

Strategy and Experiences on Procurement of Material for European XFEL Cavities

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Abstract

Analysis of the strategy for material procurement and quality management is done on base of the European XFEL experiences. In the preparation phase the requirements to material has been defined and the qualification of various companies as potential supplier for European XFEL executed. Estimation of the material for production of pressure bearing parts, creation of PMAs (particular material appraisal) acc. the European Pressure Equipment Directive and certification of the companies as producer of the material for pressure bearing parts has been done together with the notified body (TÜV NORD Systems).

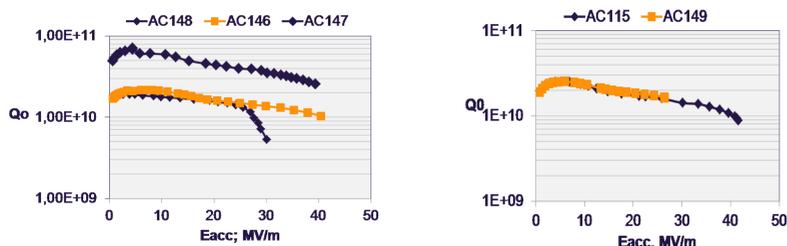
The procurement of material, QC, documentation, shipment and supervising the material workflow at cavity-producers has been carried out by DESY. Four companies produced ca. 25.000 semi-finished parts of high purity niobium and NbTi within of three years. Analysis of the main flaws and foreign material inclusions in niobium sheets is presented.

Qualification of Nb supplier for XFEL

Three steps of qualification for XFEL have been determined:

- Step 1. **Material testing** (RRR, Microstructure, Eddy current scanning, Tensile test, HV, Impurity content, Surface conditions etc.).
- Step 2. **Single cell cavity** fabrication at DESY, treatment and RF tests at DESY.
- Step 3. **9-cell cavity** fabrication at Industry, treatment at DESY and RF tests.

Several companies anticipated to be qualified for XFEL (CBMM, GIREDMET, Plansee, Ningxia OTIC)



RF test results of **9 cell cavities** produced from material of Plansee (Austria) and Ningxia OTIC (China).

These 2 companies successfully passed all qualification steps.

PED 97/23/EC (Pressure Equipment Directive) Activities

- Qualification of cavity material Nb40, Nb300, NbTi (creation the particular material appraisal (PMA)).
- Audit and certification of QM system at the companies (producing cavity material) Tokyo Denkai and Ningxia OTIC are certified by TÜV NORD. Heraeus and Plansee certified earlier.
- Supervising of the semi finished material products procurement (traceability, marking, Inspection certificate, type 3.1 according to DIN EN 10204:2005), etc.).

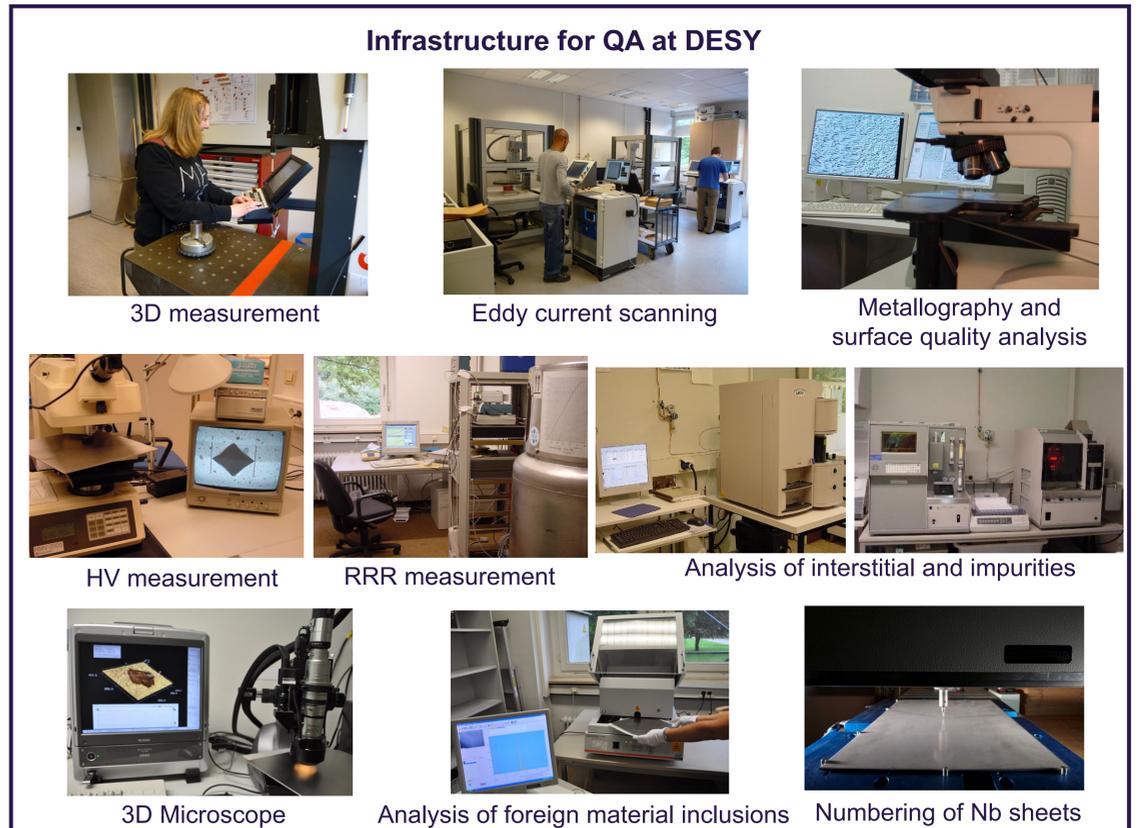


DESY Procurement: in total 24420 pieces semi-finished products of Nb and NbTi alloy are procured for fabrication of SC cavities for the European XFEL.

DESY Contracted January 31st, 2011 to companies five different types: Sheets, Tubes, Rods, Rings Coupler housing

Aim: finish the cavity material issue within 3 years.

- Heraeus (ca. 95% material for end groups)
- Tokyo Denkai (52% sheets)
- Ningxia OTIC (30% sheets, 100% NbTi,...)
- Plansee (18% sheets, ..)



Infrastructure for QA at DESY

3D measurement

Eddy current scanning

Metallography and surface quality analysis

HV measurement

RRR measurement

Analysis of interstitial and impurities

3D Microscope

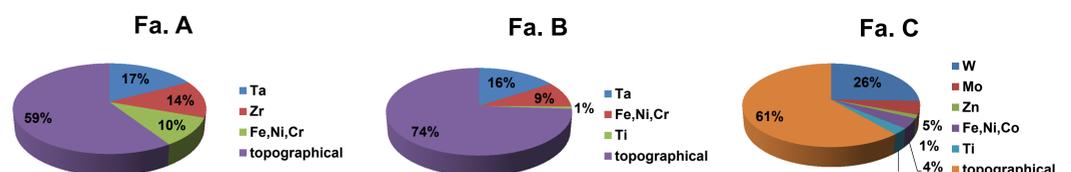
Analysis of foreign material inclusions

Numbering of Nb sheets

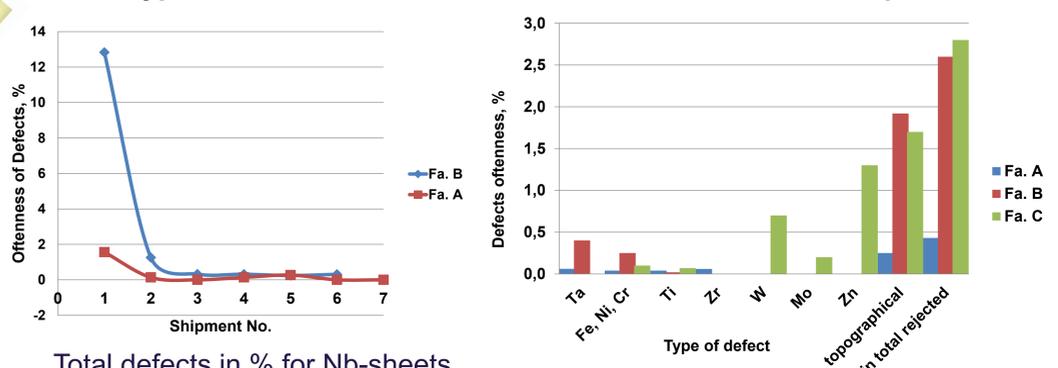
Workflow and documentation

- Ca. 250 m² for laboratories and storage areas are in use
- Detailed workflows were developed for each product
- Paperless collection of the entire documentation
- Worldwide access to the documents by using DESY EDM System
- Documentation by EDMS guarantees traceability according to the requirements of the pressure equipment directive
- Numbering of semi-finished products and shipment to cavity manufacturers

Statistic to main defects and foreign material inclusions in niobium sheets



Defect types detected in Nb-sheets of different EXFEL material providers



Total defects in % for Nb-sheets depending on shipment sequences. Quality improvement thanks to feed back

Comparison of detected defects in Nb-sheets for different suppliers

Thanks to the close contact with manufacturers and to well-timed feed-back the quality of the material became better and better from shipment to shipment.

Summary

- An intensive preparation und development of specification for the materials and manufacturing, close contact to manufacturer and well-timed feed-back contributed to successful production of cavity material for EXFEL
- DESY team of QM personnel has tested about 25.000 semi-finished products. Shipment of semi-finished products to cavity producers will be finished end of 2013
- Less than 3% of Nb-sheets for half-cell have been rejected due to detected defects and foreign material inclusions

In addition see Poster MOP032