Summary of Working Group 2 Discussions at the TTC Meeting January 14-17, 2008 at DESY

Conveners: C. Antoine, Saclay, H. Hayano, KEK and P. Kneisel, Jlab

Introduction

During the TTC meeting Jan. 14 – 17, 2008 at DESY the afternoon of January 15 was reserved for discussions in working group 2, focusing on "Diagnostics for materials and Cavity Behaviour" with the additional load of

"Report/discuss about QA on Nb material (Eddy + Squid scanning, metallurgical checks, else); instrumentation for localizing quench/FE spots (thermometry, x-ray image, else)"

The individual contributions to these working group session are posted at https://indico.desy.de/conferenceOtherViews.py?view=standard&confId=401;

here a short summary of the program is given.

Program

The program had 10 contributions as listed below; not all the contributors were physically present at the meeting and their contributions were either delivered by video conferencing or presented by their "surrogates".

1. W. Singer et al; " Eddy current and squid Scanning developments and experiences"

2. C. Antoine ; "New Developments in material characterization" (point contact spectroscopy, LIBS, replica technique...)

3. L. Cooley (presented by C. Antoine) " Material Studies at FNAL"

4. C.Reece (by video conference); " Recent HPR studies/surface modifications by HPR"

5. G.Ciovati/M.Champion (presented by P. Kneisel) " Review of T - mapping Systems"

6. D. Reschke; " Details of DESY's T-mapping system and examples of maps"

7. G.Ciovati; M. Morrone, D.Machie and P. Kneisel (presented by P. Kneisel) " Status of the 2-cell mapping system for multi-cell ILC/TESLA Cavities"

8. Y. Iwashita/H.Hayano; " Development of a high resolution camera and observations

in TESLA cavities" (25 min)

9. Y. Yamamoto; "Recent Status and Future Plan of Cavity Diagnostic System in KEK-STF" (15min)

10. Discussions, possible included in allotted time for talks

Summary of session

A). QA on Niobium Material

- Eddy current scanning is routinely used at DESY on sheets, which will be formed into half cells.)app. 1500 sheets have been scanned so far). The resolution of the "old" system (developed by BAM) is limited to defect sizes of app. 100 micron; a system with higher resolution ($\leq$ 50 micron) based on a squid as the detector has been developed by WSK and will be installed at DESY in the very near future. This system also allows for depth resolution $\geq$ 2mm . However, even this system might be marginal in detecting defects even smaller dimensions, allowing accelerating gradients of 35 MV/m (Hpeak ~ 145 mT, defects sizes based on thermal model calculations of < 20 micron)
- There are 3-5 % of the sheets initially rejected; for three 9-cell cavities fabricated from large grain niobium only sheets for two cavities have been scanned; no defects/rejections were found. The third cavity was fabricated without scanning of the sheets.
- Fermi Lab has "inherited" the eddy current system originally acquired for the SNS project and is using it for sheet scanning and material studies. Some of the obtained images are subject to interpretation and more experience has to be gained.
- RRR – values of representative samples from sheet lots used for 9-cell cavity fabrication are measured at FNAL; RRR – values vary by app. 10 %. Our FermiLab colleagues feel that there is a need for a RRR-value definition .
  Note: In all existing specifications for RRR niobium (DESY, Jlab,SNS, LANL…) it is specifically stated, how the RRR – value is to be determined.
- C. Antoine, Saclay, summarized on-going material study developments at several labs, including Saclay, Orsay, Argonne and FNAL. Among those encouraging developments are replica techniques, which can determine grain boundary steps or other surface topologies, point contact tunneling measurements on samples, which will detect changes of e.g. the gap value of niobium for different surface treatments or baking conditions, LIBS (Laser Induced breakdown Spectroscopy), which can be applied in air and has been used in diagnosing a problem with a Spiral cavity or local RRR measurements based on magnetometry. A TE011 mode cavity is under development at Orsay for material studies, utilizing thermal loss measurements.

- At Jlab, the effect of prolonged high pressure rinsing with respect to corrosion and generation of surface oxides is being studied, making use of "classical" surface analytical techniques.

B). Diagnostics/Temperature mapping

Several talks reviewed existing T-mapping systems and their application as well as systems which are in development:

- DESY has T-mapping systems for single cell cavities and multi-cell cavities (rotating and stationary for 1-2 cells)
- Cornell uses a T-mapping system on single cells
- At Jlab a fast system for single cell T-mapping is in use; and recently a 2-cell mapping system with fixed thermometers for multi-cell cavities has been implemented.
- A system is available at Saclay, but is seldomly used
- A stationary system for 9-cell ILC type cavities with app. 7000 thermometers is under development at LANL.
- Another system for multi-cell cavities is being developed at FNAL
- At KEK, a series of individual thermometers are "strategically" fixed to cavities both in vertical and horizontal tests.

T- mapping systems are very important for diagnostic purposes and should be used as often as possible. It seems very worthwhile to spend a little bit of time in assembling a system to a cavity (the Jlab system for single cells is e.g. assembled in app. 1 hr) given the wealth of information one gets from a T-map. In connection with other diagnostic methods they provide information about the causes for limitations in cavity performance (e.g."quenches")

- A very important development has taken place at Kyoto University in collaboration with KEK: an internal cavity inspection system with high resolution utilizing optical imaging of the interior cavity surface an a blue electro luminescence sheet has been used on several 9-cell cavities and the "quench" locations detected prior by T-mapping have been found and analyzed. This system is very powerful and should be applied and/or duplicated as often as possible in other laboratories. Most importantly, it should be used to inspect a very good cavity for comparison/interpretation of the detected