6 - 28 High Voltage Test of the Electrostatic Extraction Septum for HIMM

Zhang Jingjing, Zhang Xiaoying, Yang Yaqing, Zhang Jianchuan, Yao Qinggao and Ma Lizhen

In the project of Heavy Ion Medicine Machine, the electrostatic septum is one of the important components of synchrotron which will be used for beam slow extraction. The maximum electric field is 85 kV/cm, the maximum voltage is 140 kV, and the good electric field area is (10∼20) mm × 40 mm. When fabrication of electrostatic septum is finished, the high voltage test is required to make sure that the septum could work stably in the high voltage condition. In 2014, we had finished the high voltage test successfully.

The electrostatic septum will be based on technology presently used in CSR. For operation at very high electrical field strength, the cathode material of the electrostatic septum consists of titanium, thereby capable of achieving maximum field strength of 85 kV /cm at a 15 mm gap. The anode consists of 100 μm tungsten wires which are installed in a distance of 1 mm. The gap between the anode and cathode is adjustable with 4 remote controllable stepping motors. In order to make sure the surface roughness achieve to a high level (Ra 0.1), the surface of cathode needs to do polishing processing. The anode and cathode are installed in a vacuum chamber, and it needs to remove the residual burrs on the cathode surface by spark discharge in high voltage test (Fig. 1). The electrodes high voltage test would be finished in a vacuum condition (Fig. 2).

Fig. 1 (color online) Sparking discharge phenomenon.

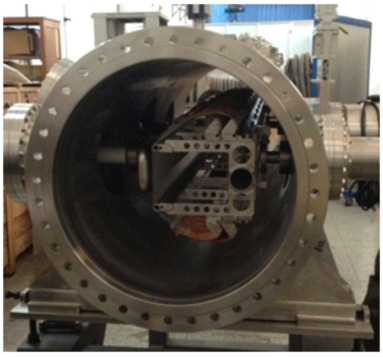

Fig. 2 (color online) The septum after assembling.

According to the physical design requirements, the high voltage is tested in different gaps (10, 15 and 20 mm). The special self-protection test power supply with good sensitivity is used to load voltage. In order to avoid the damage of the electrostatic septum, the discharge current is required less than 100 μA, and the power will be turned off if the large spark discharge happens.

In the high voltage test processing, the septum could work stably for 8 h at different voltage values, and there is no obvious electro-discharge phenomena. When the voltage is charged to the maximum design value, the high voltage test is completed. The whole high voltage test is spent 2 months, and the clearing electrodes are implemented. The test results are showed in Table 1.

Table 1 The high voltage test data

Gap/mm	Voltage/kV	Discharge Current/μA	Vacuum/mBar
10	75	0	1.7×10^{-6}
	85	0	1.7×10^{-6}
15	90	0	1.7×10^{-6}
	110	0	1.7×10^{-6}
	125	5	1.7×10^{-6}
	130	5	1.7×10^{-6}
20	100	0	1.7×10^{-6}
	120	5	1.7×10^{-6}
	130	5	1.7×10^{-6}
	140	10	1.7×10^{-6}

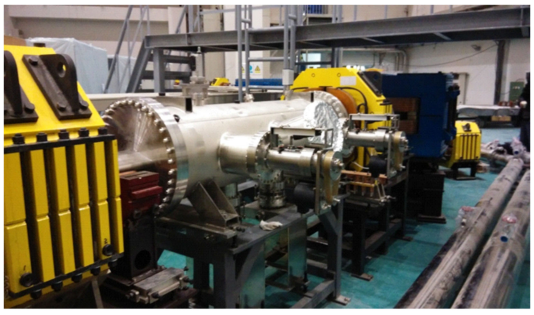

Fig. 3 (color online) The electrostatic septum is installed in HIMM.

According to the results of high voltage test, the electrostatic septum could work stably, and the electrostatic field could satisfy the requirements of the physical design. It has been installed in workshop of HIMM project (Fig. 3).