SRF ACTIVITIES AT ACCEL INSTRUMENTS

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Abstract

We report on the current activities and achievements in the field of SRF technology at ACCEL Instruments. During the last two years a wide range of projects covering cavity and component production, cavity surface preparation, SRF module development and construction has been carried out. Details of the results will be presented in the related papers.

CAVITY FABRICATION

It is widely recognized that TESLA technology is the actual driving motor for the development of high performance superconducting cavities. During the last two years we supplied about 100 TESLA type cavities for laboratories worldwide as supply for XFEL or ILC. The strict application of TESLA quality assurance rules and further improvements developed in house is the basis for high rf performance reached at the different laboratories. The cavity supply is adapted to the specific needs of the customer. It reaches from the bare cavity after final machining to finally tuned cavities with BCP surface preparation and high pressure rinsing.

New materials like large grain niobium sheets or even single crystal material demand adaptation of the deep drawing, rolling or electron beam welding processes to changed material parameters. Meanwhile ACCEL supplies TESLA nine cell cavities manufactured from large grain sheet material and single crystal one cell cavities. Together with DESY we developed a process for joining single crystal cavity half cells maintaining the crystal orientation of the base material across the welding joint [1].

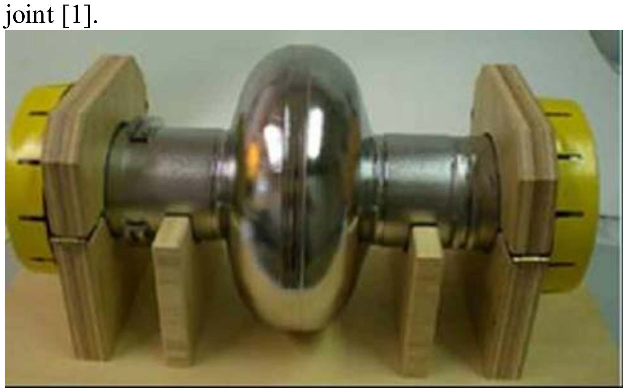

Figure 1: 1.3 GHz single crystal cavity for DESY

The high performance of TESLA type cavities encouraged accelerator laboratories worldwide to apply these optimized fabrication technologies to non electron accelerator projects. ACCEL applied TESLA standards for the fabrication of SPIRAL 2 quarter wave resonators [2] and SARAF half wave resonators.

Todays probably most complex rf resonator fabricated from niobium sheet material is the superconducting CH mode prototype cavity for Frankfurt University [3]. The 360 MHz cavity integrates 19 accelerating gaps into one cavity. This cavity was fabricated at ACCEL including final chemical surface preparation and high pressure rinsing. The achieved peak surface field of 36 MV/m sets a benchmark for cavities with geometries, which have only a very limited capability for being optimized to high pressure rinsing processes.

Figure 2: CH mode cavity before end cap welding

CAVITY SURFACE PREPARATION

During the last years ACCEL upgraded its facility for cavity surface preparation. The starting point was the buildup of a closed loop buffered chemical polishing (BCP). This installation laid the foundation for the fabrication of turn key sc accelerator modules with guaranteed performance on our site. The BCP system was supplemented by two high pressure rinsing systems (HPR) integrated into our clean room facilities.

Currently the installation of an electro polishing (EP) system at ACCEL was finished under the contract of DESY. First test runs are under way. The goal is to establish the necessary surface preparation infrastructure at industry for XFEL.

TURN KEY ACCELERATOR MODULES

Based on the superconducting cavity fabrication ACCEL expanded its business in turn key sc accelerator modules. Meanwhile five synchrotron radiation facilities are supplied by ACCEL with Cornell's CESR B-type accelerator modules [4]. The last modules were recently delivered to the Shanghai Synchrotron Radiation Facility

(SSRF). The results of the cavity tests for the different accelerator modules are summarized in figure 5. The uniformity of the Q(E) curves shows a very good reproducibility of the cavity preparation procedures. All cavities met their specified accelerating voltage >2 MV at a Q value > $5x10^8$.

Figure 3: Cornell type module with valve box and LLRF

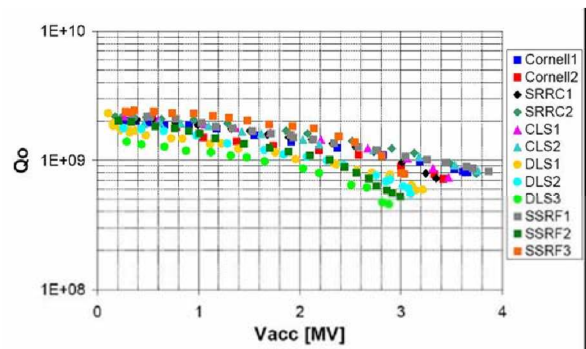

Figure 4: Cornell type cavity test results

ACCEL is the only company still providing the technique of magnetron sputtering a niobium layer onto copper cavities, a technique developed at CERN for the LEP cavities. For SOLEIL ACCEL is currently producing one spare storage ring accelerator module housing two single cell Nobium/Copper cavities. The module is in the final assembly stage. The bare cavities were sent to CERN for rf testing after final surface preparation at ACCEL. The results are shown in figure 5.

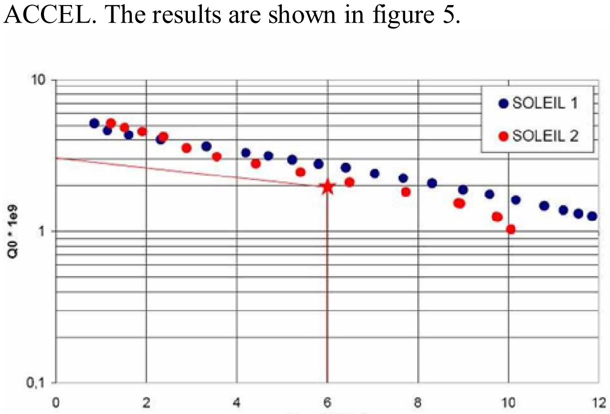

Figure 5: SOLEIL cavity test results

This year ACCEL finished the installation and commissioning of two FZ-Dresden type accelerator modules for the Energy Recovery Linac Prototype (ERLP) at Daresbury Laboratory [5]. ACCEL manufactured two superconducting accelerator modules for the injector and the linac, operating at 2K with 1.3 GHz TESLA type cavities. Each module contains two cavities and is designed to provide an accelerating voltage of 25 MV in cw mode. The superconducting bi-cavity modules (figure 6) are optimized for operation in cw mode with moderate beam currents. The module design has been developed at Forschungszentrum Dresden and is used under a license agreement.

Figure 6: FZ Dresden type module before shipment

The SRF cryomodule is a key component of the ERLP which will be used as a test bed to investigate the new technology of ‘energy recovery’ and CW operation, and resolve many issues specifically identified for the development of 4GLS.

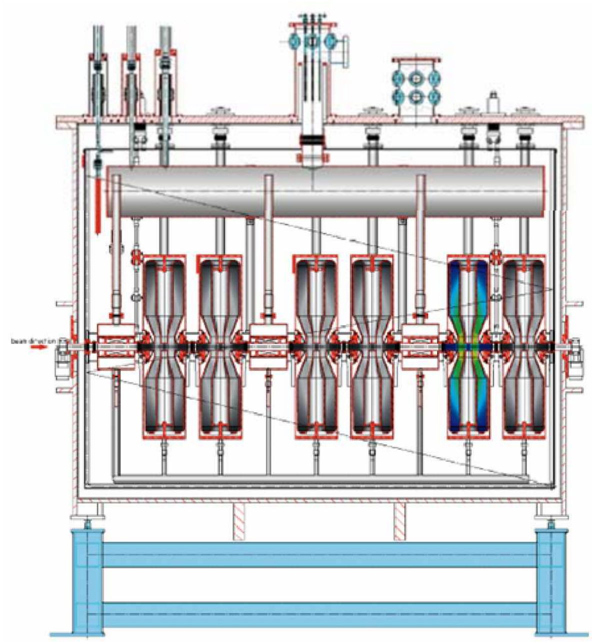
Figure 7: Cross section of the SARAF module

For the 40 MeV Proton / Deuteron accelerator at SOREQ a superconducting halfwave resonator RF module was designed and built by ACCEL. Six half wave cavities with a frequency of 176 MHz accelerate the Proton / Deuteron beam from 1.5 MeV/u to about 7 MeV/u. Three superconducting solenoids are integrated into the module for beam focusing. The module was completed in December 2006 and sent to SOREQ. After completion of the cryogenic installations the module is now under final commissioning. A cross section of the module is shown in figure 7.

REFERENCES

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