

INVESTIGATION OF SAMPLES SEPARATED FROM PROTOTYPE CAVITIES OF THE EUROPEAN XFEL

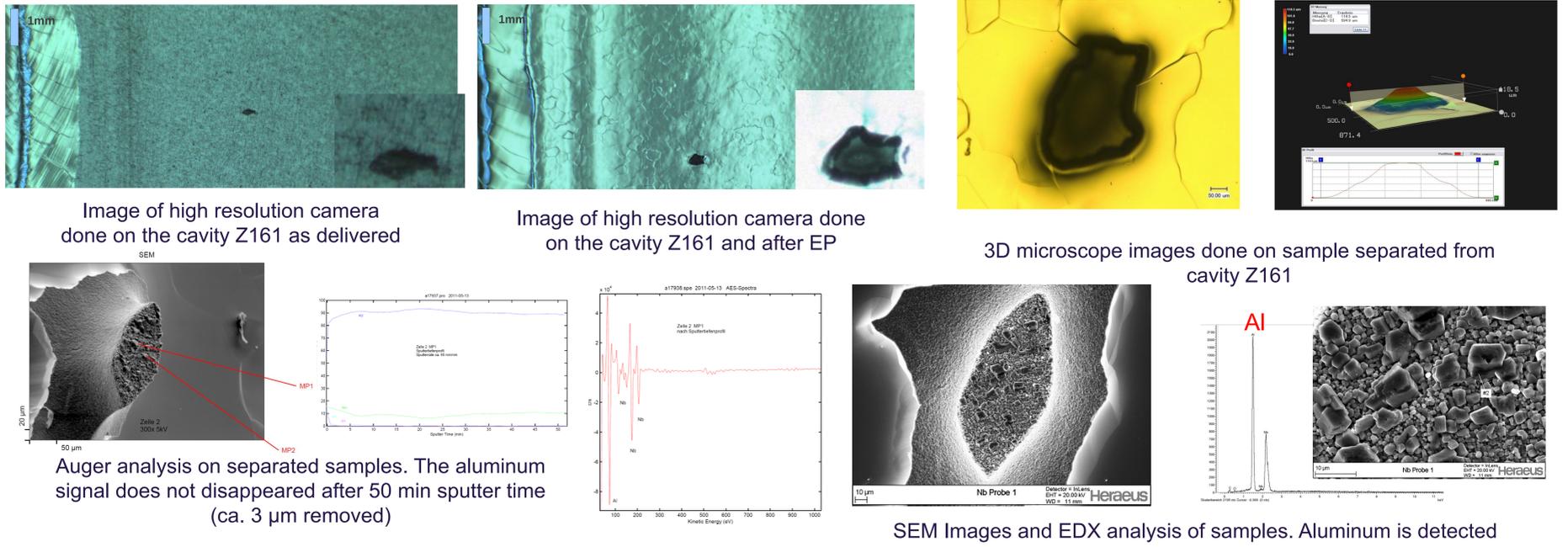
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Abstract: XFEL prototype cavities fabricated in industry and treated at DESY mainly meet the specification. Few cavities demonstrated low performance (13–22 MV/m) limited by thermal breakdown. The T-map analysis detected quench areas that are mainly close to the equator. Optical inspection by high resolution camera allowed tracking the several stages of preparation (as received, after main electropolishing EP, after RF test) and in some cases makes possible monitoring the evolution of defects.

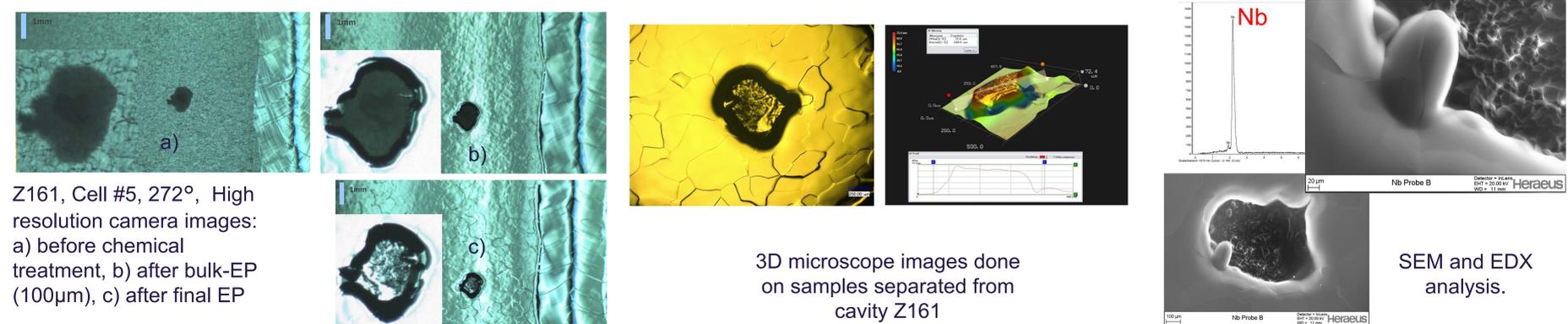
In order to understand the nature of reduced performance and get more detailed information on the origin of defects, some samples have been extracted from four cavities and investigated by light microscope, 3D-microscope, SEM, EDX and Auger spectroscopy.

Data to two last cavities (Z161 and AC126) are presented here. Several surface flaws with sizes from a few μm to hundreds of μm have been detected. The defects can be grouped in following categories: foreign elements, deviation from smooth surface profile (holes, bumps), damaged surface areas evidently by high pressure water rinsing.

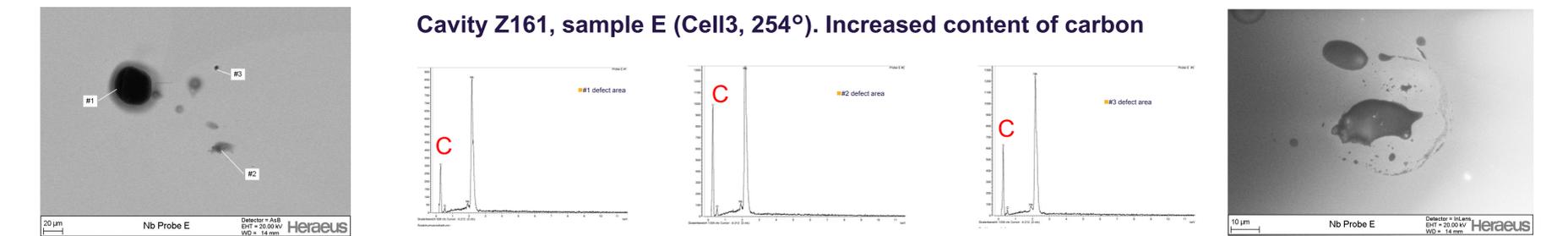
Detected foreign elements (Aluminium): Cavity Z161, Cell2, 128°. Quench in π -mode at 13,7 MV/m



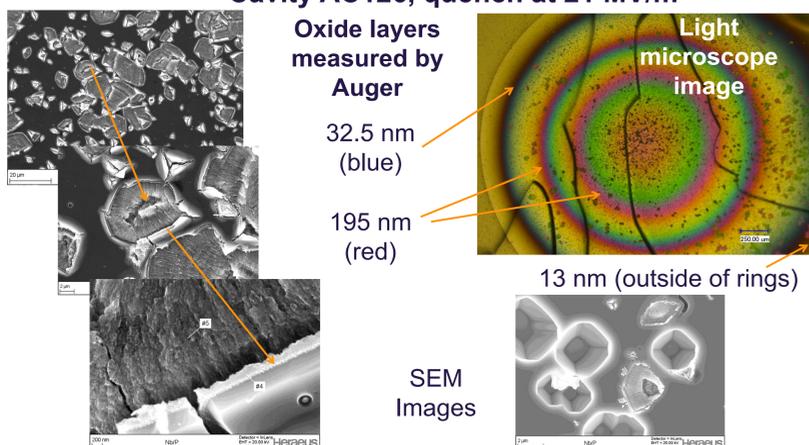
Cavity Z161, Sample B: Quench in 7/9-, 5/9- and 1/9-pi-mode, 21 MV/m, cell 5, Tmap: 280°. Topographical defect (no foreign inclusions)



Cavity Z161, sample E (Cell3, 254°). Increased content of carbon



Damaged surface (high pressure water rinsing mark). Cavity AC126, quench at 21 MV/m



Similar marks are observed on another 6 samples from AC126

Summary

- Aluminium detected in the black spot of cavity Z161, cell 2 caused quench according T-map. Another spots with Al also detected. Defects with Al are protruded.
- Defects with Al of cavity Z161, cell 2 investigated by Auger has a thickness at least more than 3 μm (not a thin layer)
- It was found out (P. Michelato) that tools used for cavity EB welding can produce Al particles during cavity assembly. Probably some Al particles are adhered on the surface and partially melted during EB welding
- Spots with increased content of carbon have been detected by EDX in cavity Z161. Similar spots have been observed earlier in samples separated from cavities Z111 and Z130
- The observation on samples correlates with data of high resolution camera. It was shown that some spots observed in as delivered cavity do not disappeared even after removal of 150 μm by electropolishing
- A high pressure water rinsing mark was detected in the cavity AC126. This defect caused quench at Eacc of 21 MV/m.