

Typical problems with EBW welding observed with OBACHT

- Incomplete welding/not full penetration
- Irregular welding seam
- Droplets or spatters on the surface
- Unexpected short beam black-out/shutdown
- Rough welding seam
- Porosity close to the welding seam
- Other aspects of EBW

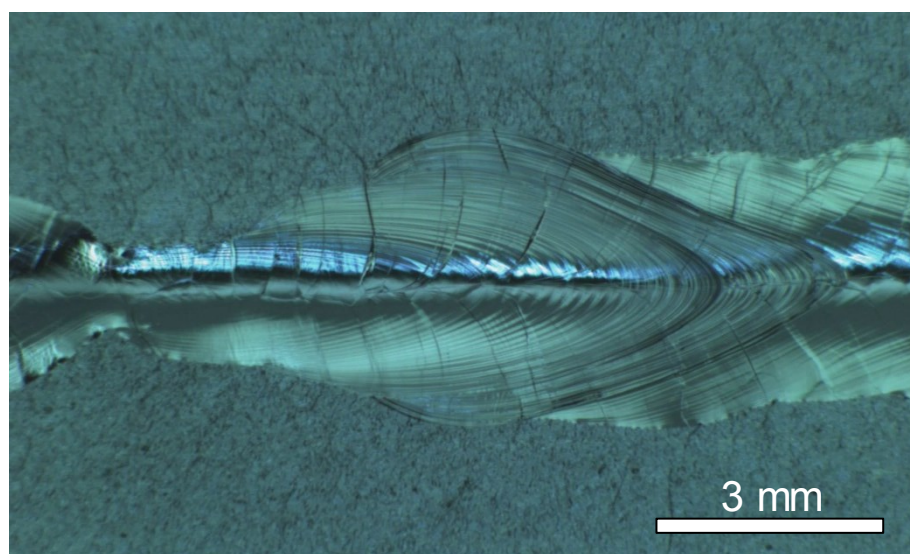
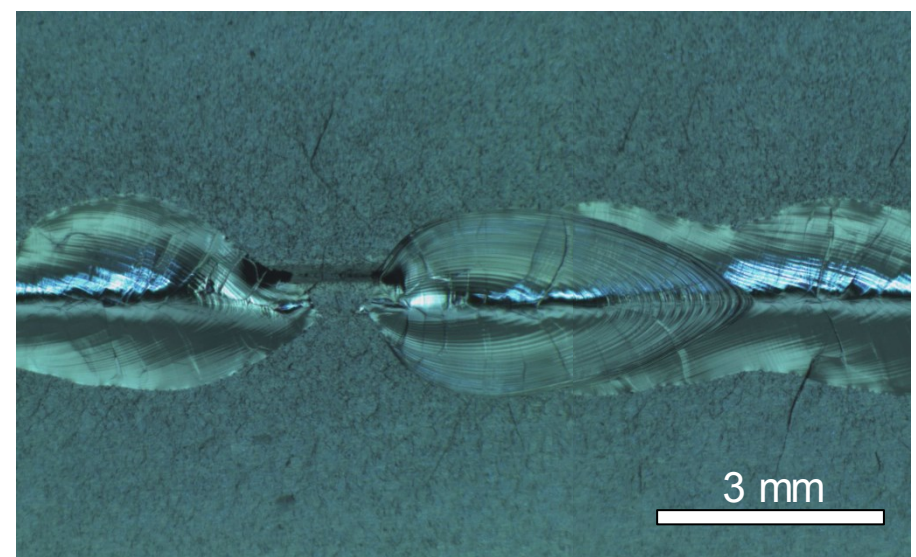
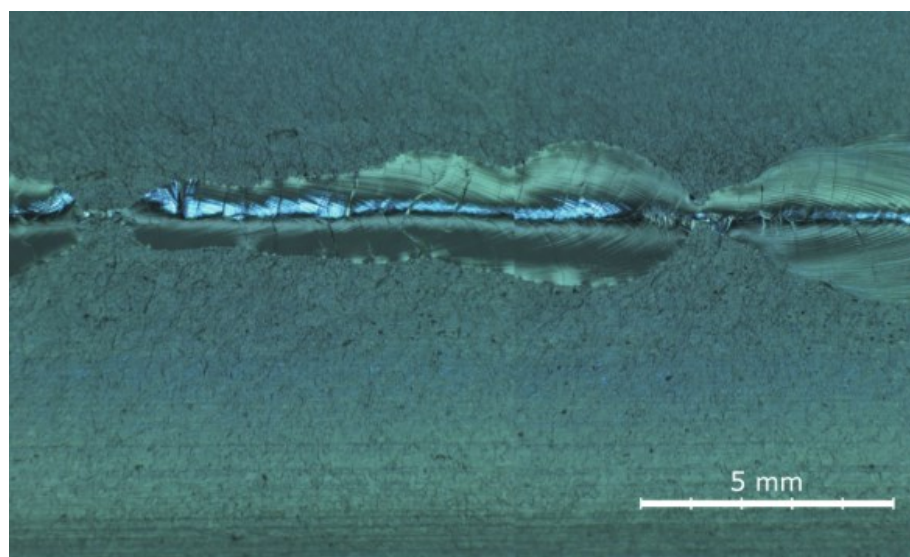


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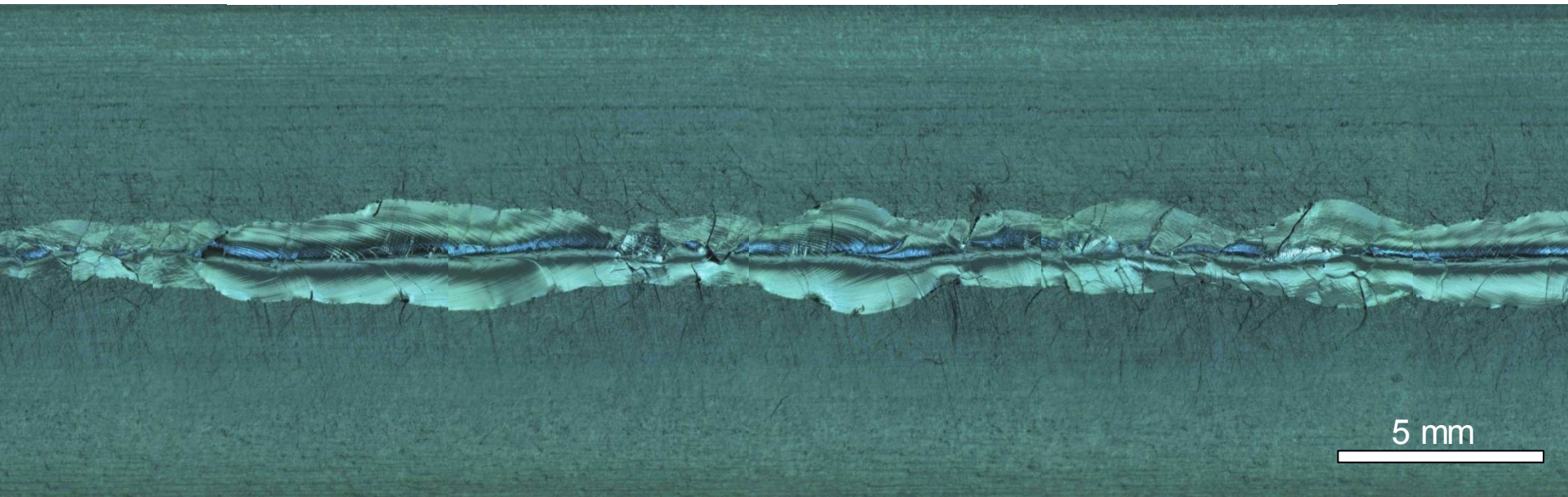


Bundesministe
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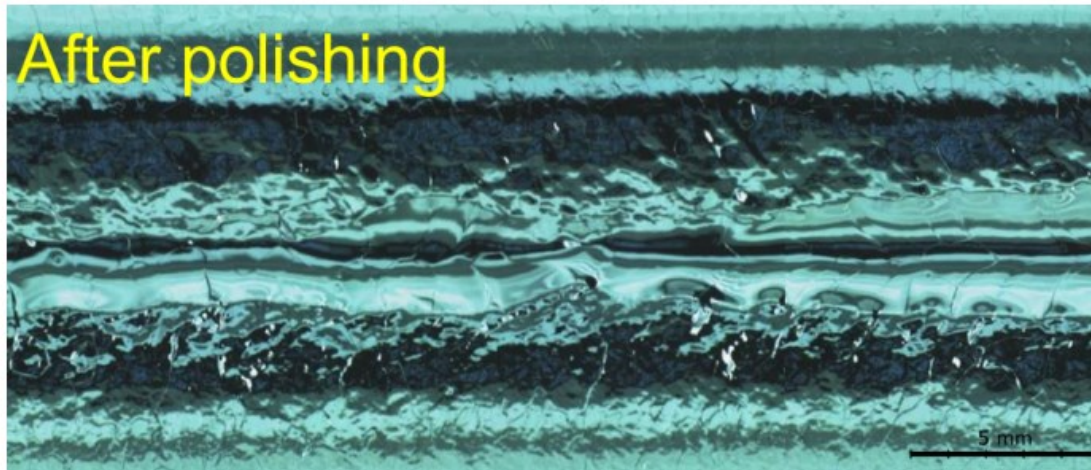
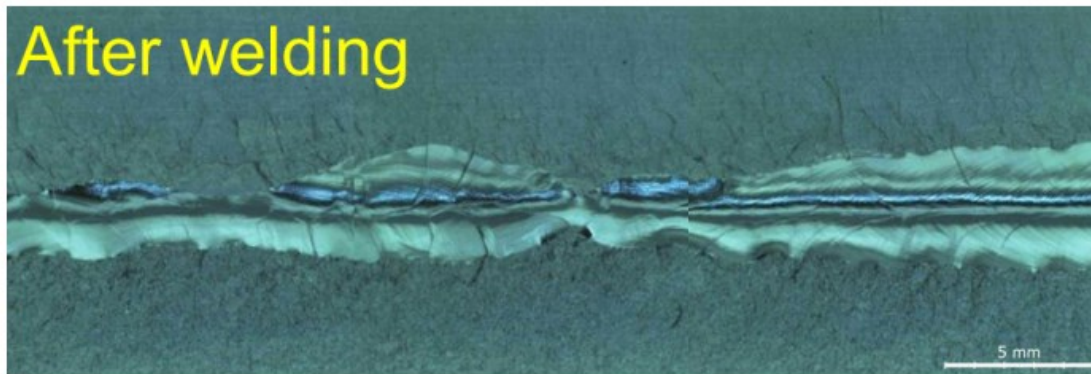




- welding seam **not penetrated** everywhere
- **strong variation** of the seam-width
- **repair** procedure to be established and commissioned
- is it an issue of PED?



→ At least factor of 2 variation of the welding seam even after a repair attempt

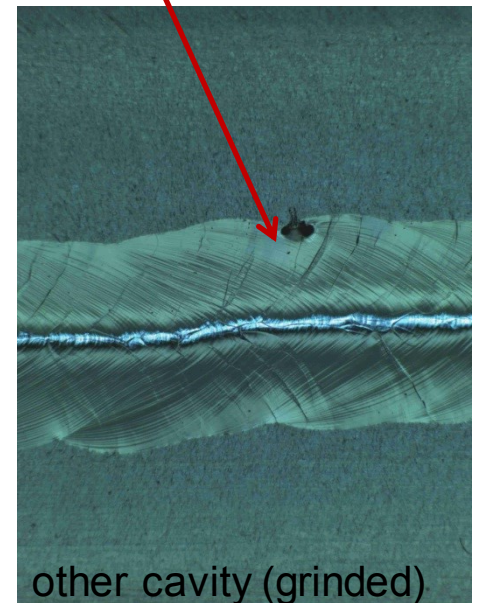
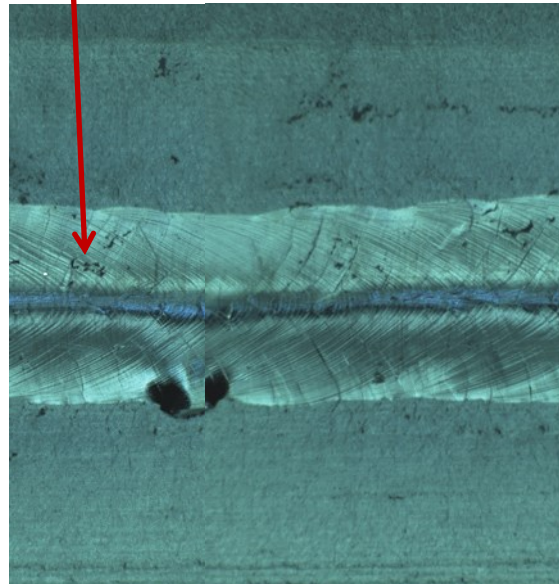
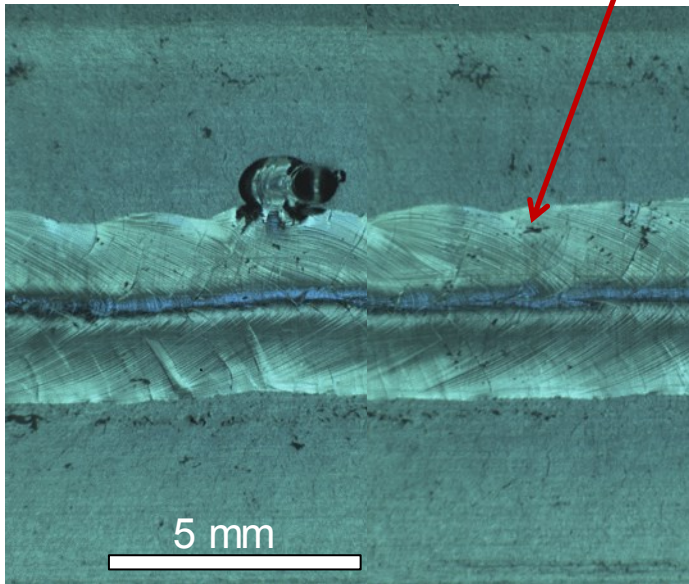
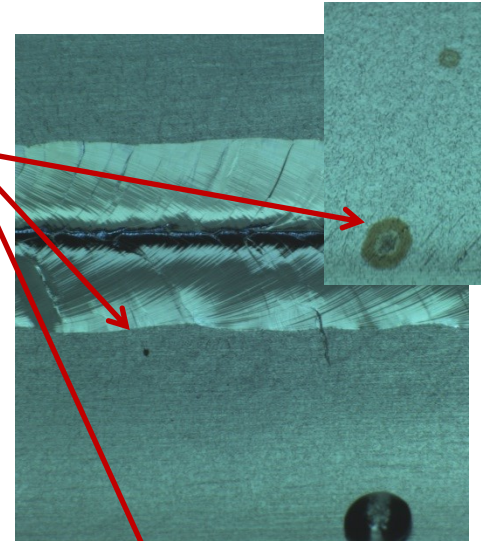
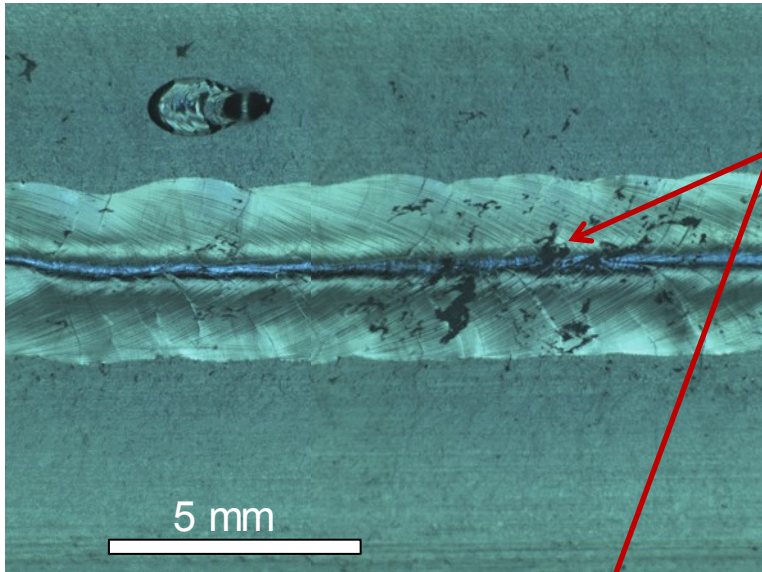


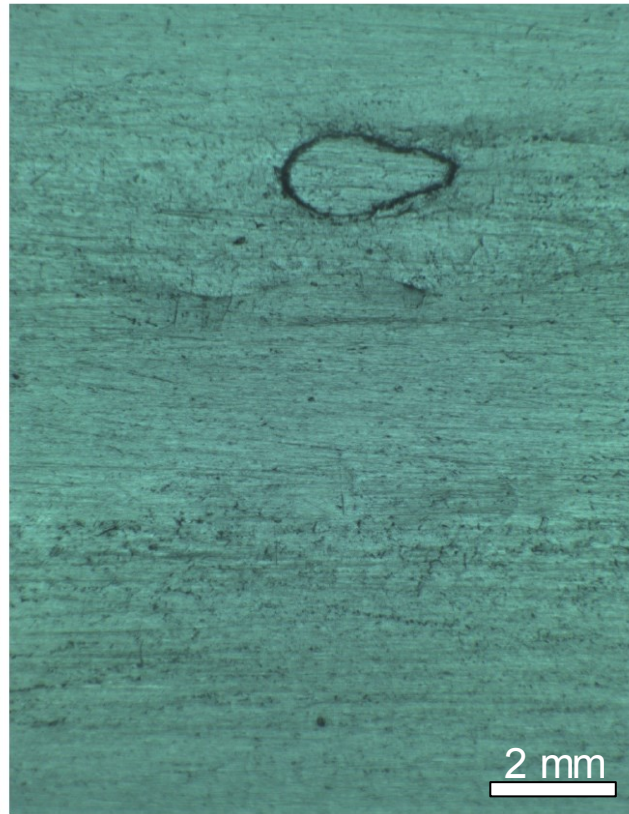
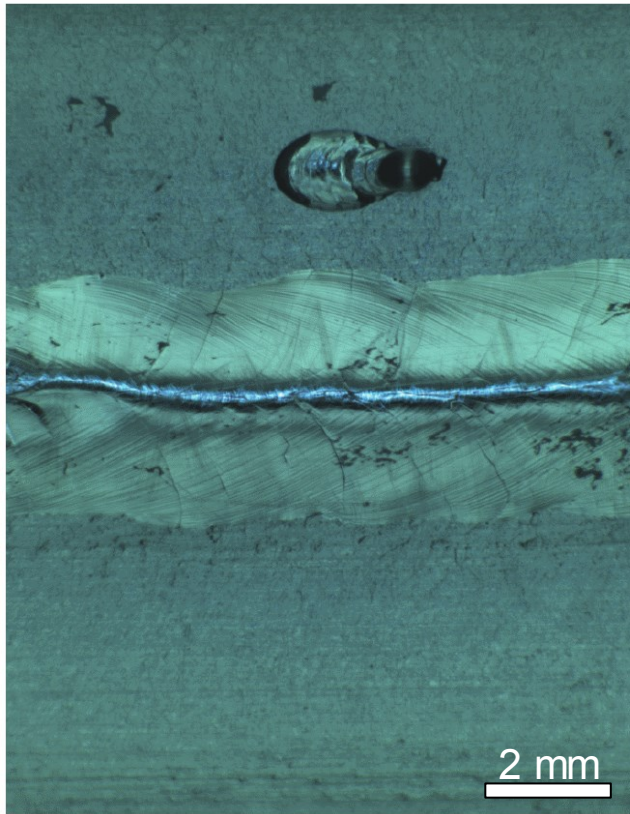
- > Unsuccessful cold RF test result with quench at **22 MV/m**, **no FE**
- > OBACHT indicates defective welding as a possible quench reason

→ **2nd Sound** & **T-map** will be applied for the quench localization and further clarifications

Endoscopes & OBACHT discover some “**spatters**” occasional occurring during the welding:

- is this dust responsible for the spatters (present only in this region, esp. for big spatters) or is it just a product?
- Is a cleanliness issue or e- beam stability?

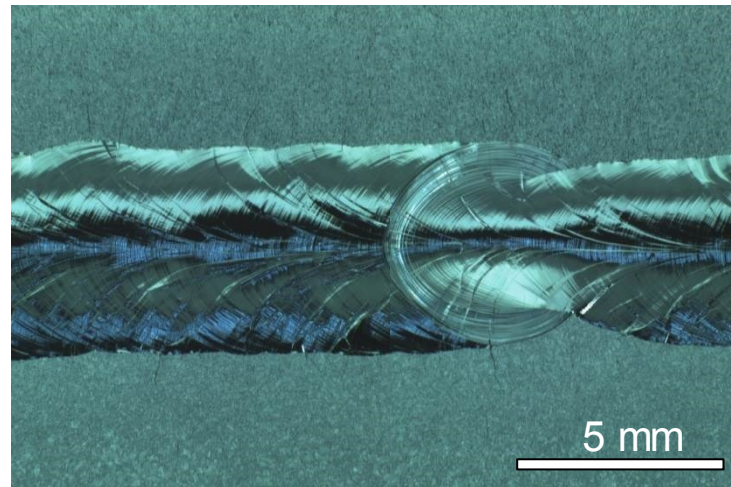
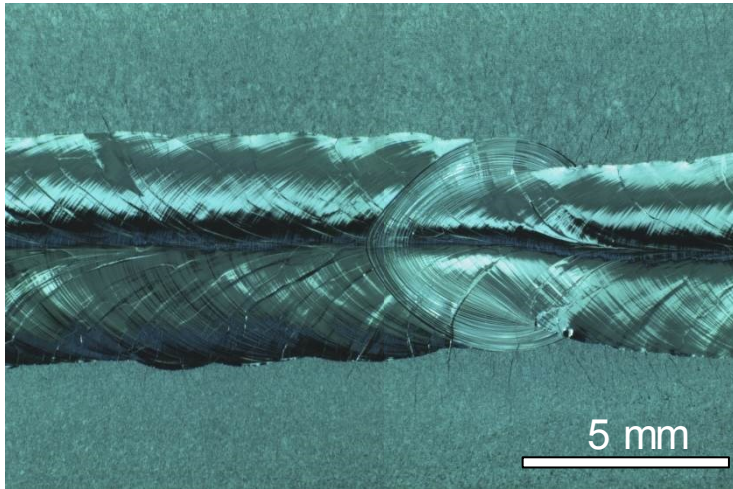




After final polishing:

→ max $E_{acc} = 30.5 \text{ MV/m}$
 → no FE

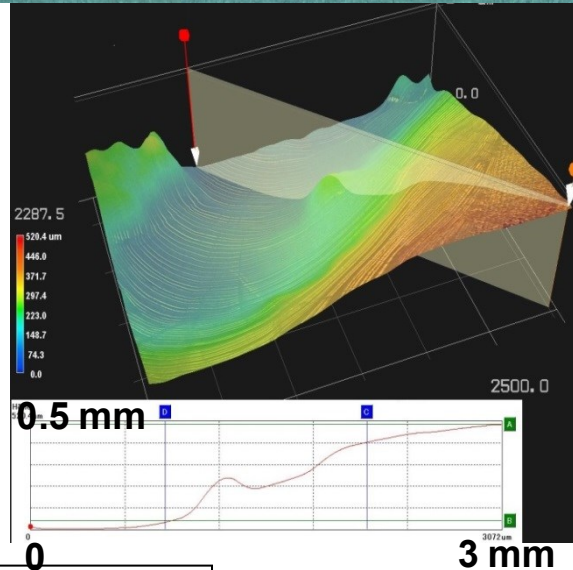
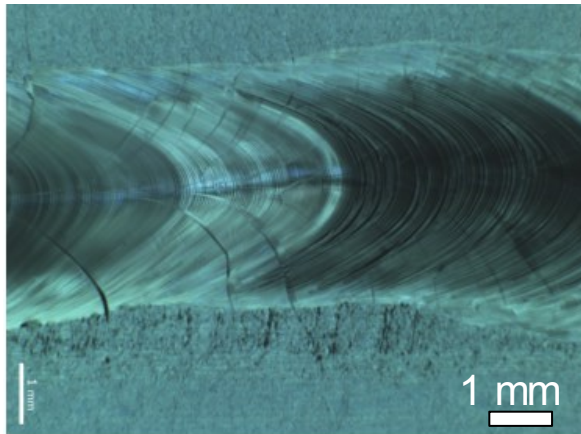
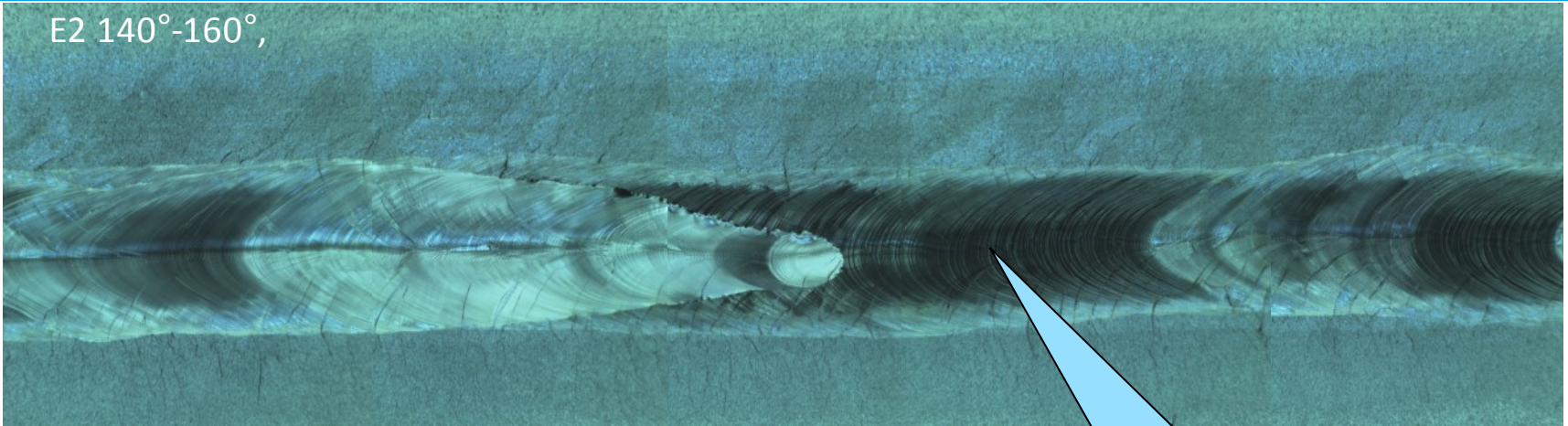
- reason is under investigation
- an **additional grinding/repair** is required
- optimum repair procedure (here shown a manual one) is under study



-> Optically the seam **looks fine**

-> Another cavity after such event (not OBACHT tested) showed **good** result with $E_{\max} = 33 \text{ MV/m}$

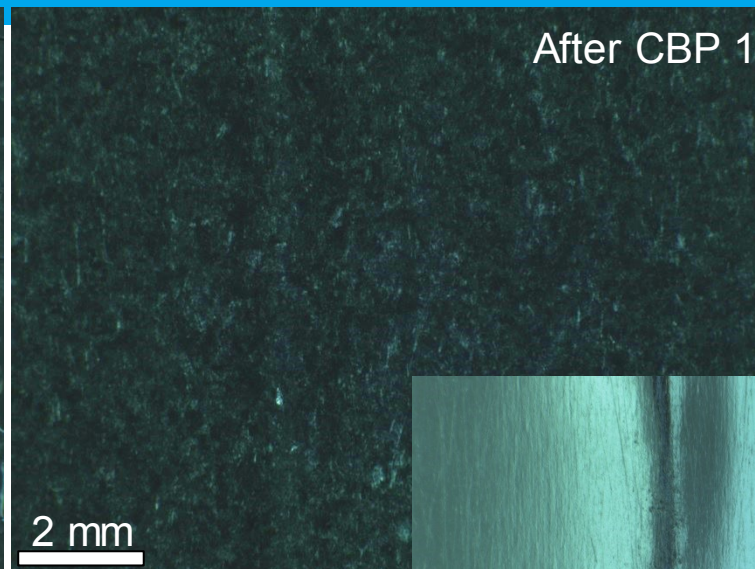
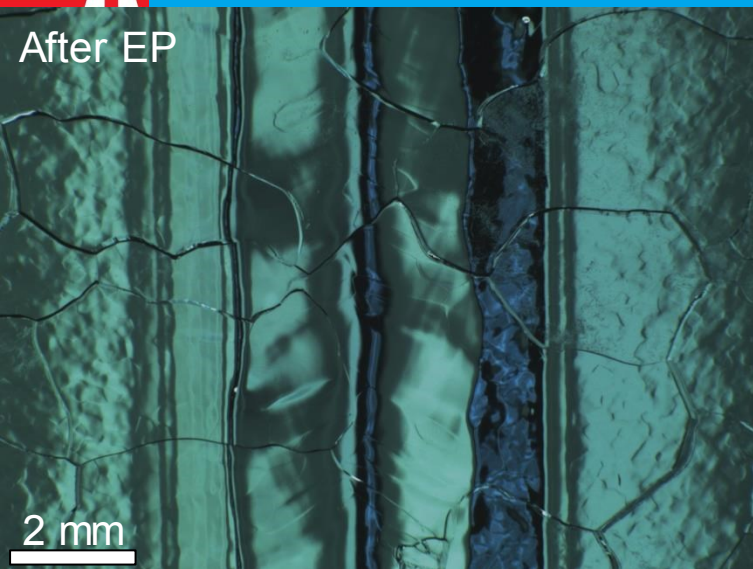
E2 140°-160°,



→ The whole welding seam (right) **protrudes >500 μm** (<300 μm specified)

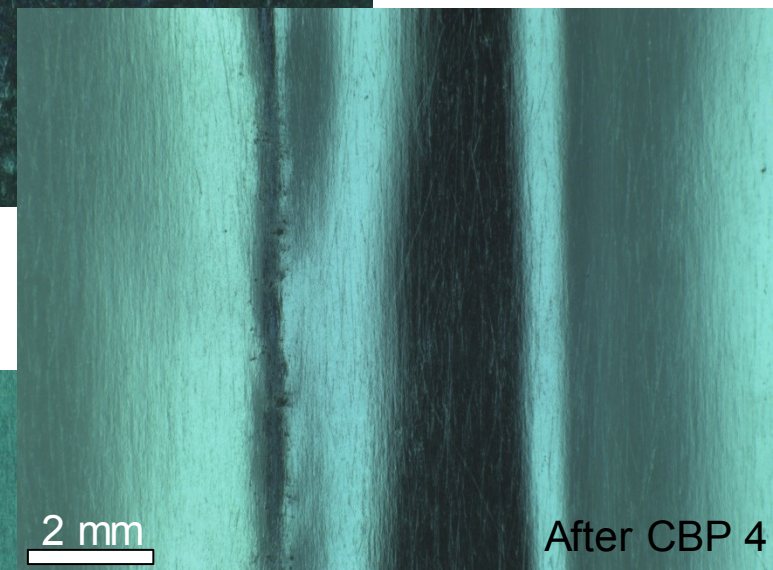
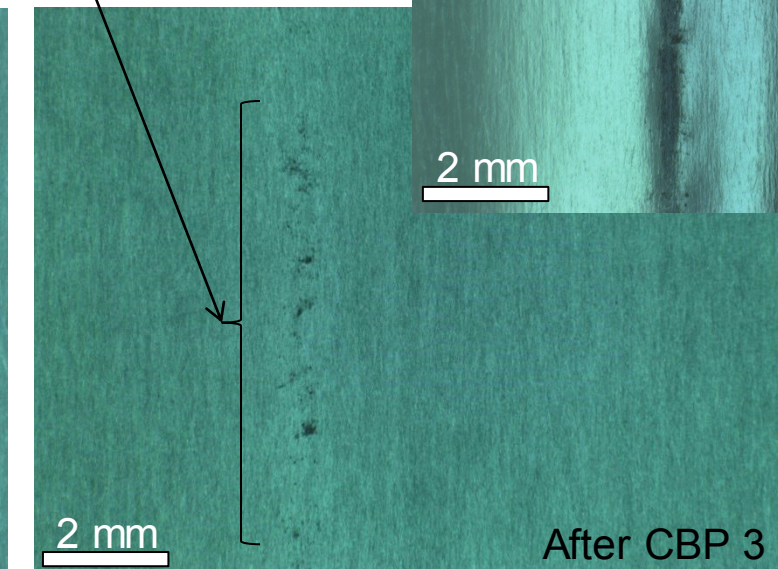
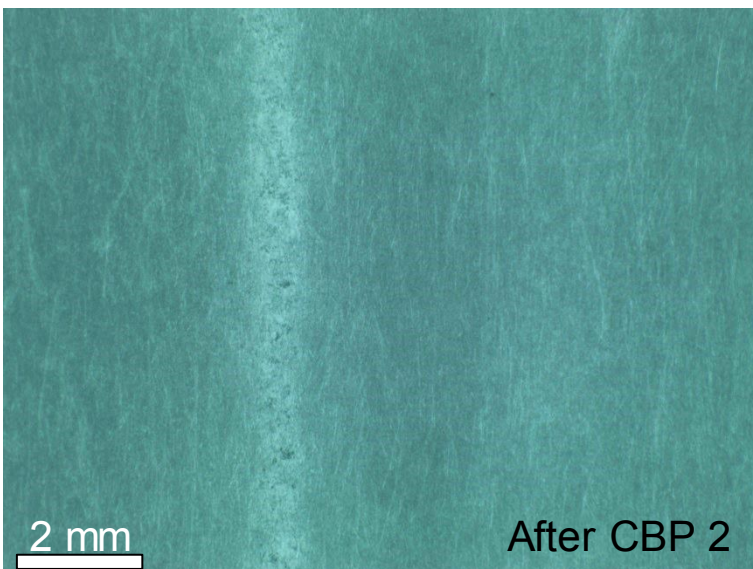
After final assembly and polishing:

→ max $E_{acc} = 34.3 \text{ MV/m}$, BD limited
→ no FE



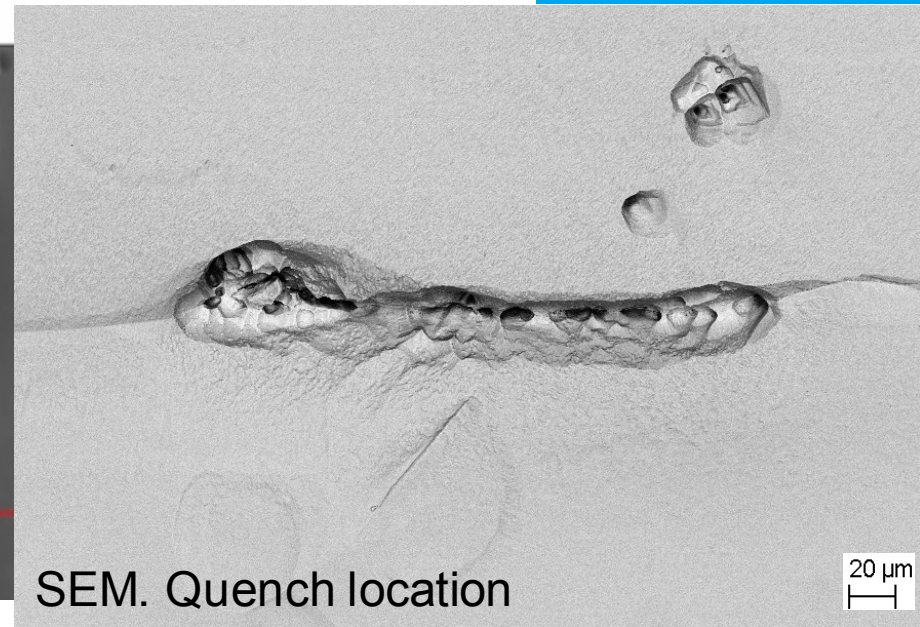
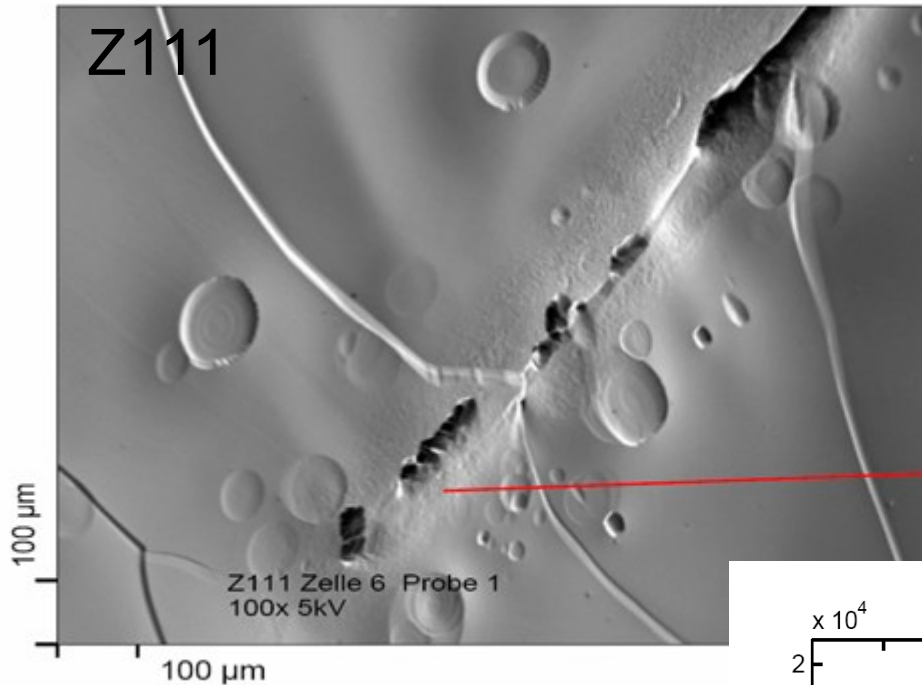
Z110_E1, 14.4°
 $E_{\text{max}} = 14 \text{ MV/m}$
 despite of add. EP

Porosity close to welding seam
 even after ~200μm CBP polishing



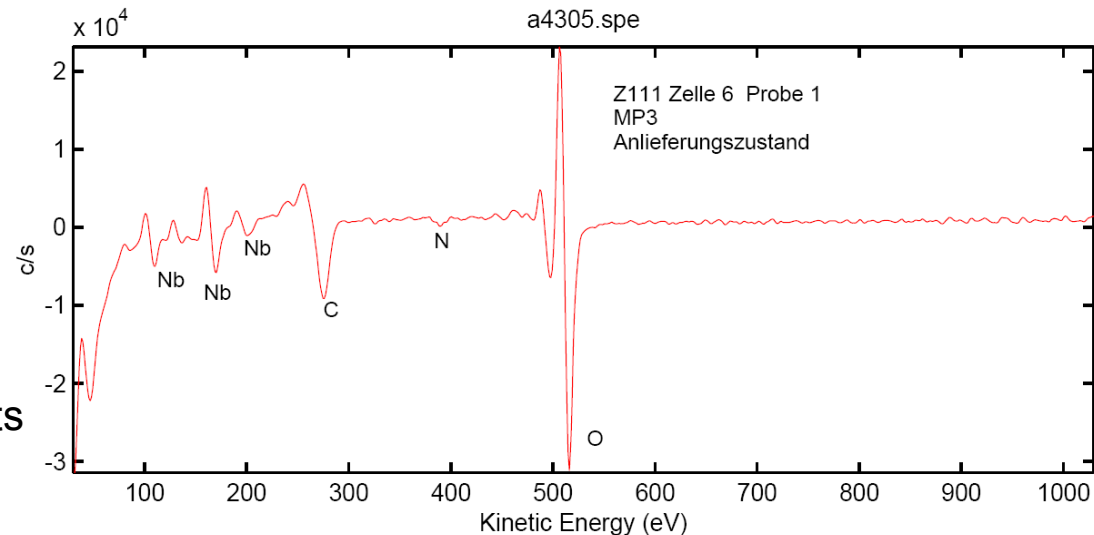
Porosity close to the welding seam

SEM 2008-11-17



The Z111 cavity from the same campaign:

- deep pores even after additional 88 + 20 μm BCP, no foreign inclusions
- max $E_{\text{acc}} = 14.8 \text{ MV/m}$, BD limited
- It is hardly possible to cure such defects



Auger analysis of the quench area (no foreign elements)

Other aspects of EBW with no OBACHT inspections but still the welding issues:

- Higher shrinkage as expected during the EBW welding
- “Banana shape” of the cavity after the welding
 - Are the reasons well understood?
 - How can it be avoided/improved?

Thank you for your attention !

Acknowledgements:

- **FLA/ILC group** & all **colleagues** participating in the XFEL cavity fabrication, treatments and tests.

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