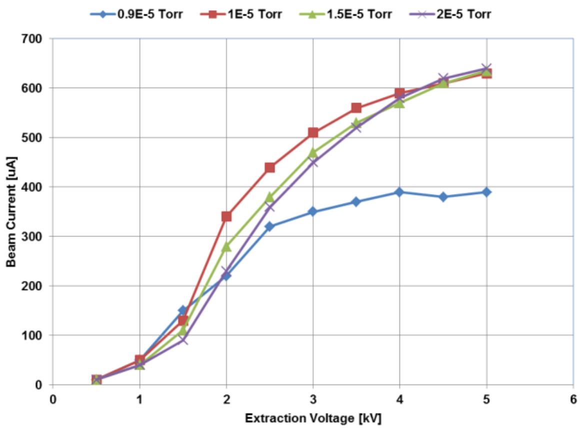


Fig. 4. Beam current depending on hydrogen gas and extraction voltage.

The beam profiles were measured according to the extraction voltage and acceleration voltage. Fig. 5 shows results beam size depending on the extraction voltage and acceleration voltage. The beam size increases as acceleration voltage when the extraction voltage was -1 kV. But the increasing slope is nearly constant at -2 kV and after that the beam size decreases as acceleration voltage when the extraction voltage was -3 kV. This tendency is well explained that the accelerating column acts like a lens whose power is proportional to the electric field. Also it can be explained that the matched beam is formed when the extraction voltage is -2 kV in current geometry.

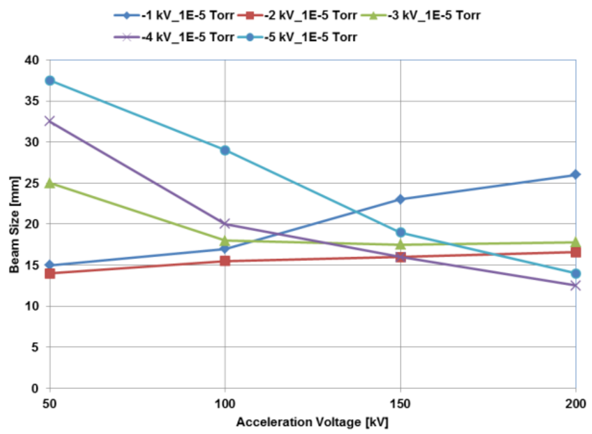


Fig. 5. Beam size depending on the extraction voltage and acceleration voltage.

## 4. Conclusions

A 1 MV electrostatic accelerator is being developed at KOMAC. The high voltage power supply is already developed. The 200 MHz RF ion source is now being tested in the 300 kV test-stand. In the test results, it is necessary to improve increasing RF power absorption into the plasma in order to supply 1 mA beam. For this goal, we need more reliable the matching circuit and should be modified the matching components.

## Acknowledgment

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## REFERENCES

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[2] Dae-Il Kim, et al., Modification of 300 kV RF Ion Sourcefor 1-MV Electrostatic Accelerator at KOMAC, Transactions of the Korean Nuclear Society Spring Meeting, Jeju, Korea, May 7-8, 2015