6 - 29 Design of Ceramic Vacuum Chamber

Yang Weishun

Ceramic material is inorganic, non-metallic, solid, and inert. Alumina ceramic (Al_2O_3) is a kind of important engineering and structural ceramic that has been widely applied in many fields due to its unique high strength, good excellent high-temperature mechanical and electrical insulation properties. However, ceramic is difficult and expensive to fabricate into components with large scales and complex shapes. By joining ceramics to metals, it is possible to combine the respective advantages of ceramics and metals. Active metal brazing has been considered one of the most effective joining methods owing to its simplicity, high bonding properties, and good repetitiveness, as well as its perfect adaptability in terms of joint size and shape.

A ceramic-friendly design is necessary to reliably integrate the ceramic into the overall system. It must be noted that ceramics have a low number of slip systems. Unlike metals, they do not possess any plastic deformation capacity for stress relief, which leads to spontaneous crack propagation. The occurrence of tensile stresses is critical for ceramics, particularly.

To reduce eddy current effect in high-frequency magnetic field, the ceramic tubes are used in accelerators. By using a ceramic-friendly design, we developed runway section ceramic vacuum tube as shown in Fig. 1. Its thickness is 8 mm. The tensile stresses and bending stresses are transferred to the metal, while the ceramics can be exposed to high compressive stresses. The appearance of ceramic vacuum tube is shown in Fig. 2. The structural design shows high gas tightness and mechanical strength. Its leakage rate under metal seal is 5.0×10^{-8} Pa·L/s. The deformation at room temperature is almost zero.

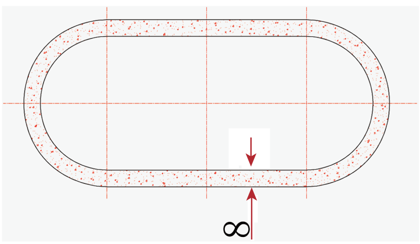

Fig. 1 (color online) Schematic of runway section.

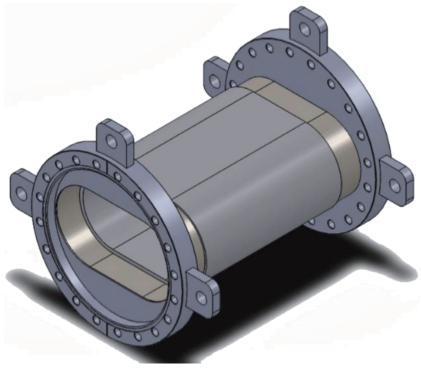

Fig. 2 (color online) Appearance of ceramic vacuum tube.

6 - 30 Work Progress of Slow Control Group in 2016

Wang Yanyu

In 2016, through the efforts of all the members in Slow Control Group in IMP, we had got several good results in HIRFL-CSR control, monitor and alarm system. In HIRFL-CSR operation and maintenance area, our group is in charge of the running and maintains of several accelerator state monitor and alarm systems such as the water leakage detection system, the water pressure/temperature monitor system, and magnets temperature monitor system, vacuum detection, ion source control system, and so on. Main achievements in HIRFL maintenance and other research work are listed below:

(1) **Design of Dose monitor and gate control system for personal safety in HIRFL-CSR.** For personal protection purposes, the slow control group designed a dose monitor system and a gate control system for the radiation protection group in HIRFL-CSR. The hardware design of these two controllers is based on TI's MSP430F169 mixed signal processor and the GUI design is based on C++. Up to now, the dose monitoring system has been successfully applied in Linac and RIBLL1, and the gate controller is applied in the HIRFL-CSR personal safety interlock system. These two systems are stably running since installed in Aug. 2016.

(2) **Upgrade of Electronic Cooler Control System in HIRFL-CSRm.** This work realized some important device control in electronic cooling equipment, including the current and voltage read of the HV power, voltage set, slight tuning function, the leakage current curve show and the temperature, magnetic switch state monitoring