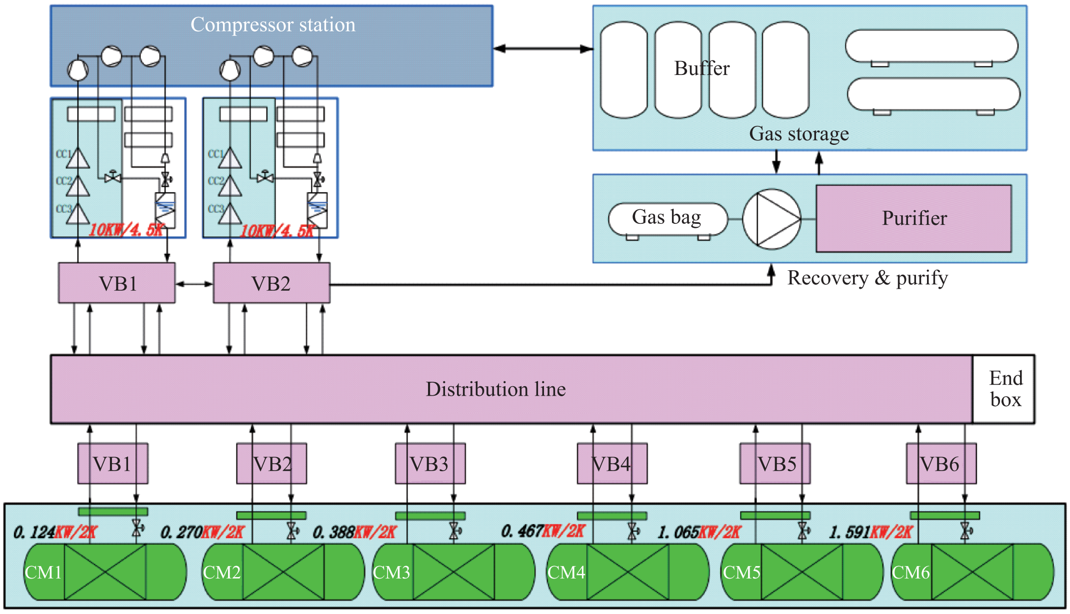

Fig. 2 Simple flowchart of CIADS cryogenic system.

6 - 26 Work Summary of Vacuum Group in 2016

Meng Jun

The main works completed by vacuum group in 2016 are as follows.

1. Operation and maintenance of HIRFL vacuum system

To ensure the normal running of vacuum system of SFC and SSC, a total of more than 15 refrigerators and compressors about CVI, CTI and LEYBOLD have been repaired, a total of 18 adsorbers of helium compressors used for the vacuum system have been replaced, and more than 20 regenerators of cryogenic pumps have been cleaned already, as shown in Fig. 1. Moreover, the cooling water systems of compressors used for SFC and SSC have been updated. Now, the pressure of SFC and SSC vacuum systems are 3.8×10^{-8} mbar and 2.5×10^{-7} mbar respectively. Through the above improvement measures of cryogenic pumps, a great improvement has been achieved compared with the previous vacuum environment.

In the aspect of the operation and maintenance of HIRFL-CSR UHV system, the vacuum system of the second part has been promoted repeatedly, mainly including the installations of a electrostatic deflector and a all-metal CF200 valve as shown in Fig. 2. The pressure of the second part is still within the range order of 10^{-12} mbar after the promotions.

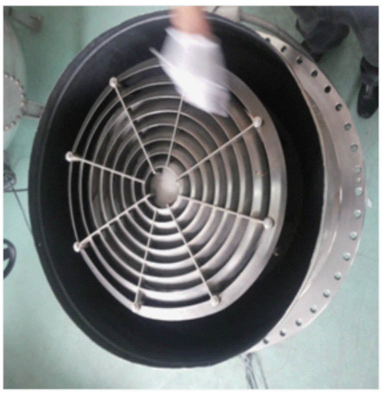

Fig. 1 (color online) Assembly of CTI800 refrigerator.

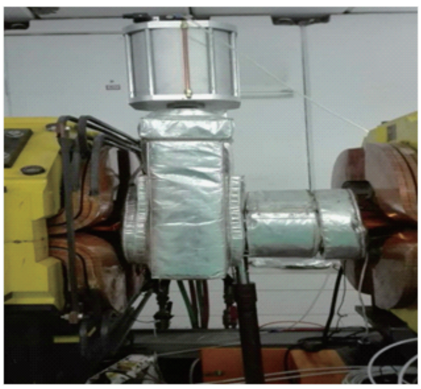

Fig. 2 (color online) Installation of a all-metal CF200 valve.

2. The key technologies of the HIAF vacuum system

In order to suppress the electron cloud in the vacuum system and improve the stability of the ion beam, a experimental study on the TiN film plating on the ceramic vacuum chamber has been developed already and a TiN 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.

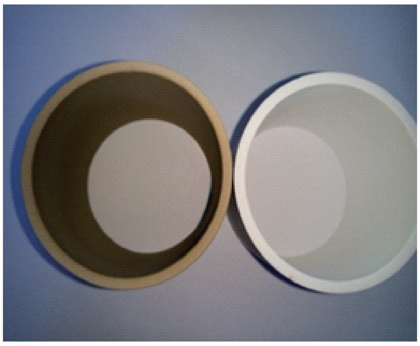

Fig. 3 (color online) The sample of TiN thin film coated on ceramic tubes.

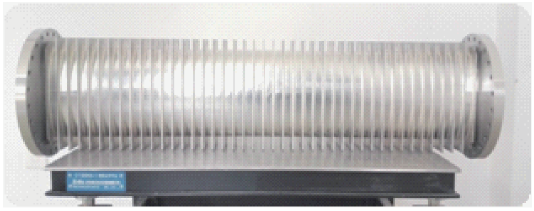

Fig. 4 (color online) The 1.2 m long prototype of thin-wall vacuum chamber.

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]:

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

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).