film coating device by double targets has been set up. Until now, the samples have been developed successfully by adjusting a series of process parameters such as the sputtering current and the working gas pressure. The average film thickness of the sample is 400 nm as shown in Fig. 3.

In order to reduce the eddy current effect in the wall of the vacuum chamber caused by the rapid rise of the dipole magnetic field, a 1.2 m long thin-wall vacuum chamber prototype with the wall thickness of 0.3 mm has been successfully developed as shown in Fig. 4. A structure of the thin wall with reinforced ribs has been uesd for the prototype, in order to withstand the atmospheric pressure and the on-line high temperature baking of 250 ℃. The 3 m long thin-wall vacuum chamber prototype has been currently in processing.

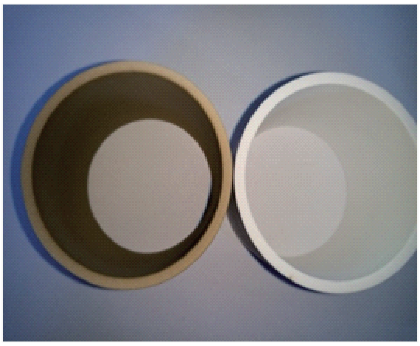


Fig. 3 (color online) The sample of TiN thin film coated on ceramic tubes.

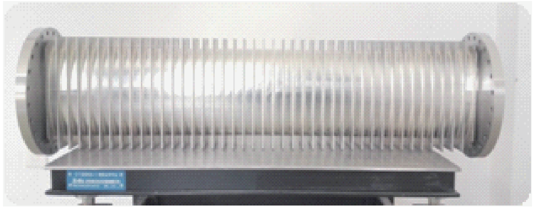


Fig. 4 (color online) The 1.2 m long prototype of thin-wall vacuum chamber.

The studies on the desorption rate of materials have been carried out already, in order to reduce the dynamic gas load induced by the collision between the ion beam and the vacuum chamber wall, at present, a desorption rate testing device of the oxygen free copper has been established, which is connected with the 320 kV high pressure platform. The desorption rate of oxygen free copper is 179 mol./ion under the bombardment of Xe^{10+} with the energy of 2 500 keV and the current of 3.85 eμA.

3. The works of the HIMM vacuum system

The installation of the HIMM vacuum system in Lanzhou is nearing completion, and the debugging of the cyclotron is about to begin. The EMC detection works of HIMM vacuum system in Wuwei have been completed already and the effective corrective actions about Electrical safety of the vacuum system have being carried out. At the same time, in the aspect of document writing of GMP, a series of documents such as the instructions of the vacuum system, the information documents about vacuum equipments and the risk analysis about the vacuum system have been accomplished.

6 - 27 Device Design and Experimental Research of Desorption Yields of Oxygen-Free Copper

Xie Wenjun, Meng Jun, Li Peng, Dong Zhiqiang and Luo Cheng

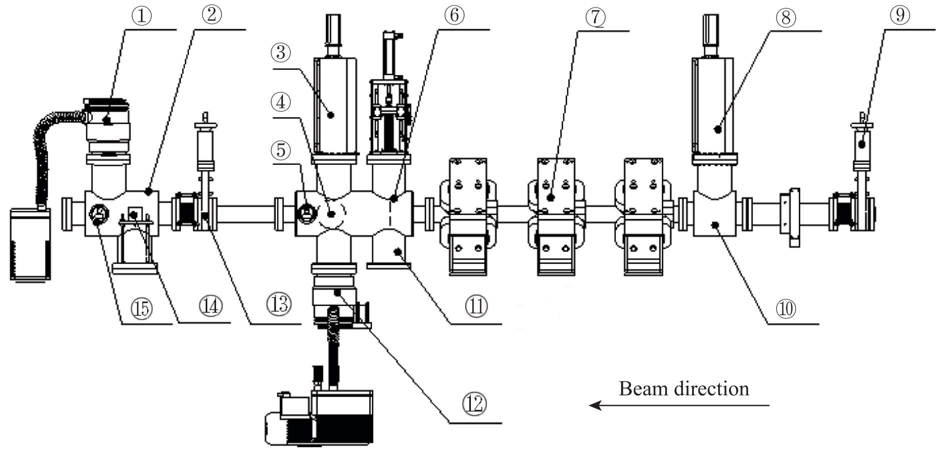
The beam bombards with the vacuum chamber walls and desorbs a certain amount of molecules and ions from the surface of the chamber, which will destroy the system's dynamic vacuum and limit the beam lifetime[1,2]. In order to reduce the effect on the dynamic vacuum, it is necessary to find a low desorption material as a collimator coating material[3]. Firstly, based on the 320 kV high charge states ion experimental platform designed the measurement device of desorption yields.

The experiment device, which layout is shown in Fig. 1, is installed behind 320 kV experimental platform. The main equipments are vacuum chambers, molecular pumps, fluorescent targetsvacuum gauges, and so on.

The effective ion induced desorption yields η(molecules/ion) is given by the following formula[4]:

$$\eta=\frac{\Delta N}{\dot{N}}=\frac{\Delta p\cdot S}{\dot{N}\cdot k\cdot T}. \quad (1)$$

Where ΔP is the pressure increase in the test chamber A under ion bombardment, S is the pumping speed in L/s, $\dot{N}$ is the number of impacting ions per second, k is the Boltzmann constant (1.3806488E-23 J/K), T is the room temperature (300 K).



1. Molecular pump A; 2. Test chamber A; 3. Fluorescent target A; 4. Faraday Cup; 5. Vacuum gauge A; 6. Copper slit; 7. Quadrupole magnets; 8. Fluorescent target B; 9. Vacuum valve A; 10. Vacuum chamber B; 11. vacuum chammber C; 12. Molecular pump B; 13. Vacuum valve B; 14. Oxygen-Free Copper; 15. Vacuum gauge B.

Fig. 1 Schematic drawing of the experimental device.

According to the above formula, it can be concluded that the measurement precisions of pressure increase Δp and the effective pumping speed S are the key parameters for high accuracy of desorption yields.

The setups of gauge calibration and pumping speed measurement are shown in Fig. 2. The results are shown in Fig. 3. The calibration factor of the gauge is 0.986, which can meet the accuracy requirements. Simultaneously, the pumping speed of the molecular pump is shown in the Fig. 3, the pumping speed is kept at 350 L/s in high vacuum range.

Fig. 2 (color online) The devices of the gauge calibration and pumping speed measurement.

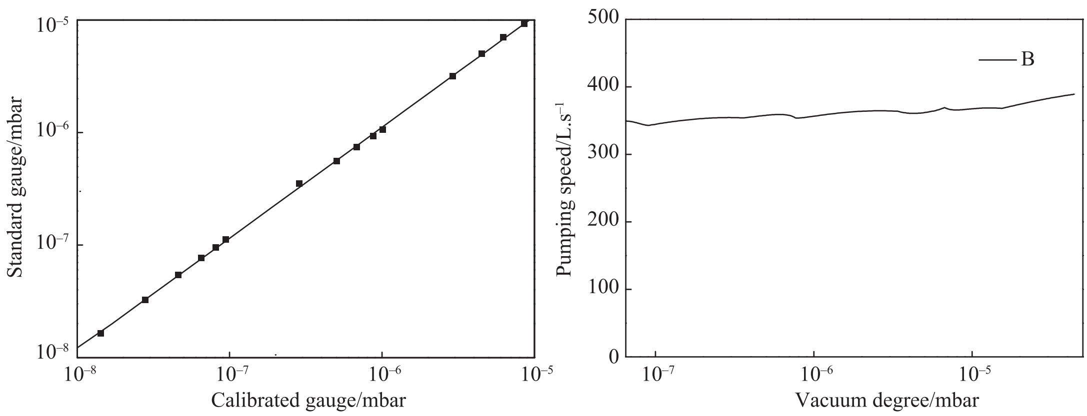


Fig. 3 The results of the gauge calibration and pumping speed measurement.

Based on the above analysis the experimental study of desorption yields was carried out with oxygen-free copper as the test target, and the desorption yields of oxygen-free copper under different energy and different intensity Xe^{10+} and O^{1+} beam was obtained, as shown in Table 1.

The result shows that the desorption yields of oxygen-free copper increases with the increase of beam energy.

Table 1 The desorption yields of oxygen-free copper bombarded with different energy and different intensity Xe^{10+} and O^{1+} beam.

Particle type	Beam Intensity/μA	Beam Energy/keV	Pressure difference/mb($\times10^{-8}$)	Desorption yields/molecules/ion
Xe^{10+}	4	1 000	1.52	42
		1 500	3.11	85
		2 000	3.10	86
		2 500	6.97	193
O^{1+}	5	100	3.78	10
		150	4.83	13
		200	4.97	14
		250	6.57	18

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6 - 28 Vacuum System Predesign of Beam Lines and Terminals in HIAF Project

Chai Zhen, Meng Jun, Yang Xiaotian, Sheng Lina and Ma Xiangli

The HIAF(High Intensity heavy ion Accelerator Facility)project has been proposed by IMP(Institute of Modern Physics Chinese Academy) since 2009. The facility is being designed to provide intense beams of primary and radioactive ion for a wide range of research fields[1]. The complex which latest layout is shown in Fig. 1 includes several parts: BRing SRing, BRing injection beam line BRing extraction beam line, SRing injection beam line low energy nuclear structure spectrometer low energy irradiation terminal, high energy external target terminal, radioactive isotope beam terminal and HFRS as well.

To obtain UHV/XHV (ultra-high vacuum/extreme high vacuum)in ion accelerator is to reduce the beam loss which caused by the beams colliding with the residual gas. According to the requirements of physical design, it is needed to be considered that the problem of vacuum transition where the beam lines linked to synchrotron. Therefore, to achieve transition from UHV to XHV, the vacuum system of injection and extraction beam lines adopt the pattern of baking section and non-baking(conventional) section. The vacuum degree of baking part is as equal as the CSR vacuum system, which pressure is a mean of 6×10^{-9} Pa[2]. And the other vacuum systems all belong to the conventional ones with the design of vacuum degree 1×10^{-6} Pa.

Generally the vacuum system is mainly divided into two parts: 5 conventional systems and 3 compounded ones BRing injection vacuum system whose layout is shown in Fig. 2 is being proposed for instance because of the similar system structure method.

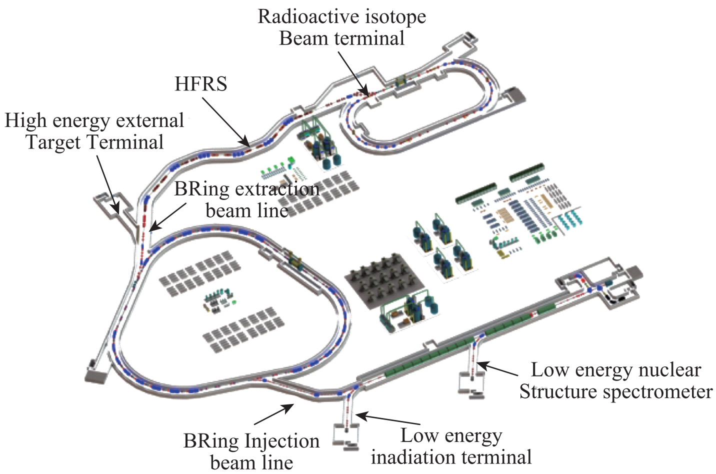

Fig. 1 (color online) Layout of HIAF complex.