

## SRF CAPABILITIES AT ACCEL IN VIEW OF ILC/XFEL

Michael Pekeler, Stefan Bauer, Michael Peiniger, Hanspeter Vogel, Peter vom Stein,  
ACCEL Instruments GmbH, Bergisch Gladbach, Germany

### Abstract

In the last decade, ACCEL has manufactured a variety of prototype SRF cavities but also more than 100 TESLA shape 1.3 GHz 9 cell cavities and more than 100 SNS 805 MHz 6-cell cavities. For the ILC R&D at FNAL, we have delivered 12 ILC 9-cell 1.3 GHz cavities and are currently producing 12 additional such cavities. ACCEL is prepared for the industrial production of cavities, couplers and also the module assembly for the XFEL. We have internally evaluated the needs and costs for an in house production of the XFEL cavities. Within an industrial study we have analyzed the coupler production for the XFEL, developed a series production adapted XFEL coupler design based on the TTF-III coupler and determined the costs for the series production. ACCEL participated also in a module assembly study and investigated the costs for manpower and infrastructure to manufacture the needed modules for the XFEL within the foreseen time of three years. Last year ACCEL was contracted by DESY to build up an industrial plant for electro polishing 1.3 GHz 9 cell cavities. This plant is in routine operation since November 2007 and we have successfully electro polished the first series of 10 cavities for DESY.

### MANUFACTURING OF XFEL AND ILC CAVITIES

More than 100 XFEL and ILC cavities have been manufactured at ACCEL in the last 10 years. Also the production of the titanium helium vessel and the welding of the helium vessel to the cavities is standard procedure at ACCEL. Typical manufacturing times are currently 6 months after receipt of material. For various customers we have also purchased the necessary reactor grade and RRR niobium as well as the niobium-titanium flange material.



Figure 1: XFEL cavity before and after welding of the helium vessel. The vessel shown (Rossendorf design) is of slightly difference than the XFEL helium vessel. Original XFEL helium vessel have been also produced.



Figure 2: First 4 ILC cavities prior shipment to FNAL. For FNAL the purchasing of the niobium material was within our scope.

### STANDARD PREPARATION OF XFEL CAVITIES FOR HOBICAT TESTS AT BESSY

For BESSY ACCEL has produced four XFEL cavities so far and has furnished those cavities with helium vessel. In collaboration with BESSY, the cavity preparation including buffered chemical polishing, high pressure water rinsing and clean room assembly with high power coupler was done at ACCEL on two of those cavities. The cavities were then tested by BESSY in their horizontal test cryostat HOBICAT. Gradients close to the XFEL specifications were reached already (see figure 3). We have installed more diagnostics as for example particle counter for determination particle content in the outlet water during high pressure water rinsing, to further improve the quality and the reliability of the cavity preparation. A test program of 5 consecutive cavity preparations is currently under way.

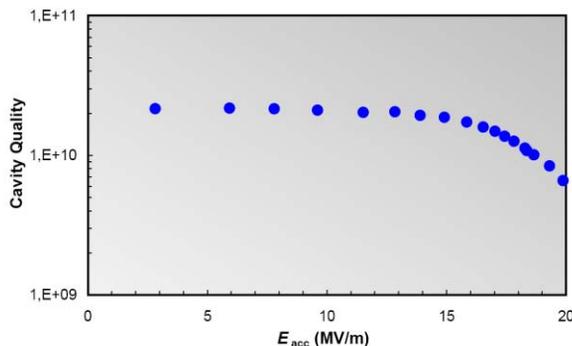


Figure 3: Test result of cavity completely prepared for horizontal test at BESSY. The cavity received buffered chemical polishing, high pressure water rinsing and clean room assembly (including high power coupler assembly). The results are close to XFEL specification of 23 MV/m.

## CONSTRUCTION OF EP PLANT FOR XFEL CAVITIES

DESY contracted in January 2007 an industrial plant for electro polishing XFEL 9-cell cavities. The basic design parameters were specified by DESY and taken from their existing EP plant. ACCEL built up the plant with special view on the industrial series treatment of cavities for the XFEL project. In November the first cavities were treated in the new EP plant. The test results achieved so far are very encouraging. More than 35 MV/m were achieved at tests at DESY.

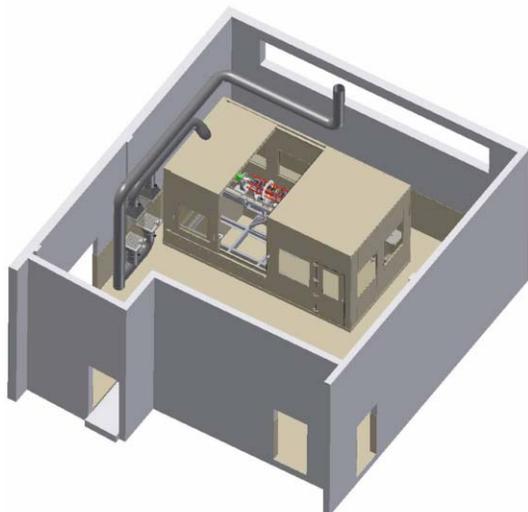


Figure 4: Layout of EP plant at ACCEL, EP plant is integrated into an existing building and installed inside a housing. The complete building is air conditioned and pressure controlled.

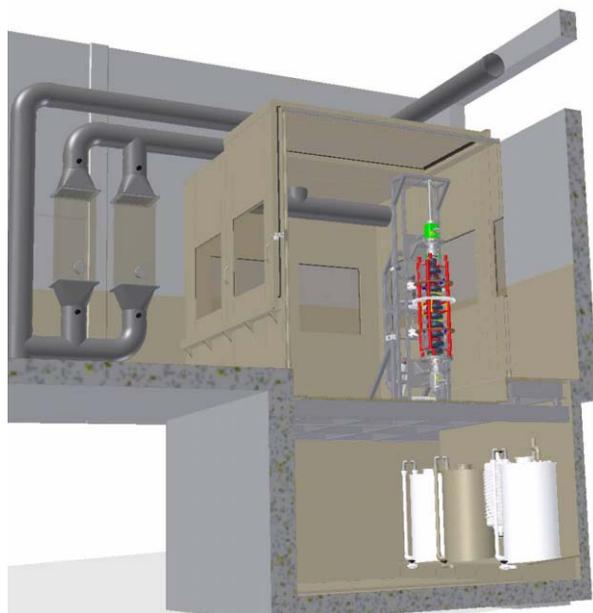


Figure 5: Cut through EP plant showing that it is built above a pit. All chemical installations like containers, pumps and all piping are mounted inside the pit.



Figure 6: Completely installed and commissioned EP plant at ACCEL. In this plant every day at least one cavity can be treated.

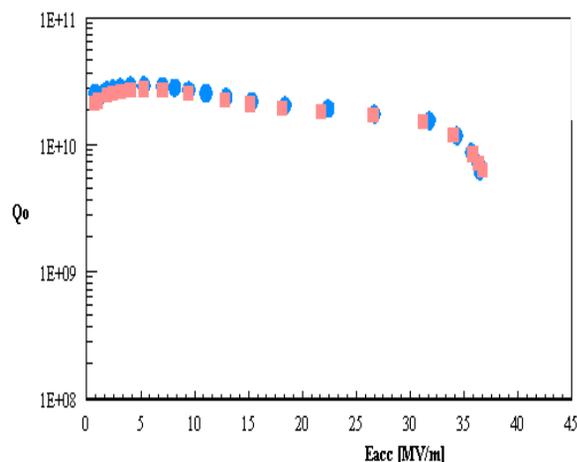


Figure 7: Vertical test result of 9-cell 1.3 GHz XFEL cavity treated with EP at ACCEL and high pressure rinsed, assembled and tested at DESY.

The new electro polishing plant is used currently only for removal of the first 130-150  $\mu\text{m}$  from surface (damage layer removal). However, the plant is designed to allow also final treatment prior high pressure water rinsing and clean room assembly for a later XFEL series production. We expect that at least one cavity treatment can be done in this plant every day.

## INDUSTRIAL STUDIES FOR XFEL

ACCEL has conducted two industrial studies in the last two years for the XFEL project. In a study for DESY the XFEL module assembly was analyzed. ACCEL personnel witnessed the assembly of two XFEL modules at DESY. In addition the cost for the assembly of all XFEL modules was calculated and will be presented to DESY soon.

FOR LAL a study for production of all XFEL couplers were performed. Part of this study was the production of two prototype XFEL couplers. Those couplers were designed according to the required RF, thermal, geometrical and vacuum specifications. The two

prototype couplers will be tested at LAL soon. Based on this design, the cost for the production of all XFEL couplers was calculated.

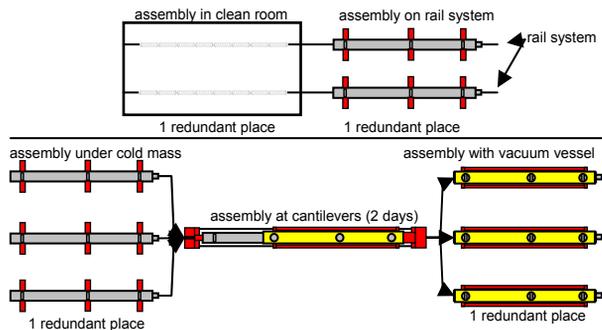


Figure 8: Layout of assembly hall for assembly of all XFEL modules within two years period of series production (ramp-up not included).

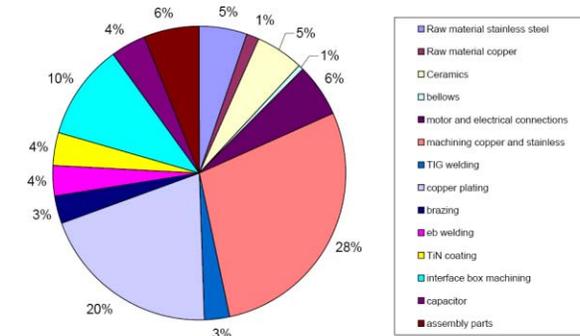


Figure 9: Cost distribution of XFEL high power couplers.

### CONCLUSION AND OUTLOOK

In the last years ACCEL steadily developed know how and infrastructure for manufacturing superconducting cavities and couplers as well as for processing these key accelerator components. Our capability and productivity in mass production of short term projects like the European XFEL has improved accordingly.