

ILC R&D Board Task Force on High Gradients (S0/S1)

Request for Consultancy from TTC

H. Hayano, T. Higo, L. Lilje, J. Mammosser, H. Padamsee, M. Ross, K. Saito

Version: 31-Aug-06

1 Introduction

The TTC has been addressing issues related to the high-gradient performance of bulk niobium cavities since a long time. Although very high gradients have been achieved in individual nine-cell cavities, a significant variation of maximum gradients has been observed in production-like experiments in the preparatory work for the XFEL¹. For the demanded higher gradients of the ILC the current yield of the cavity preparation cycle is not sufficient. Therefore, a task force has been set up by the GDE R&D board to develop an R&D programme which addresses this issue². The ILC R&D Task Force on High Gradients (or S1 Task Force for short) acknowledges the important work of the TTC in addressing the cavity performance issues.

Specifically, the TTC has addressed the following issues related to cavity surface preparation in the past:

- A comparison of EP parameters in the various EP facilities has been compiled
- A website has been set up for exchange of information and activities on EP³
- A proposal for a dedicated programme of single cells has been written up⁴
- A Setup to compare HPR systems⁵
- Experience on acid QC

The above information has entered the discussions for conceiving a focused R&D programme for the ILC on multi-cell cavities for 2007⁶.

¹ See e.g. talk by A. Matheisen:

<https://ilcsupport.desy.de/cdsagenda/askArchive.php?base=agenda&categ=a0561&id=a0561s3t7/document>

² For S1 Task Force information see:

http://www.linearcollider.org/wiki/doku.php?id=rdb:rdb_external:rdb_s1_home

³ See:

<http://ilc-dms.fnal.gov/Members/tajima/EP/>

⁴For the TTC Proposal see:

http://www.linearcollider.org/wiki/lib/exe/fetch.php?cache=cache&media=rdb%3Ard_external%3Attc_proposal17jan2006.pdf

⁵ See:

<https://ilcsupport.desy.de/cdsagenda/askArchive.php?base=agenda&categ=a0561&id=a0561s4t3/document>

⁶ This can be found on the S1 Task Force Wiki page.

2 The need for further information from TTC

Nonetheless more specific details are required for the ILC R&D to compile a focused programme yielding high-gradient performance. Several institutes are pursuing these goals. Currently, the various setups result in a large variety of recipes. Although, the basic recipe for “final surface preparation” has been agreed upon (EP, HPR and ‘In-situ’ bakeout as described in the ILC BCD⁷) several other activities are not consistent between the laboratories such as after-EP rinses, rinse times etc.

A significant effort has now been directed towards high gradient work on the basis of the documents mentioned above. The S1 Task Force is seeking advice on the following issues to improve the yield of the “final preparation steps” :

- Optimum cavity preparation process
 - A detailed list of preparation steps would be desirable.
- Optimum set of EP parameters established today
- Optimum set of HPR parameters
 - A proposal on how to implement a consistent and verifiable parameter set for these systems would be desirable
- Optimum set of bakeout
 - An optimum parameter set should include temperature, duration and vacuum.
- List of critical process parameters to be monitored during cavity preparation
 - This applies to all of the processes above
 - Recommended monitoring devices for process control

The task force would like to request a document prepared by TTC which includes the aforementioned information. This document should serve as a guide book/manual. It is assumed that the upcoming TTC Meeting at KEK will address this with a focus on a next generation EP systems for production. The task force hopes that the resulting document will help to synchronize the efforts on the cavity preparation.

3 R&D towards Improvements of the Current Preparation Process

The success of the first phase R&D programme critically depends on the realization of the aforementioned issues. For the second phase of the ILC multi-cell R&D programme further improvements could be added. These improvements need to be verified in a dedicated single-cell programme which would compare several tests of single cells with improved treatments with several tests of the baseline treatment. For inclusion of improvements into the ILC R&D programme the information needs to be available by October 2007.

3.1.1 Rinsing studies

Special attention has to be paid to the rinses of the cavities after the EP process. Several

⁷ ILC Baseline Configuration Document. This can be found at:
http://www.linearcollider.org/wiki/doku.php?id=bcd:bcd_home

methods of rinsing have been proposed. The list reflects a prioritized view of the task force:

1. Oxipolishing
 - a. HF rinsing
2. US degrease
3. Megasonic rinse with water only
4. Ethanol
5. H₂O₂

It is proposed that the TTC develops a focused, detailed single-cell programme studying and comparing the various rinses. This is needed to be augmented by sample studies. This should be implemented at the labs interested in the ILC as soon as possible.

3.1.2 Acid quality monitoring

The quality control of the electrolyte needs further improvement. This is true for both offline measurements between EP cycles and online during the EP process. A standard set of data should include the HF content and the polarization curve amongst others. Methods for offline acid quality control should be developed in each region and compared to each other. This should be supplemented with niobium sample studies. It is acknowledged that work has already started within the XFEL framework pursued at DESY.

It would be desirable to get a report of the TTC on the potential methods for analysis, so that they could be implemented and verified as soon as possible in the ILC R&D programme.

3.1.3 High Pressure Rinsing parameters

A method needs to be established to make water rinsing cycles in the different labs comparable. This should follow the method proposed by P. Michelato et al. A proposal by TTC on how to implement a consistent parameter set for these systems would be welcome.

4 Final remarks

The new initiative on high-gradient research originates from previous activities and achievements of TTC and naturally extends the research on cavity performance to the levels currently foreseen by the ILC.