Modification of 300kV RF Ion Source for 1-MV Electrostatic Accelerator at KOMAC

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1. Introduction

1-MV electrostatic accelerator at KOMAC (KOrea Multi-purpose Accelerator Complex) is developing for industrial applications with high current and high reliability. Basic study related with high voltage power supply and accelerating column was done. The specifications of the 1-MV electrostatic accelerator are shown as below [1].

Beam Current Max.	1mA
Operating Voltage	0.2 – 1.0MV
Energy Stability	±0.5%
Ions	Gaseous
Power for Ion Source	<1kW
Life Time of Ion Source	>1,000 hrs

High voltage power supply is electron transformer rectifier (ELV) type which was developed in Nuclear Physics Institute (Novosibirsk) for industrial electron accelerators. And accelerator column consists of alumina and metal electrode rings were 0.5m-long brazed structure which can be installed horizontally [1].

In case of ion source for 1-MV electrostatic accelerator, it is chosen a thonemann type rf ion source and 300-kV test-stand was made up to confirm the stable operating conditions [2].

High voltage power supply is fabricated by domestic company, and its operation has been confirming at KOMAC site. Equally, the ion source of 300-kV test-stand should be modified to install into the high voltage power supply. In this paper, modification of ion source of 300-kV test-stand for 1-MV electrostatic accelerator is presented and its processes are considered.

2. Fabrication

2.1 300-kV test-stand

300-kV test-stand located in KOMAC site is shown in Fig. 1. It consists of 300-kV high voltage made by terminal, a battery for the ion-source power, a 60-Hz inverter, 200-MHz RF power, a 5-kV extraction power supply, a 300-kV accelerating tube, and a vacuum system. The terminal for 300-kV high voltage is verified to distribute uniformly the electric field around insulator surface. 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 is controlled by a signal generator used optical converter. On the high voltage terminal, Cockcroft-Walton which can be applied high voltage is operated from 0 to 300 kV [2].

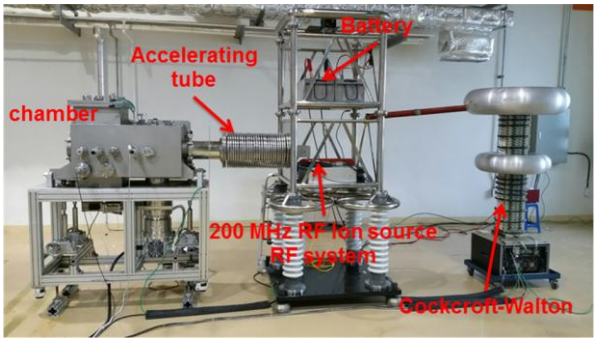

Fig. 1. 300-kV test-stand

2.2 High voltage power supply

The high voltage power supply for 1-MV electrostatic accelerator consists of HV vessel with high voltage circuit, SF6 gas generator to fill the SF6 into the vessel, and 450Hz invertor as shown in Fig. 2. The high voltage circuit inside HV vessel is accommodated in a tank filled with SF6 gas under a pressure of 0.5MPa. Due to the massive coils of ELV circuit, the high voltage power supply is installed in vertical position in a pressurized tank [1].

Fig. 2. High voltage power supply fabricated at KOMAC site

2.3 Impedance matching

To match the impedance for ignition of plasma in condition of 0.1 T of magnetic field at the center of the permanent magnet, it is important to adjust L-network using air variable capacitors. Fig. 3 is impedance

matching program produced by Labview. Typically, it used a network analyzer to match the impedance value monitored on smith chart. This program can be checked the impedance value through calculation with reflected and incident wave.

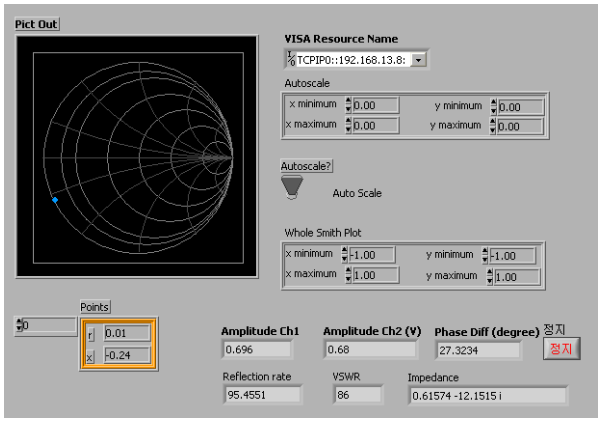

Fig. 3. Impedance matching program made by Labview

3. Modification

To install RF ion source with accelerator column inside HV vessel, multi-purpose flange and support should be fabricated as shown in Fig. 4. The direction of connection with ion source should be tightened from SF6 gas. And another side is linked to vacuum chamber for vacuum pump, vacuum gauge, beam measurement and monitoring.

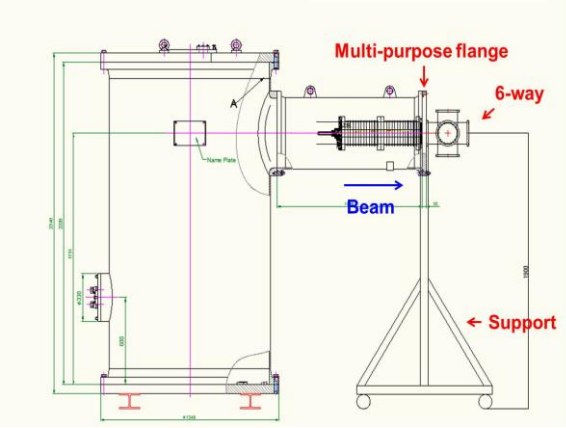

Fig. 4. Drawings combined with 300-kV RF ion source and HV power supply

4. Conclusions

300-kV RF ion source and power supply are testing for the 1-MV electrostatic accelerator and trying for combination between them. Especially, we should be improved method in order to find the impedance matching, effectively. Furthermore, the study and test for optimization of RF and gas system are required. The 1-MV electrostatic accelerator will be fabricated with domestic companies and tested in the beam application research building at KOMAC.

Acknowledgment

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[2] Sae-Hoon Park, et al., High-Voltage Terminal Test of Test Stand for 1-MV Electrostatic Accelerator, ICABU2014, Daejeon, Korea, 2014