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FIRST TEST OF ELECTROPOLISHING SYSTEM AT IMPCAS

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Abstract

IMP（Institution of Modern Physics） has designed, fabricated and installed the first SRF cavity electropolishing system of China. It is sized for 1.3GHz SRF cavities, and works for multiple cell cavities with further upgrade of structure.

INTRODUCTION

Producing high field and Q-values in superconducting RF cavities of niobium has required the removal of a substantial layer of the inner cavity surface, typically of the order of 100 microns in depth. Two methods have commonly been used: EP (electropolishing) or BCP (buffered chemical polish). EP of niobium cavities is proving to yield consistently better performance than BCP [1, 2]. To take advantage of high performance levels obtainable with EP technique, a completed EP system was installed and operated at IMP.

IMP EP SYSTEM

The electropolishing system, consists by a chiller, a heat exchanger, an acid sump, tilt-rotation tooling and instrumentation for process control and direct current power supply variable up to 160 amperes and 40 volts. Figure 1 and 2 shows the end groups of tilt-rotation tooling designed for assembly and disassembly of cavities and electrodes into and out.

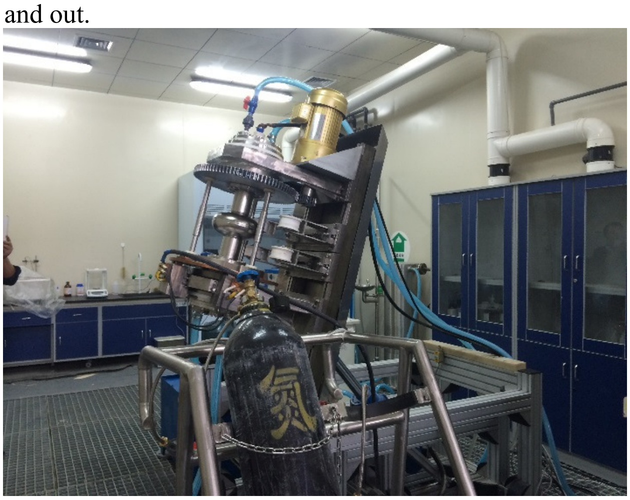

Figure 1: Tilt and rotation tooling on the vertical section.

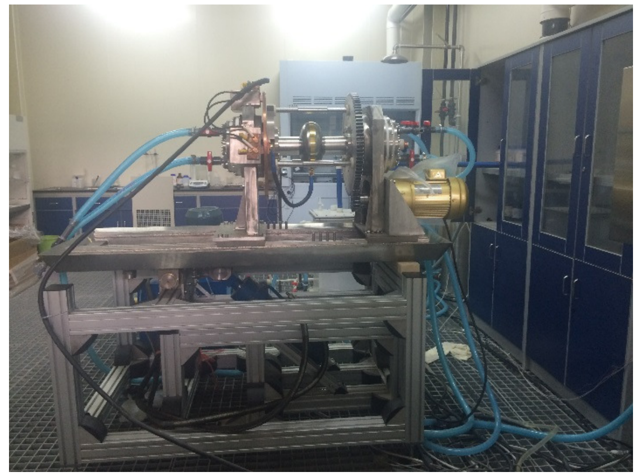

Figure 2: Tilt and rotation tooling on the horizontal section.

FIRST TEST OF EP SYSTEM

Our first 1.3GHz one-cell cavity test has been started. Figure 3 and 4 shows the typical Voltage-Current Density curves as a function of adjustments of the working parameters by use two different shapes of cathodes. Figure 3 shows the U-C curve of system run with a regular kind of cathode. It's a straight stick made up with pure aluminium. We control the acid temperature between 12 to 18 ˚C with heat exchanger and cavity outside cooling water spray. Figure 4 also shows the U-I curve of system run with a different kind of cathode. It's designed by our institute. It looks like a boot and also made up with pure aluminium. The flow acid temperature was controlled between 12 to 18 ˚C. We control the system run with different acid flow rate about 4 L/min, 6L/min and 8L/min. And under each flow rate, we try different rotation speed of 1rpm, 2rpm and 3 rpm. Here, we use different parameters of the shape of cathode, rotation speed and acid flow rate, to try to find out the optimal processing control. Compared Figure 3 and 4, the new shape of cathode working under 1rpm, 4L/min acid flow rate, power supply between 18 to 20 v is the optimal parameter of processing control for this EP system with one-cell cavity.

Figure 5 shows the comparison of inner surface performance of one-cell cavity after bulk BCP and EP (the surface removal of more than 100 μm).

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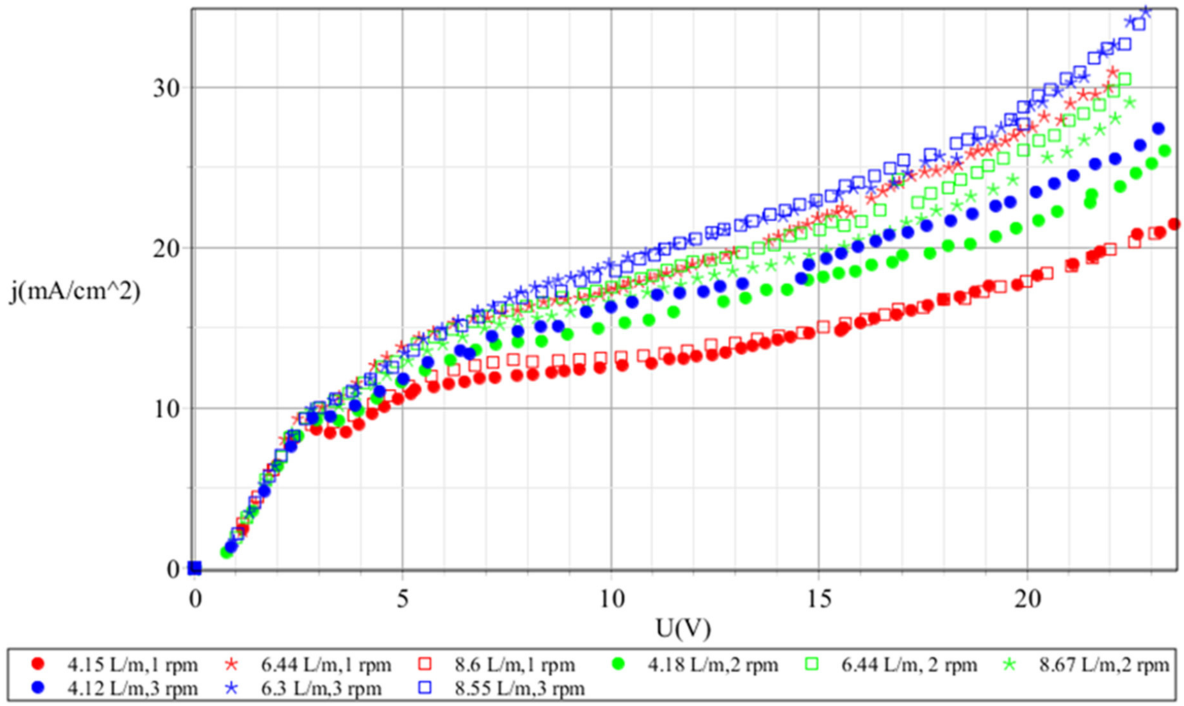

Figure 3: U-I characteristic for a one-cell SRF cavity at different rotation speed, acid flow rate with stick cathode.

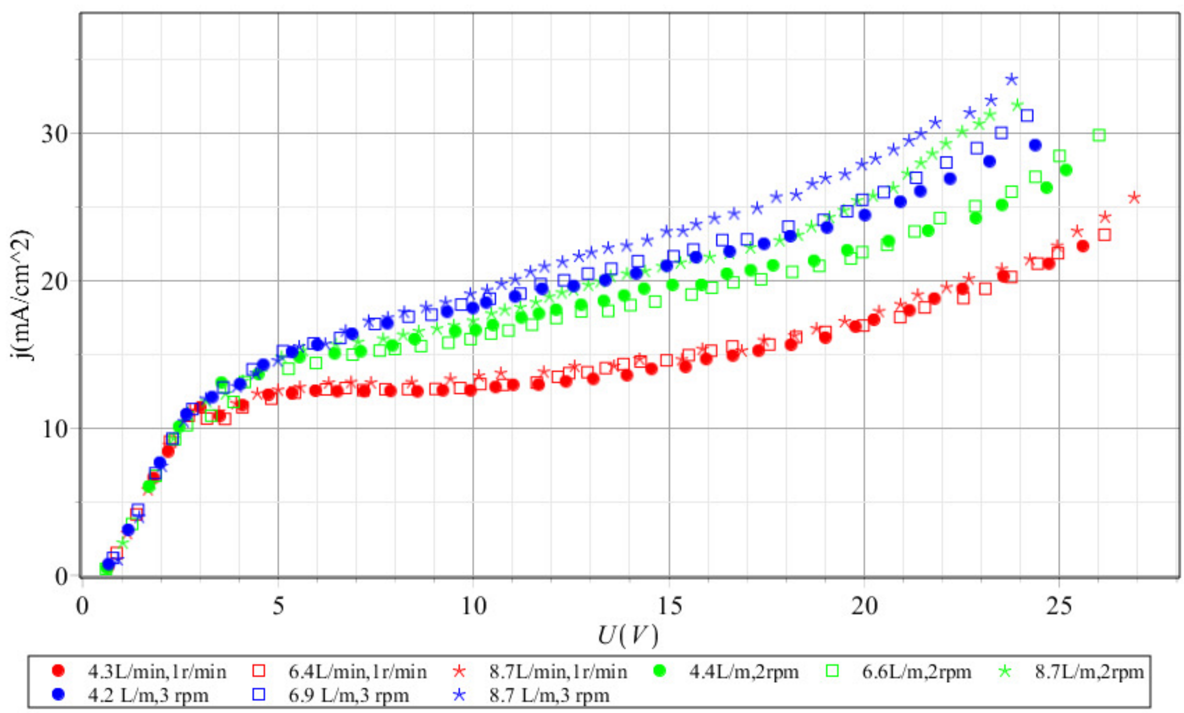

Figure 4: U-I characteristic for a one-cell SRF cavity at different rotation speed, acid flow rate with boot cathode.

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Figure 5: The inner surface of one-cell cavities after EP (left) and BCP (right).

CONCLUSION

EP process obtained optimally more smooth and bright surfaces than BCP. This can be demonstrated that EP process is an essential step in the processing of high gradient SRF cavities. The further process optimization and understanding will be pursue.

REFERENCES

[1] J. Mammosser *et al*., in *Proc. PAC'03*, paper RPAB062.

[2] Andy T. Wu *et al*., "Smooth Nb surfaces fabricated by buffered electropolishing", vol. 253, pp. 3041-3052, 2007.