With the PLC(Programmable Logic Controller)redundancy, it is important and necessary for the particle accelerator machine protection system to improve its stability and efficiency. The master PLC and slave PLC are connected by optical fiber, and the interval distance between the two PLC can be 80 km. If the master PLC goes wrong, the slave PLC will take over the work. The switch time can be very short, so the system will be worked uninterrupted and stably. Fig. 1 shows the hardware of both master and slave PLC controllers.

EPICS(Experimental Physics and Industrial Control System) is used in this control system. The EPICS IOC (Input/ Output Control) redundancy and the seamlessly switch between the master and slave PLC have been finished and achieved in machine protection system. If the IOC cannot receive data from the master PLC, the connection will be closed and a new connection with the slave PLC will be established. The redundant system can communicate with the EPICS IOC successfully and the parameters can be also easily monitored, modified and stored by this control system based on EPICS. Fig. 2 shows the testing interface of EPICS communicated with PLC. The IOC program and the interface will be modified and perfected in the further work.

References

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6 - 14 Automated Facility for SRF Cavity BCP Process

Guo Hao, Xiong Pingran, You Zhiming, He Yuan and Shi Zhixiong

Buffered chemistry polishing (BCP) has been widely used for surface treatment of SRF cavities, which uses mixed acid with hydrofluoric, nitric and orthophosphoric. There is a simple BCP facility for BCP processing of HWR cavities in IMP, currently. But there are several defects for BCP processing with this facility. For example, the operators have to mix acid manually, which increases the risk of operators hurt by acid; the process fumes have to be exhausted to the outdoor, which is harm to environment. In order to solve these defects, an automated BCP facility has been designed and processed.

Fig. 1 The photograph of automated BCP facility.

The automated BCP facility is shown in Fig. 1, which concludes 4 cells: 1 cell for BCP etching, 2 cells for acid mixing and 1 cell for acid transporting. The main concept of this facility design is to provide the safest environment for entire BCP processing. The most pipelines are installed in the cells which is made of polypropylene (pp), and the rest pipelines which are used for transporting acid in and out are placed in a PVC pipeline to prevent acid leaking. The control system is separated from pipeline, cavity and acids, which could protect operators from exposure to acids and fumes. The frames of facility are made of PP, and the pipelines used for acid transporting are made by PVDF which is one of the best anti-corrosion materials. The pipelines used for ultra pure water (UPW) transporting are made by C-PVC which could maintain the quality of UPW. There are two methods for reaction temperature controlling: acid cooling and cavity spray cooling. The ventilation system is designed to capture fumes at potential source, such as tanks of acid, inside cells and so on and the fumes would been transported into neutralizing tower for filtering nitrogen dioxide and hydrogen fluoride.

There are several detectors used for monitoring the condition of the facility. The temperature probes are used for monitoring the temperature change of acids before and after etching. There are hazardous gas detectors in every cell, which are used for monitoring NO_2 and HF. A pH meter and a resistivity meter detect the acidity and resistivity of the rinsing water.

The facility could complete the BCP processing which includes acid mixing, sealing test, acid cooling, etching and water rinsing automatically, and the acid mixing cells and acid transporting cells could be used for S. C. niobium parts chemical etching machine and EP facility. The processing of automated BCP facility has been completed and it is waiting for installing.

6 - 15 Progress of Barrel Polishing of HWR Superconducting Cavity

Zheng Hai, You Zhiming, He Yuan, Xiong Pingran, Wang Wenbin and Shi Zhixiong

Barrel polishing (also called CBP or roll grinding and polishing) is generally used in polishing treatment of cell type Niobium cavity wall and able to remove irregularities like scratches and especially any roughness at electron beam weld seams. The mixtures of water and ceramic particles or plastic particles are put in Niobium cavity. By means of horizontal rotary of cavity, the polishing effect can be achieved by centrifugal force which leads to relative movement between abradant and cavity wall. Before chemical treatment to cavity, roll grinding and polishing are applied to wipe off thicker Niobium layer and then EP or BCP is used to remove thinner ones. There is no inner conductor for cell type Niobium cavity, so Niobium cavity can be effectively removed by roll grinding and polishing. The removal efficiency is related to abradant composition and rotate rate. At different rate, the polishing quantity could reach from 0.4 to 25 μm/h. But for HWR type cavity, the cavity is composed by internal and external conductor. With great current density, the inner conductor is the mainly distribution area of electric field. Therefore, the polishing effect of inner conductor should be considered when roll grinding and polishing are used to surface treatment for HWR type cavity. Small centrifugal force and appropriate addition of abradant are needed to polish internal conductor.

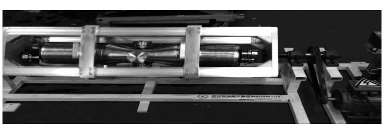

Fig. 1 Device of roll grinding and polishing.

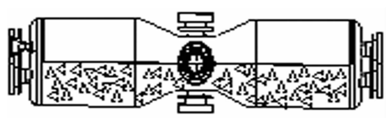

Fig. 2 Theory of polishing.

In order to obtain appropriate technology, different technological parameters were selected during roll grinding and polishing. The cavity was polished for two times and two kinds of parameter were adopted. The data is described as follow. Microstructure of cavity and removed thickness were investigated in detail.

Table 1 Polishing parameters

	Rotation rate (r/min)	Addition quantity (kg)	Proportion of volume (%)	Polishing time (h)
First time	42	3.7	23	96
Second time	60	9.7	58	96

The sampling shooting was conducted by endoscope at internal and external conductors in cavity after polishing, especially near weld joint at inwall.

For the first time polishing, little abradant was added, polishing material did not exceed the central line when held horizontally as shown in Fig. 2 and lower rotation rate was used. After 96 h rotation, internal conductor polishing was inefficient and much sputtering placed near weld joint. Meanwhile, external conductor polishing showed good effect and sputtering cannot be found.