

# MATERIAL FOR EUROPEAN XFEL RESONATORS

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## Abstract

Ca. 20 t. of high purity niobium required for European XFEL superconducting resonators will be provided by DESY to cavity producers.

Work on material for XFEL cavities is divided in three phases (prototyping, pre-series and series production). Two new companies (Ningxia OTIC from China and Plansee Metal GmbH from Austria) have been qualified as XFEL supplier in addition to available three companies; material for the pre-series is already delivered to cavity producers (RI and E. Zanon). Material for the series is contracted now to 4 companies (Ningxia OTIC, Plansee Metal GmbH, Tokyo Denkai and Heraeus) and partially already delivered.

Special effort is done to insure that material for pressure bearing sub-components of cavities is build according PED/97/23/EC Pressure Equipment Directive.

Procurement of serial material includes: incoming visual control, testing for required parameters (RRR, interstitial impurity analysis (H, N, O, C), metallic impurities analysis, metallography, tensile test, hardness HV, surface roughness), documentation using the DESY EDM, definition of numbering system and marking, delivery to company. Appropriate infrastructure for guiding through many thousands of semi - finished parts for XFEL cavities is created.

## Qualification of Nb suppliers for XFEL

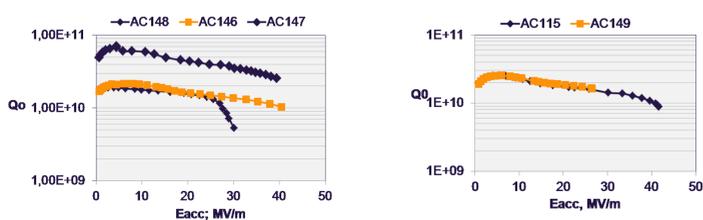
### Three steps of qualification for XFEL have been determined:

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. **Nine cell cavity** fabrication at Industry, treatment at DESY and RF tests.

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



RF test results of **9 cell cavities** produced from material of Plansee (right) and Ningxia OTIC (left). Only this companies successfully passed all qualification steps. **5 qualified suppliers now.**

## Incoming inspection, quality control (QC) and documentation

### incoming inspection and QC at DESY

- incoming visual control
- dimensional control
- scanning of sheets
- testing for required parameters
- documentation using the DESY EDMS (guarantee of traceability for pressure bearing parts)
- definition of numbering system and marking
- delivery to company



Equipment for sheets marking



Equipment for eddy current scanning of XFEL niobium at DESY



Equipment for tactile 3D dimension measurement

## Infrastructure for independent QC at DESY



Metallography and surface quality analysis



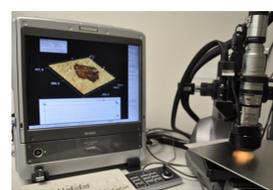
HV measurement



Analysis of interstitial impurities



Analysis of substitution impurities



3D Microscope

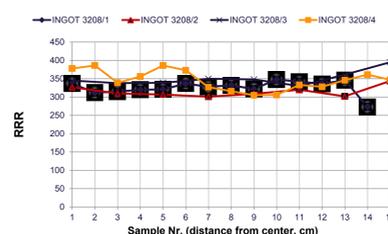


RRR measurement

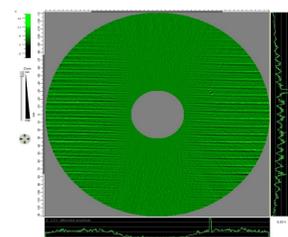


Analysis of substitution impurities

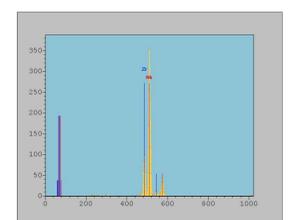
## Examples of the QC at DESY



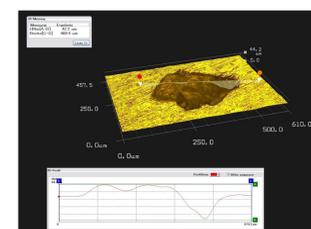
The ingot's RRR does not depend on the distance from the center



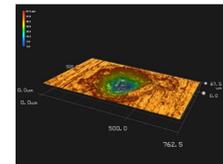
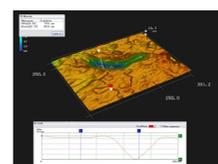
Scanning image



Fluorescence spectrum of the defect area (Zr ca. 19% detected)



Optical 3D image and profile of the defect area (protrusion of ca. 16  $\mu\text{m}$ )

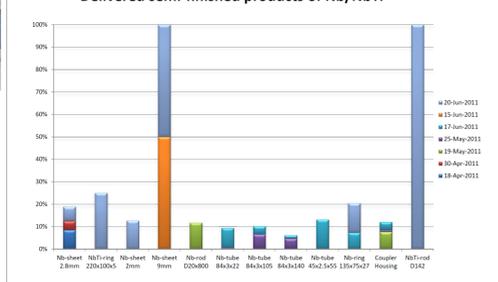


Examples of holes and scratchers on sheets

**Example of detected defect on the Nb sheet**

## Procurement of Nb and NbTi semi-finished products

### Delivered semi-finished products of Nb/NbTi



Courtesy of Ningxia OTIC



19543 pcs of semi-finished products (sheets, tubes, etc.) ordered and partially delivered (status end of June 2011)

## Summary

- DESY has taken over the material procurement, incoming inspection, quality control (QC) and documentation
- Material for 680 Cavities is contracted on January 31<sup>st</sup>, 2011 to companies: Heraeus (ca. 90% material for end groups), Tokyo Denkai (50% sheets for half cells) Ningxia OTIC (25% sheets for half cells, 100% NbTi,..), Plansee Metal GmbH (25% sheets for half cells, ..). Material production and delivery to cavity manufacturers is foreseen for two years 2011-2012
- Incoming control of ca. 2000 pieces for first delivery to cavity manufacturers (RI and E.ZANON) is finished