Construction of Cavity Fabrication Facility in KEK

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1. Purpose of Cavity Fabrication Facility at KEK(1)

- We would like to improved cavity performance that we can not satisfy the present conditions.
- Uniformity of bead width, no pit and stable bump after electron beam welding (EBW) must be solved.
- Surface treatment facilities of EP after cavity completion have already functioned in KEK. We can treat an R & D about the cavity performance in one place, if a Cavity Fabrication Plant stands up in KEK.

Purpose of Cavity Fabrication Facility at KEK(2)

- Cost of cavity is high so we try to lower the cost of EBW process.
- We want to spread EBW technology and production technology about the cavity in Japan. We want to establish this facility as model plant.
- We started collaborative research with Japanese venders. We will work with them using this plant.
- We expect to reveal factors of high gradient performance, establish cavity manufacturing procedure for mass production, cost down by competition.

Superconducting cavity ILC—STF Process & production ratio





Superconducting cavity ILC-STF

Length 1247. 6mm

Large diameter φ 206. 85mm

Nb Melting point 2415°C、

Density 8.56

- 18, 000 cavities/5 years
 - 6, 000 cavities/ Asia area
 - 6 cavities/day



Establish EBW (Electron Beam Welding) technology Achieve high vacuum, strength at 2K and high gradient

Process of superconducting cavity



Courtesy KEK Eiji Kako

2. Progress of gradient for superconductivity cavity at KEK

Vertical test result

Test result in cryomodule



3. Construction of Cavity Fabrication Facility & Activity



Main Equipments of Cavity Fabrication Facility



EBW room EBW machine Installation on April 2011



CP room, Draft chamber



Measure Cell for

Measuring system for half cell form (Under developing)





Inspection equipment for Nb surface

Press machine (servo control)

9 Vertical lathe

4.High quality EBW machine and vacuum chamber



Vacuum level :1×10^2Pa, within 20 minutes Inside material:SUS316L, Volume:10.56 m³

150kV,15kW

Vacuum test of EBW machine

Vacuum chamber size is 10.56m³



Level at 1×10^{-2} Pa: 11 minutes ---->EBW working is available Best vacuum condition 9×10^{-4} Pa : Running after 2 hours

Specifications of EBW machine

- 15kW Electric power ۲
- Acceleration voltage
 Indication digital unit
 60kV 150kV continually
 0.1kV of the out put voltage
- Voltage stability in 60kV 150kV •

Less than $\pm 0.5\%$ (p - p) for control voltage.

- Electron beam current in 60kV 150kV ٠ From 0mA to 100mA continually. The smallest indication unit of the electron beam current is digital indication at 0.1mA.
- Minimum beam radius size 0.25mm •

as work distance 200mm

- Positioning repeatability ± 0.05 mm Actual data 0.01 to 0.04 mm
- Chamber size of inside 3200,1500,and 2200mm height

Our conclusion:

The quality of the beam is the most important in EBW for cavity.

Reduction of set up time: six cavities with one batch processing



Vertical style six cavities

No drawing : horizontal style with six cavities is available

5. Manufacturing of cavity Engineering, Manufacturing of dies & manufacturing of half cells

Pressure 1500kN(150t) Stroke 225mm

Power 35kw

Slide motion type 9 kinds





Final program check

Just pressing

Manufacturing of dies and evaluation for center cell



— # of cells - Variation ± 0.05 mm

Maximum deviation data from engineering data on nineteen cells

15

Measuring port

Completed dumbbell and EBW for equator Using the High voltage EBW machine made by Steigerwald



Center cell is completed and result of inner inspection of cavity



Center cell of EBW is completed at July 2011

Test piece of EBW condition for center cells EBW.

EBW condition: 120kV, 35~39mA

Oscillation 3. Ommwidth. 1kHz



Inner inspection of cells



Equator

Temperature at EBW Calculation by ANSYS



Schedule of cavity manufacturing



Industrialization of Cavity Fabrication

Start preparation of ILC mass-production technology development

Accelerator Laboratory Mechanical engineering center Cryogenics engineering center

KEK Pilot Plant

mass-production R&D, technology in hand

Participation of collaborative company

mass-production technology transfer by KEK initiative

company A production line

company B production line company C production line

6. Summary

- To manufacture the high gradient cavity for ILC, we planed to build the cavity fabrication plant at KEK.
- This cavity fabrication plant started in April,2010.
- The purpose of this facility is R & D of the cavity production technology and establishment of the cavity production technology and demonstrate capability for mass production cavity and industrialization.
- Training for personal on EBW and technology on fabrication of cavity