

Update on Large Grain/Single Crystal Activities at JLab

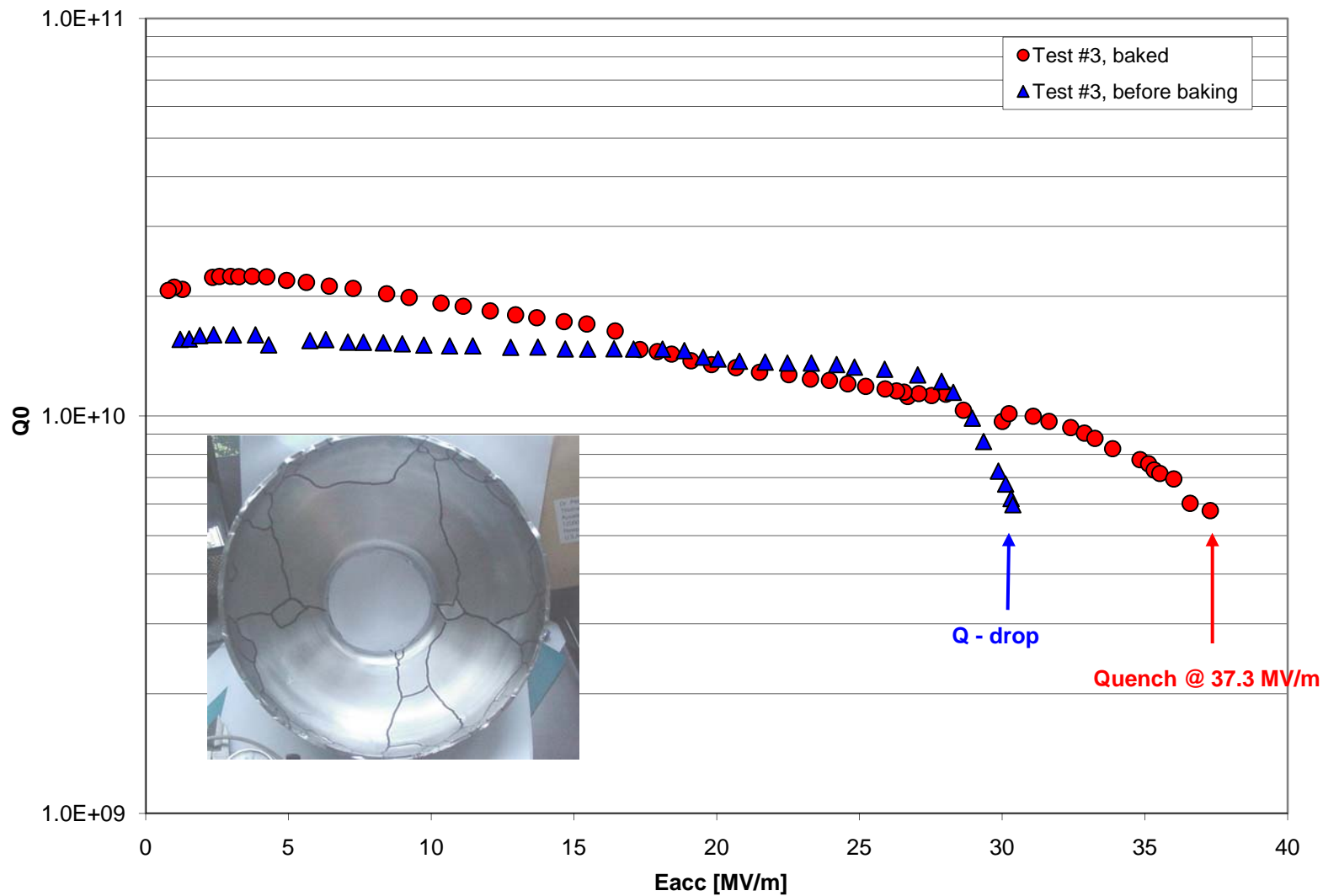
Peter Kneisel

April 15, 2009

Single Cells

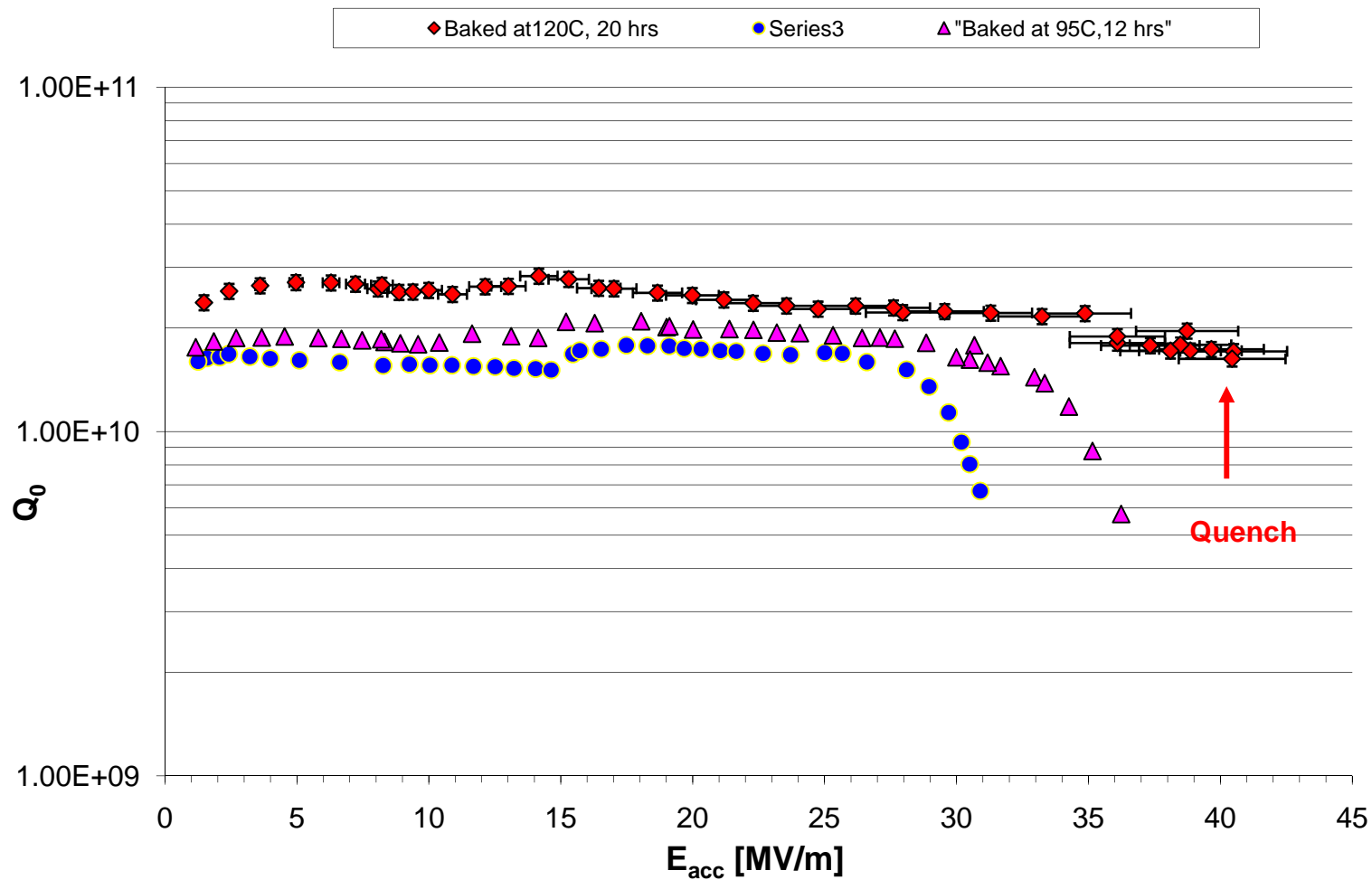
- Reproducibility tests with single cell cavities made from large grain niobium of different suppliers (W.C.Heraeus, CBMM, Ningxia and Tokyo Denkai) continues with slow progress
- Six cavities have been fabricated from Tokyo Denkai material and all have been treated with the same procedure.
- Two have been tested before and after baking
- Two have been tested before baking (one was limited by FE and needs to be re- rinsed)
- The plan is to post-purify all cavities after their initial tests as outlined above and retest them before and after baking.

Tokyo_Denkai Large Grain Cavity TD1



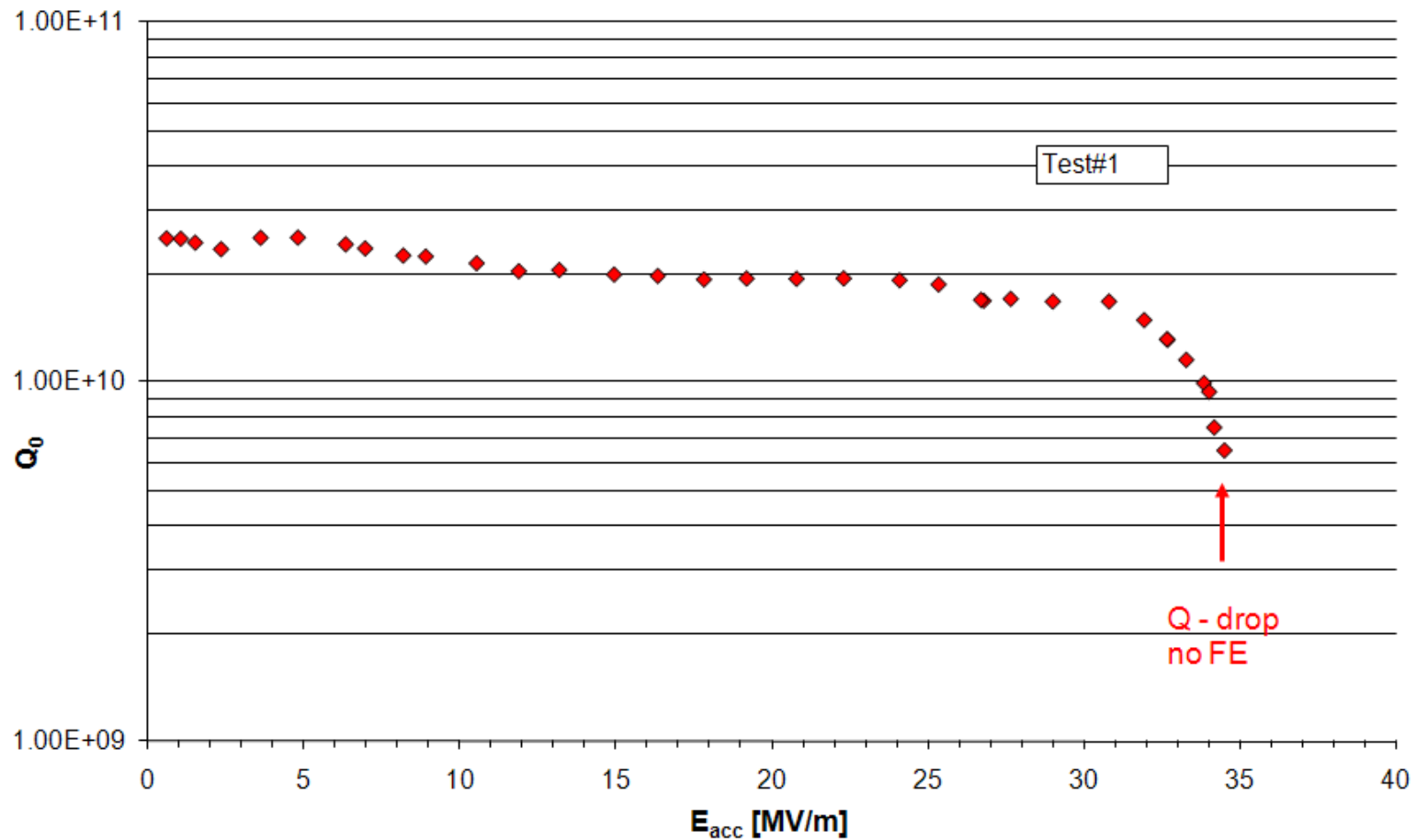
TD #4

Large Grain TESLA Cavity Shape TD4



Tokyo-Denkai #2

Large Grain TESLA Cavity Shape TD2



Single Crystal

- A thick sheet of a large crystal from a large grain ingot provided by CBMM has been enlarged at DESY (X.Singer, W.Singer)
- Six sheets could be prepared, large enough to deep draw half cells for TESLA/ILC – type single half cells
- We are in the process of fabricating 3 single cell cavities



Multi-cell Cavity Manufacturing/Procedure

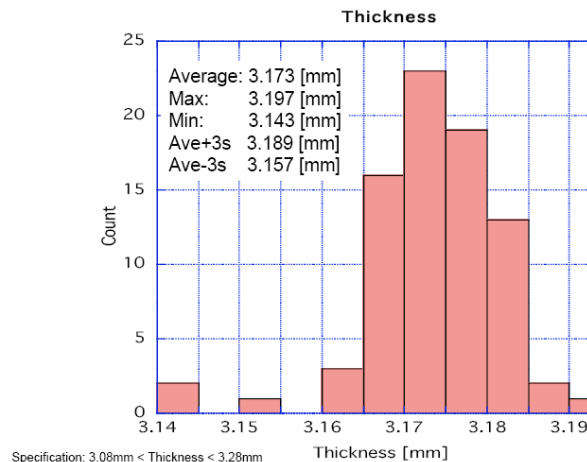
- Based on Jlab's experience over the past years, we want to apply the following steps to the manufacturing and testing of our next cavities (two 7-cell LL cavities for the Jlab FEL and two 9-cell Ichiro/LL cavities):
 - Deep drawing of half cells
 - Cleaning ,bcp ~ 30 micron
 - Stress relieving at 600C for 10 hrs
 - Re-stamping
 - Trimming for EBW with a butt weld joint
 - Bcp 10 micron , welding of dumbbells
 - Mechanical grinding to remove blemishes and grain boundary steps
 - 10 micron bcp for welding of equators
 - Bulk bcp ~ 60 micron
 - Hydrogen degassing at 600C, 10 hrs
 - Tuning
 - Final bcp , ~ 50 micron, HPR, drying

Multi-cell Cavities for ILC

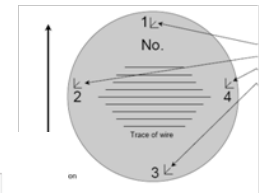
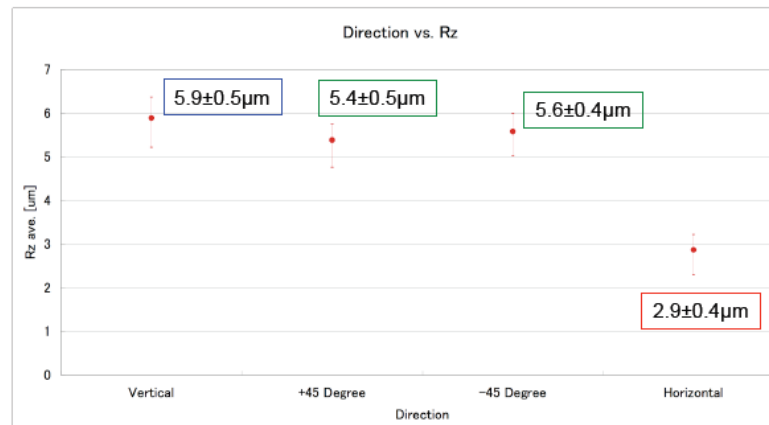
- The fabrication of two LL/Ichiro-type 9-cell cavities has started; niobium from CBMM and Tokyo-Denkai will be used
- The 20 sheets of TD material were sliced simultaneously by multi-wires – **development done by K.Saito with Japanese Industry** – with very good tolerances and surface quality.
- The sheet slicing produced very smooth surface finishes and small deviations in thickness. App. 60 sheets were slice simultaneously in only 40 hrs.

Graphs courtesy of H. Umezawa, Tokyo-Denkai

Histogram of Thickness



Surface Roughness



Other Cavities

- Fabrication of two 7-cell upgrade cavities for the FEL
- Fabrication of one (of two) 3.5 cell photo-injector cavities (CRADA with FZD)
- Fabrication of a 2-cell CRAB cavity
- Fabrication of a 1050 MHz, $\beta = 0.47$ single cell cavity
- Fabrication of a 2.45 GHz cavity for studies with a magnetron
- Fabrication of two R&D cavities for investigation of the influence of surface roughness on performance
- Half cell cavity for laser heating/flux trapping/flux moving to study effect on Q-drop

All these various projects are intended to demonstrate the usefulness/reproducibility of large grain material and bcp treatment

Final Remark

- It has been shown in the past that single cell cavities made from large grain niobium and treated by bcp only are comparable in performance with cavities made from fine grain niobium and electropolished.
- The proof/ extension to multi-cell cavities is still missing
- Several (8 in total) cavities have been made by ACCEL for DESY. Two of them performed quite nice, the 6 new one's need testing
- At KEK, K.Saito has several Ichiro-type cavities in the "Pipeline"; also Jlab is fabricating two Ichiro cavities
- The cost advantages of cavities made from large grain material have been discussed at several occasions; with the inexpensive slicing method developed by K.Saito a cost reduction in material and streamlined procedures by a significant amount is not out of the question.
- Therefore it seems "puzzling" , that the GDE and/or the regional organization or not pursuing this option with some more support.