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ILC-Americas
FY06 Work Package Technical Progress Report

Work scope period: 10/1/05 to 7/1/06
Work Package WBS Number: 3.9.2.1
Work Package Title: Fabrication of two 9-cell TESLA cavities from large Grain Niobium
Work Package Leader :P. Kneisel
Laboratory: Lab
Date: Aug. 2, 2006

1. Technical progress.

Monthly progress reports on this work package have been submitted to Helen Edwards as the FNAL representative for the MOU with Jlab.

- All raw cavity parts have been fabricated
- All dumbbells have been welded with stiffening rings
- Frequency measurements on the dumbbells are being done presently and subsequently the dumbbells will be trimmed to the appropriate dimensions and frequency.
- End groups are in fabrication, some weld parameters for some components (e.g. HOM cans) are being developed.
- 30 raw end groups have been ordered from W. C. Heraeus with a delivery in September. Six cans have been loaned from DESY and need to be replaced.
- We anticipate that the fabrication will be completed during September

2. Goals and plans for the remainder of FY06 and beyond

a. The cavities will be tuned, hydrogen degassed and after buffered chemical polishing tested at 2K
b. During BCP a stirrer for the acid will be used to achieve uniform material removal; this system has been delivered.
c. DESY has offered to purchase three helium vessels as a "tag-on" to their presently placed PO; these helium vessels will be delivered soon
d. Helium vessels will be welded onto the 9-cell cavities, followed by an additional cold test.

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FY06 Work Package Technical Progress Report

Work scope period: 10/1/05 to 7/1/06
Work Package WBS Number: 3.9.2.1
Work Package Title: Fabrication of two TESLA 9-cell cavities from polycrystalline niobium

Work Package Leader: Peter Kneisel
Laboratory: Jefferson Lab
Date: Aug. 3, 2006

1. Technical progress.

e. No funds have been spent on this work package
f. A material list is being put together and the material will be requested from FNAL
g. A tentative schedule (on a best effort basis for the fabrication) is being developed.

2. Goals and plans for the remainder of FY06 and beyond

- As priorities at Jlab permit it, the two cavities will be fabricated

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FY06 Work Package Technical Progress Report

Work scope period: 10/1/05 to 7/1/06
Work Package WBS Number: 3.9.3.2
Work Package Title: EP and Vertical Testing at JLab
Work Package Leader: J. Mammosser
Laboratory: JLab
Date: Aug. 3, 2006

1. Technical progress.

Monthly progress reports on this work package have been submitted to Helen Edwards as the FNAL representative for the MOU with Jlab.

Adapt Production Tooling to 9 Cell Cavity

- All tooling for processing 9-cell cavity completed, several development runs completed and starting on production runs for first production cavity
- All tooling for testing a single 9 cell cavity completed, a second setup is still needed to meet ILC R&D tight loop planning

Develop Production Procedures

- Five assemblies and vertical tests completed
- Integrated particulate monitoring and video taping completed (reference starting point)
- Started development on improved assembly techniques which includes monitoring and tooling for hands free assembly
- Demonstrated that quenches reached on cavities in vertical is multipacting barrier

Develop EP Procedures

- Investigations on rotation speed, flow rates completed
- Investigation on anode contact point underway (processing with helium vessel)
- Investigation on HF monitoring started
- System operational and many improvements completed
- Final electropolish on S35 completed

Process, Qualify &Turnover 8 Cavities to FNAL for String Assembly

- A-7 Bulk electropolish completed

Electropolish Development

- Single cell cavity process cabinet moved into place
- Single cell facilities and hardware underway
- Last four of the five assemblies show no field emission up to multipacting barriers

2. Goals and plans for the remainder of FY06 and beyond

FY06

- Complete treatment, tuning, processing and vertical testing of A-7 cavity
- Complete the first flow and thermal model for the Jlab EP process system
- Complete and implement a prototype HF monitoring cell for the chemical sump

FY07

- Complete the processing on the 7 nine cell cavities for FNAL
- Develop procedures and weld helium vessels to all eight cavities
- Deliver cavities to FNAL

Jefferson Lab is just getting started with the electropolishing of nine cell cavities and has not yet demonstrated ILC gradients, therefore it is most important to determine if the processes and facilities at JLab are capable of meeting the gradient requirements. The focus of FY06 and FY07 is and will be to determine what problems will be encountered and to quickly overcome them by adapting processes and procedures as necessary to achieve gradient and Q-value goals as outlined. Throughout this process an understanding of performance variability at JLab and the parameters that affect it will be the focus of our efforts. This understanding will be approached by several methods as follows:

- Single cell cavity processing and testing focused on reaching high gradients as well as identifying the reason for Q-disease in some cavity tests
- 9-Cell cavity assembly performance improvement through reduced field emission by applying specialized tooling to reduce assembly errors and particulates

- Improving process understanding and monitoring with focus on the following:
    - HF loss and its monitoring
    - Better understanding of the chemistry and QC of the electrolyte mixture
    - Reduction of sulfur residues by applying appropriate cleaning methods after electropolish procedures are completed without damaging cavity performance

This work will be carried out in a collaboration of international efforts as well as a focused Jefferson Lab with involvement of local Universities.

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ILC-Americas
FY06 Work Package Technical Progress Report

Work scope period: 10/1/05 to 7/1/06
Work Package WBS Number: 3.9.5
Work Package Title: Development of a Superstructure for the ILC based on large grain/single crystal high purity niobium
Work Package Leader: Peter Kneisel
Laboratory: Jefferson Lab
Date: Aug. 2, 2006

1. Technical progress.

This work package has been established to evaluate the performance of cavities made from large grain/single crystal niobium and to pursue the possibility to use superstructures as an ACD alternative to the "standard" 9-cell TESLA-type cavities for ILC. Collaborators in this package are: J. Sekutowicz, DESY, G. Ciovati, JLab, and G.R. Myneni, JLab.

Milestone goal 1:

Fabricate and evaluate several single cell cavities and at least one multi-cell cavity of the LL design, made from large grain/single crystal niobium

- Several single cell cavities of various shapes and frequencies, made from 8 ingots from 4 different suppliers and different properties (CBMM, Ningxia, W. C. Heraeus, Wah Chang) have been fabricated and tested after BCP only.
- All cavities are limited by quench.
- With two single crystal cavities gradients (peak magnetic surface fields) of $E_{acc} \geq 45$ MV/m ($B_{peak} \geq 165$ mT) have been achieved.
- The best performances of the large grain cavities are as listed.
  30 MV/m ≤ E_{acc} ≤ 36 MV/m ("quench" fields 128 mT ≤ H_{peak} ≤ 160 mT)
- There is no systematic dependence of cavity performance on RRR – value or Ta content (120 ppm to 800 ppm) as a recent comparative study of TESLA-shape

cavities made from W. C. Heraeus, Ningxia and CBMM material showed. The spread in the achieved gradients was ± 5%.

- To gain better statistics, 5 cavities each from Ningxia and W. C. Heraeus niobium will be evaluated. The cavities from the Ningxia material are in fabrication, the W. C. Heraeus niobium is on order. Two nine-cell TESLA cavities are in fabrication from CBMM material.
- One TESLA cavity was made from CBMM material. In a separate development, two proton driver cavities were made from the same material. Consistent performance was obtained from all three, ranging from 131 mT $\leq H_{peak} \leq$ 148 mT.
- Stiffening rings have been welded onto the CEBAF 7-cell LL cavity made from large grain material; this cavity is being tuned (it turned out to be more difficult than anticipated without them).
- Material studies (mechanical formability, oxidation behavior of single crystals of different orientation, interstitial interactions and internal friction) are on-going.
- Q vs. E_{acc} (H_{peak}) behavior at high fields ("Q-drop") is being studied and the influence of the oxygen distribution in the penetration depth is being explored.

Milestone goal 2

Implementation of an improved buffered chemical polishing system for producing very smooth rf surfaces on large grain/single crystal material

- This system has been received.
- It will be used for the BCP of the 2 large grain 9-cell TESLA cavities being fabricated for FNAL (Work package 3.9.2.1.).

Milestone goal 3/4

Fabricate a test cavity for superconducting rf joint investigations and provide test results

- A TM_{010} test cavity for joint investigations has been fabricated as well as a two-cell cavity of the TESLA design has been transferred from DESY to JLab.
- A test of each cavity has been done, however, with little success so far.
- More tests with different joint and gasket configurations are in preparation.
- A single cell cavity from Nb55Ti is in fabrication to explore the SRF capability of Nb55Ti (the present sc joint scenarios depend on Nb55Ti flanges carrying rf currents).

Milestone goal 5

Optimization study of super-structure configurations

- Some work is continuing at SLAC (K. Ko) guided by J. Sekutowicz of DESY.

2. Goals and plans for the remainder of FY06 and beyond

- Complete the statistical study of various large grain materials (Ningxia, W. C. Heraeus, CBMM) as indicated above.
- Complete the testing of the 7-cell LL cavity after final tuning.
- Explore various sc joint and gasket configurations on the test cavities as described above.
- Test the Nb55Ti cavity several times and explore the limitations of this material.
- Continue with optimization studies for a super-structure configuration.
- Fabricate possibly an additional 9-cell LL cavity (if the 7-cell test is successful).