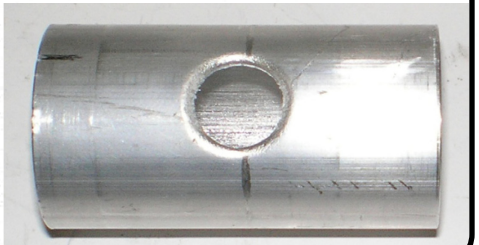
Joining of Dissimilar Materials : Weldability of Copper to Brass and Aluminium to Steel using Magnetic Pulse Welding

Koen Faes
Belgian Welding Institute
Nicolas Debroux
CEWAC

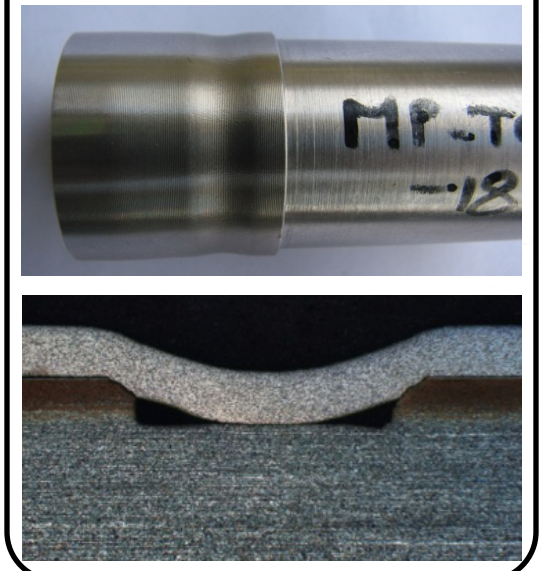
Activities

Tube cutting

Tube perforation

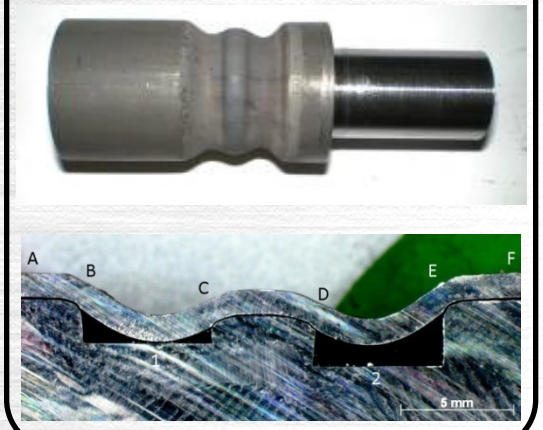


Case studies

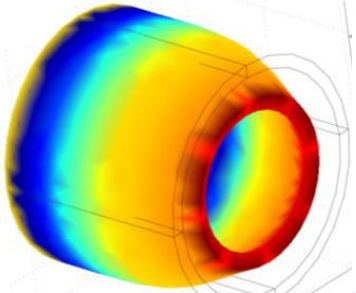


Stainless steel

Axial crimp joints



Modelling

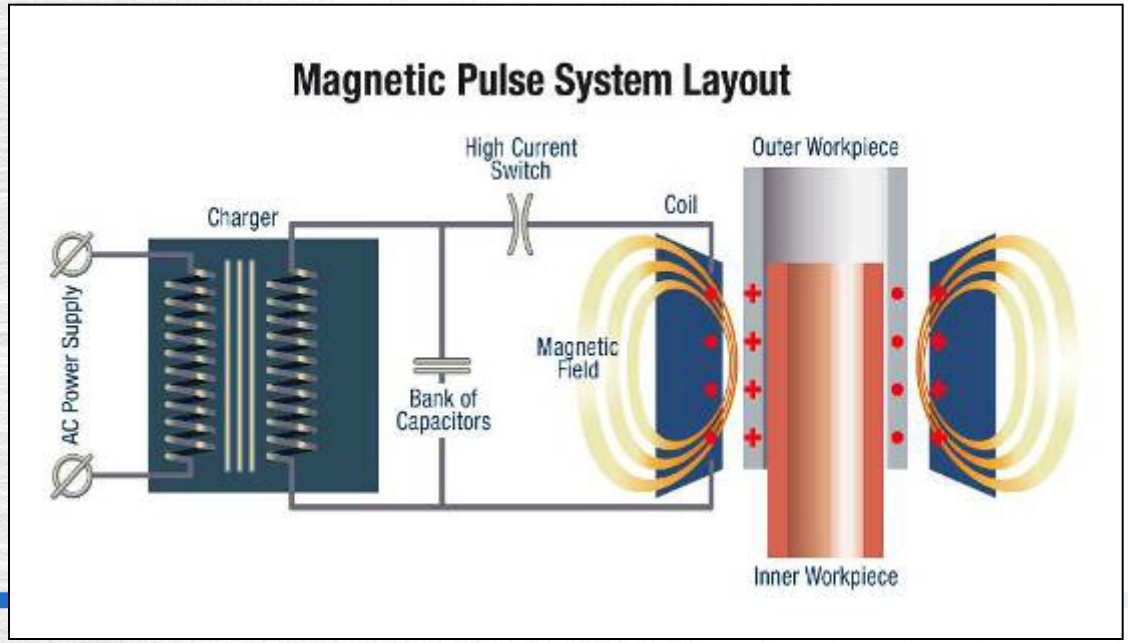


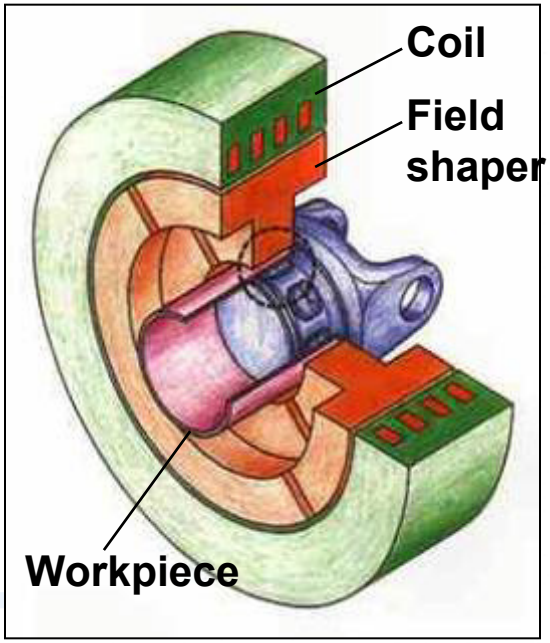
Welding

Magnetic pulse welding technology

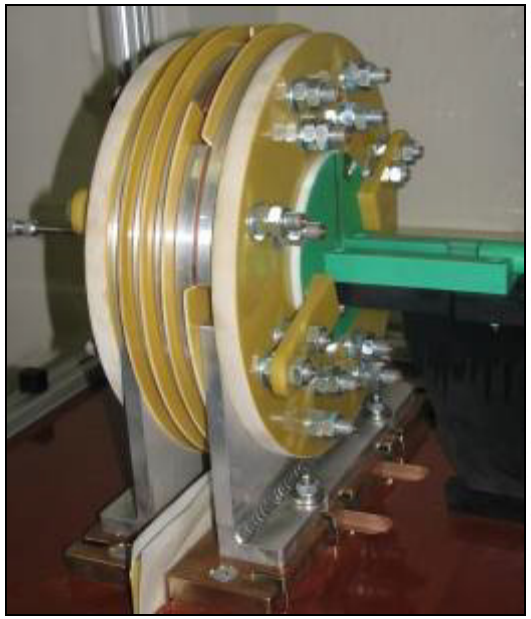
Electromagnetic welding process :

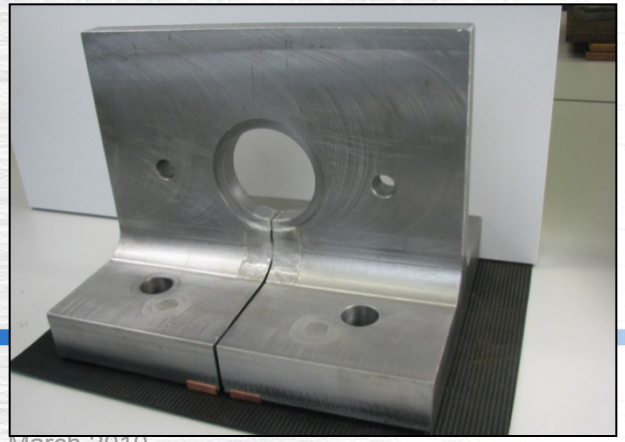
- Similar to explosive welding
- Similar process
- Different (safer) source of energy

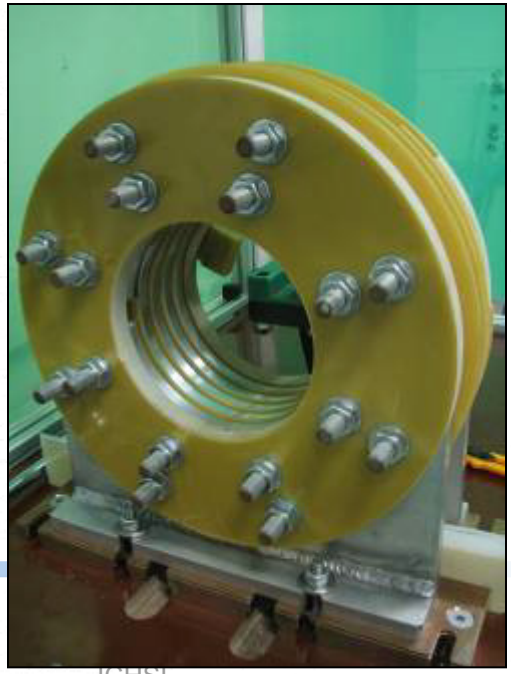


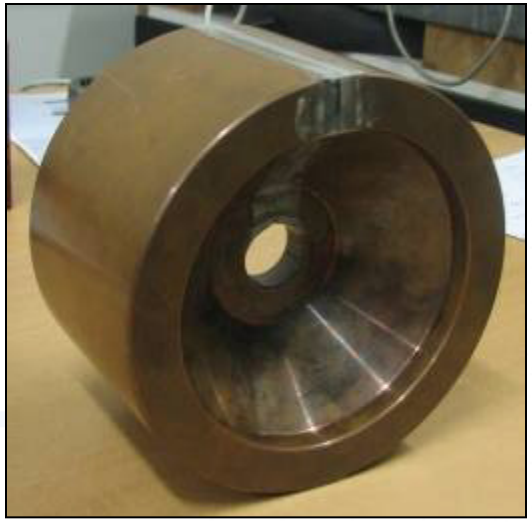


Experimental test set-up



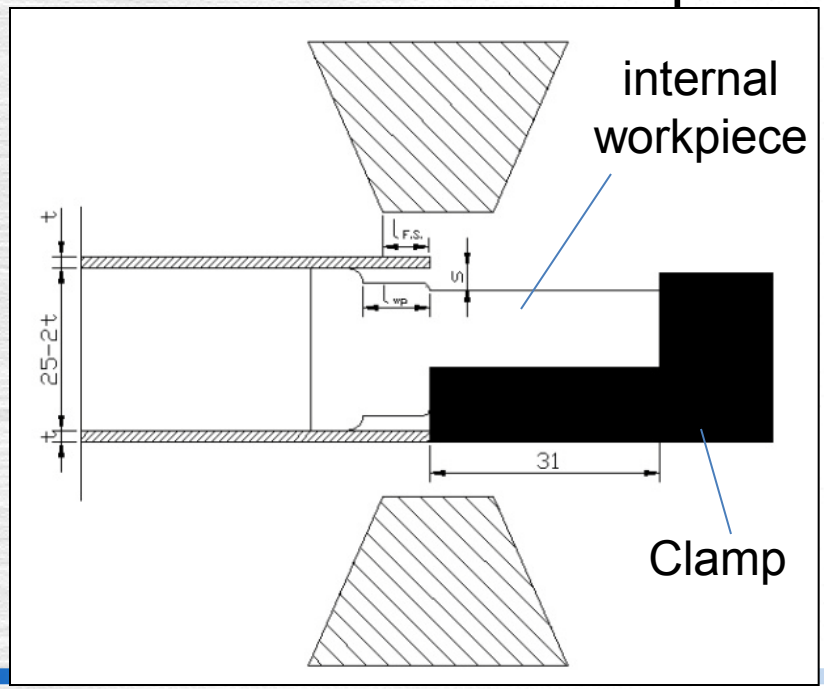






Experimental test set-up

- Welding experiments with : - Copper – Brass
  - Aluminium – Steel
- Tubes : O.D. : 25 mm – Wall thickness : 1,5 mm
- Solid internal workpieces



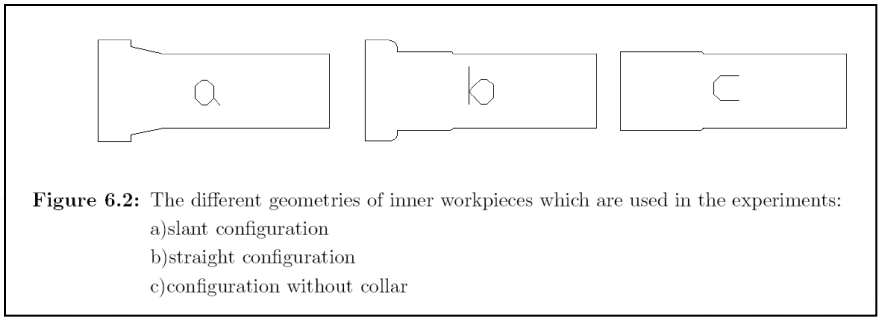
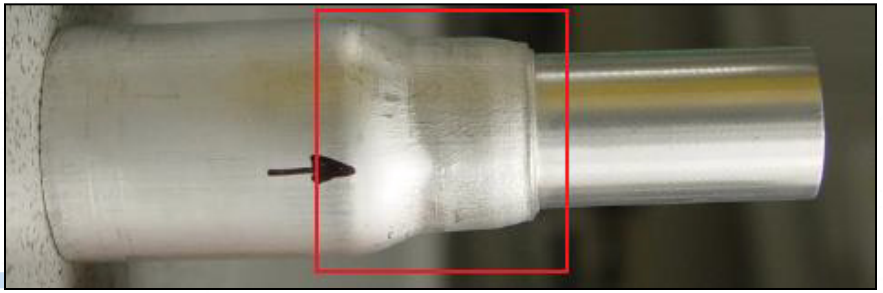


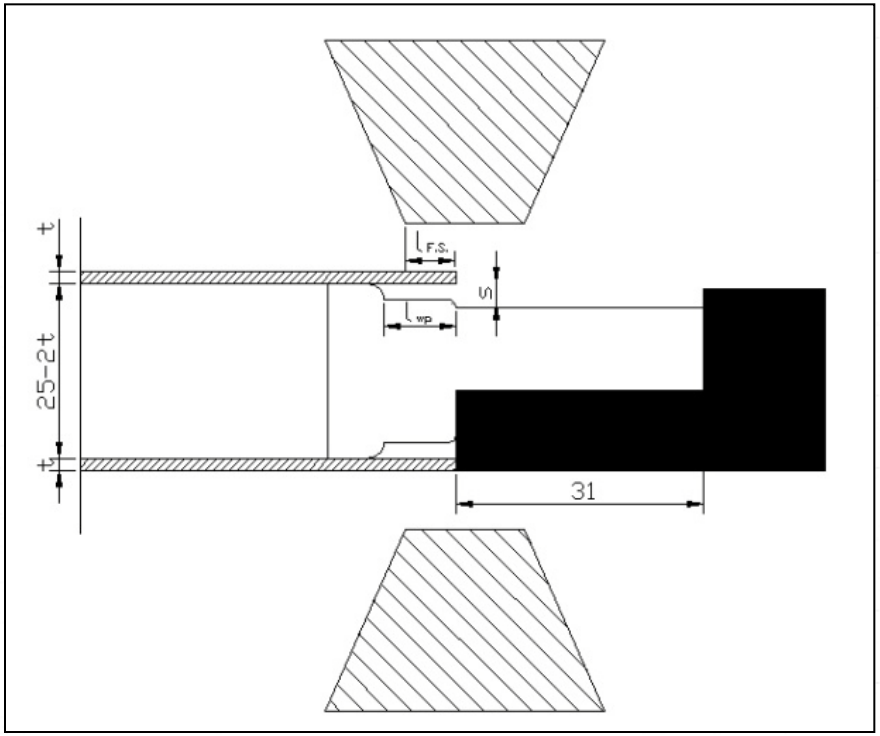
Figure 6.2: The different geometries of inner workpieces which are used in the experiments:
a)slant configuration
b)straight configuration
c)configuration without collar



Parameter optimisation

Parameters varied :

- Air gap width
- Tube end position (field shaper overlap)
- Charging voltage



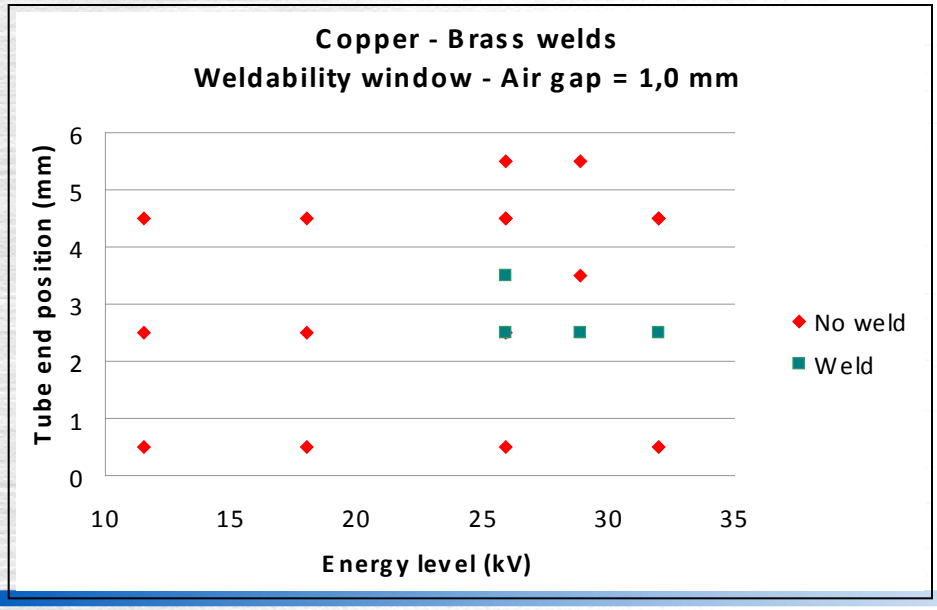
Investigation methods :

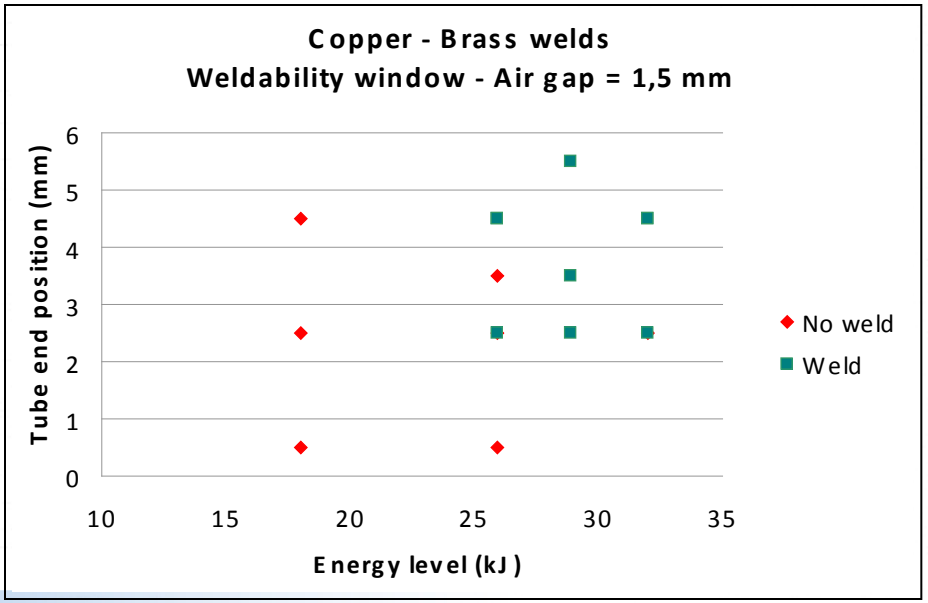
- Metallographic examination (weld length)
- Scanning electron microscopy
- Hardness measurements & leak tests

Cu – Br : Parameter optimisation

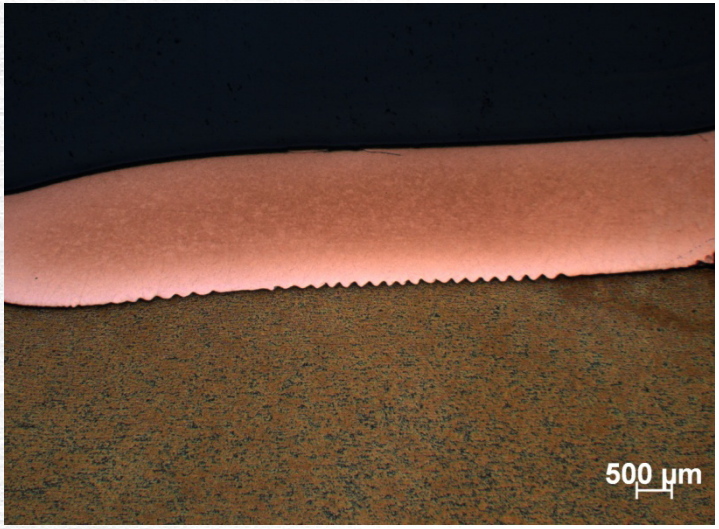
Optimal parameters :

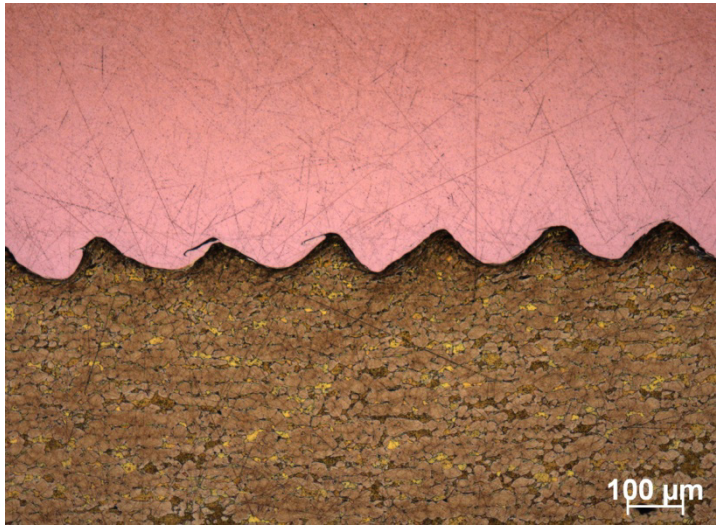
- Air gap : 1,0 – 1,5 mm
- Tube end position : 2,5 mm out of the centre of the field shaper
- Energy level : > 26 kJ

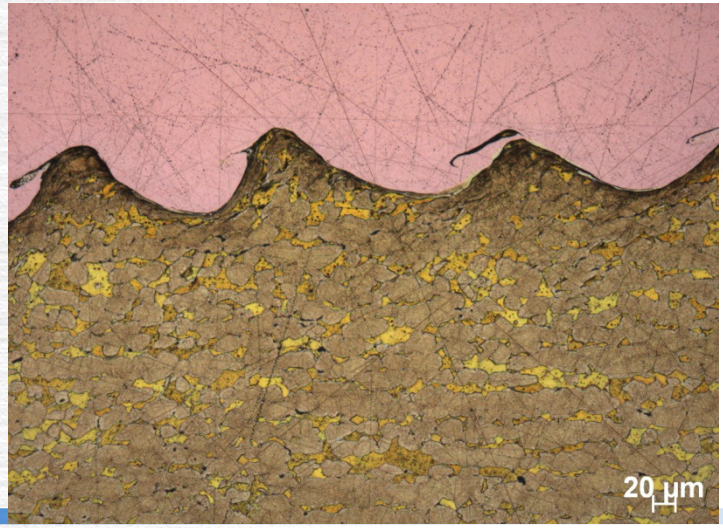




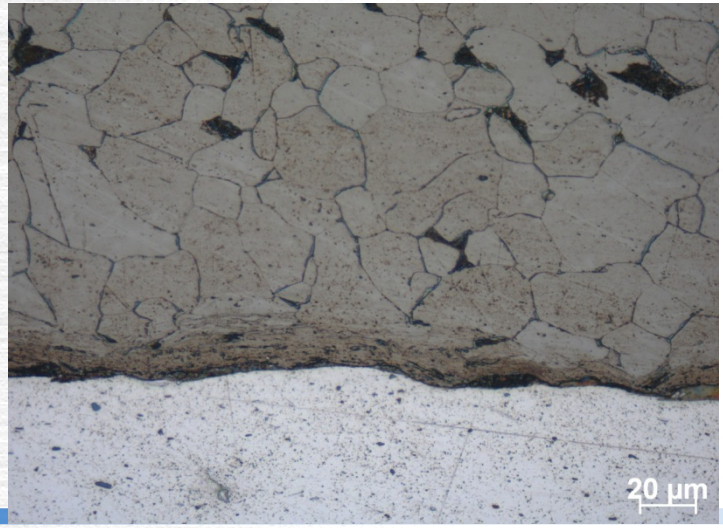
Cu – Br : Interface morphology

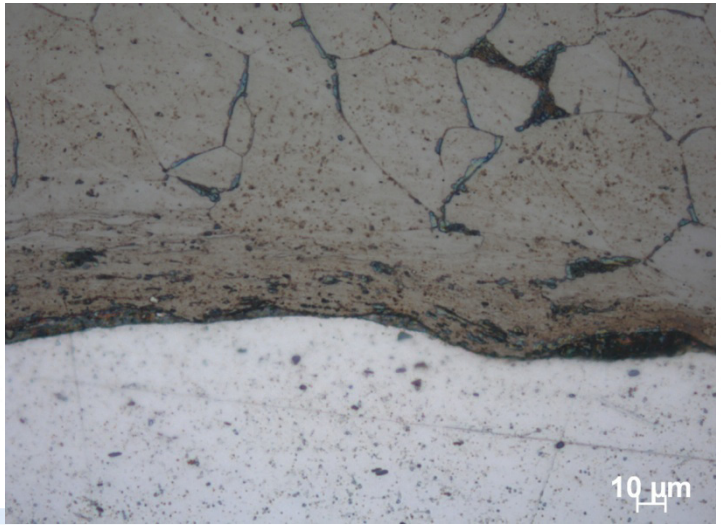




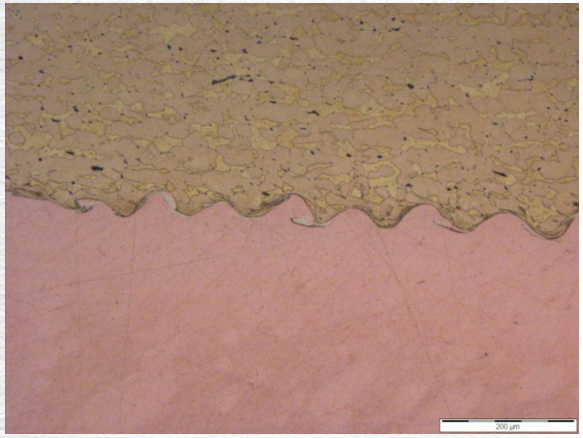


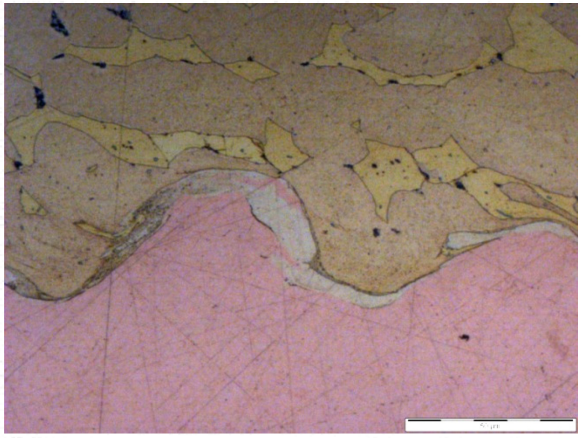
Al – St : Interface morphology

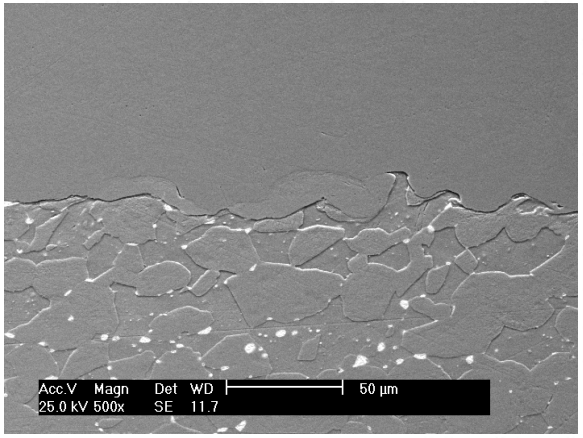


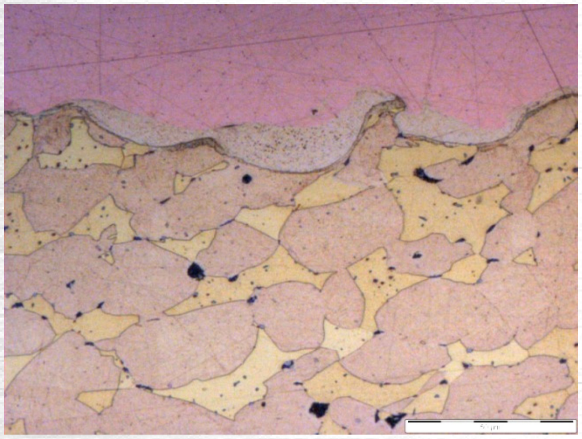


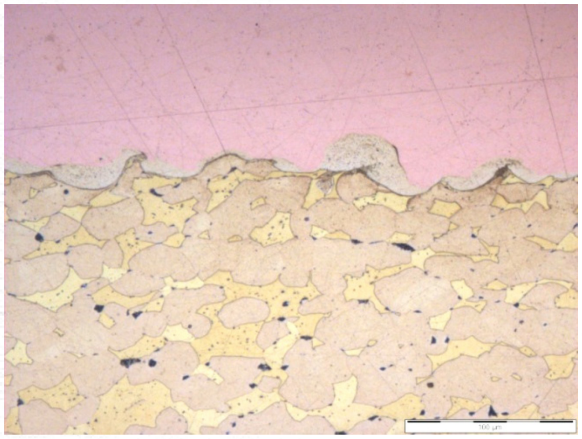
Cu – Br : Intermetallic layers

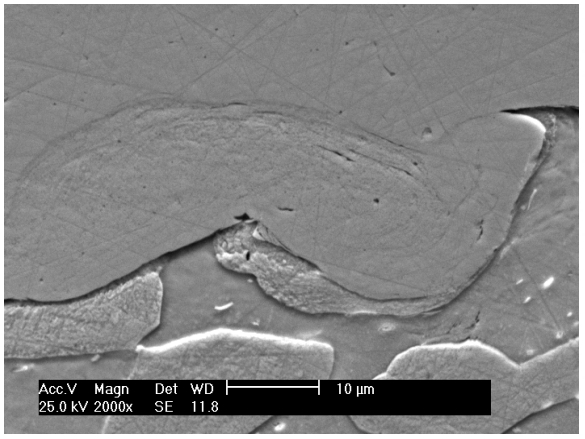




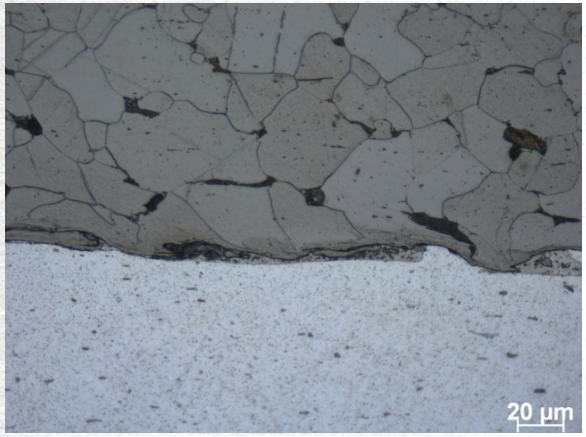


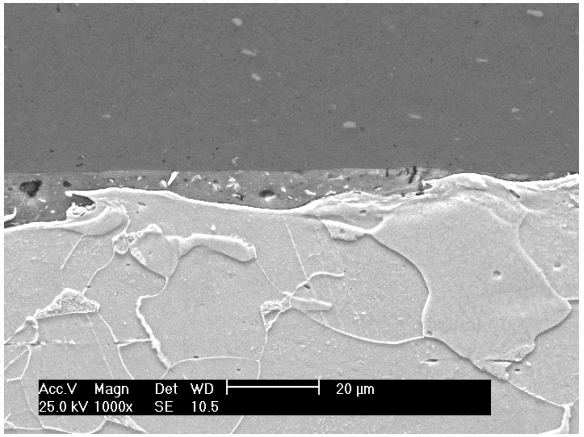


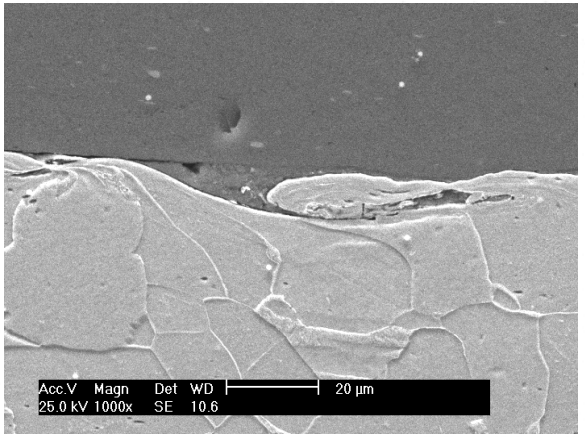


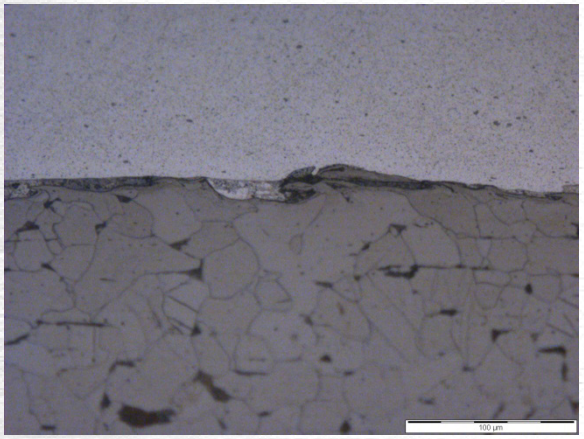


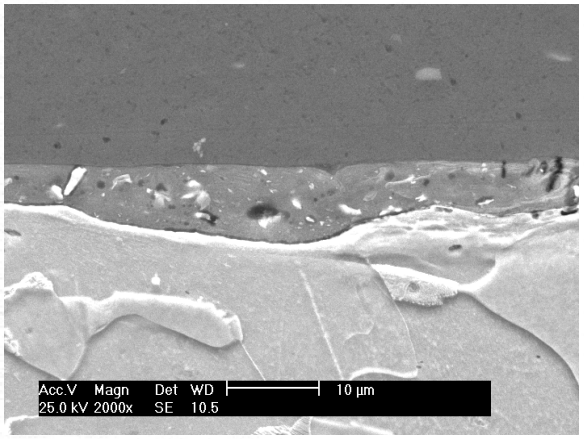
Al – St : Intermetallic layers

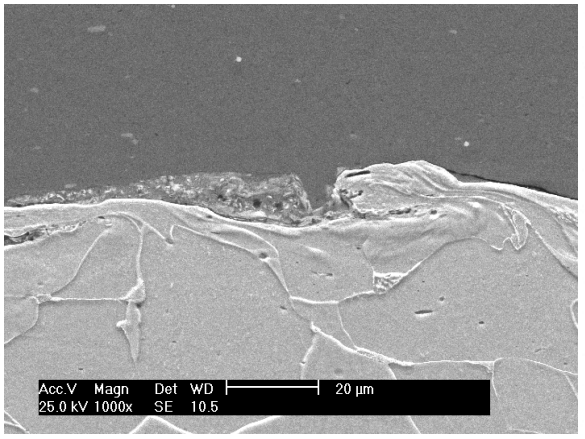




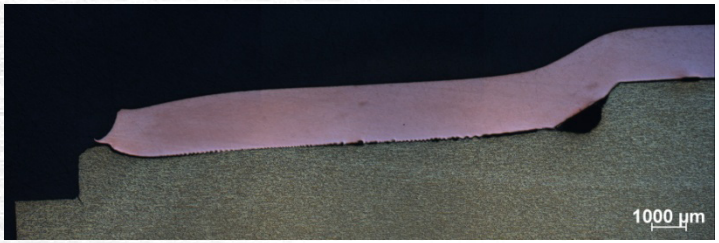


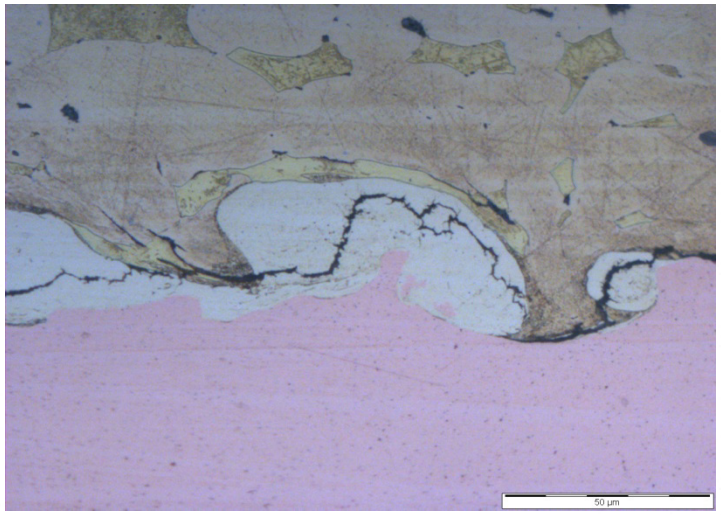


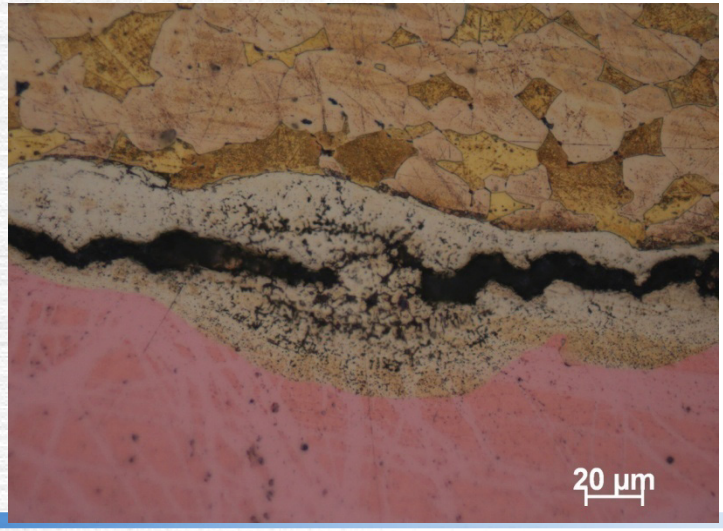


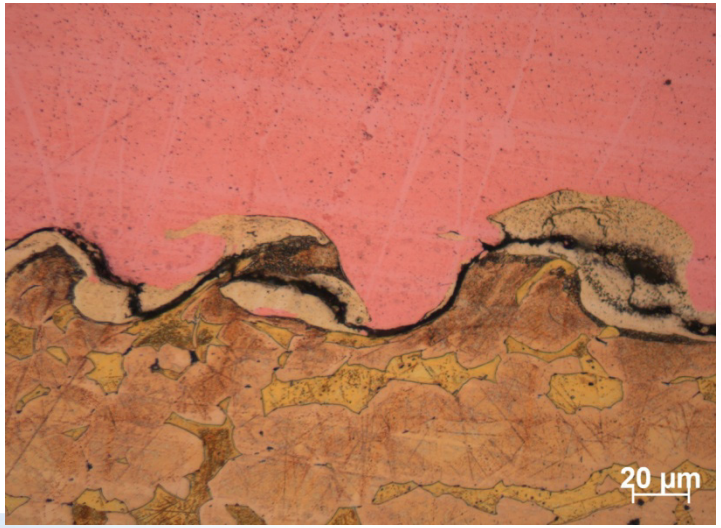


Cu – Br : Melting phenomena









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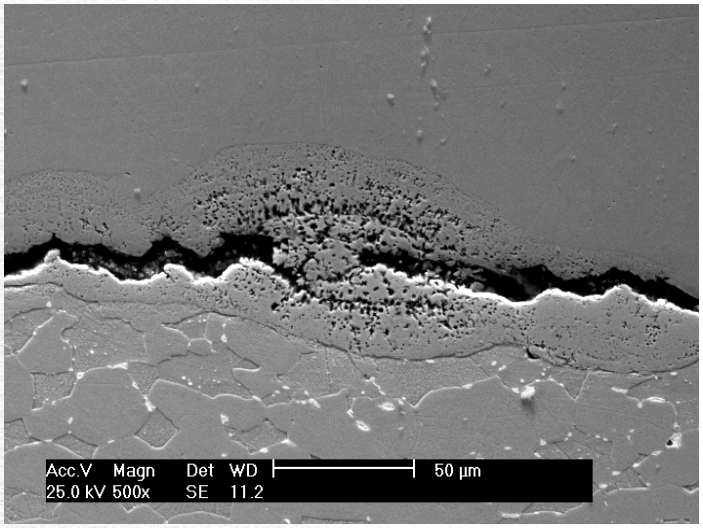

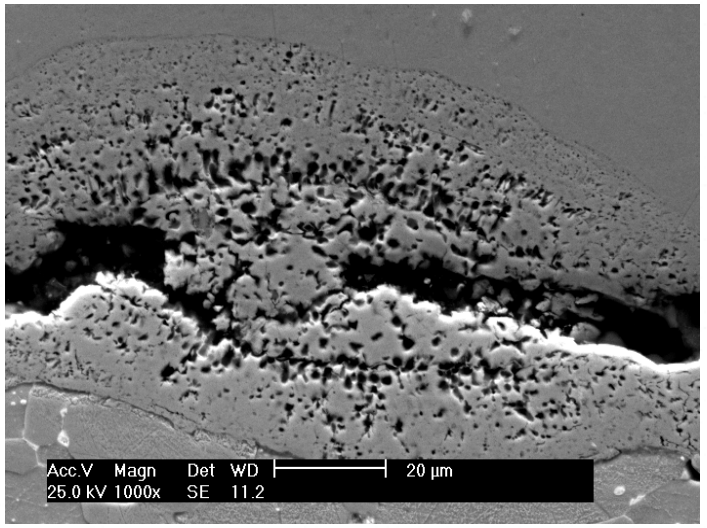

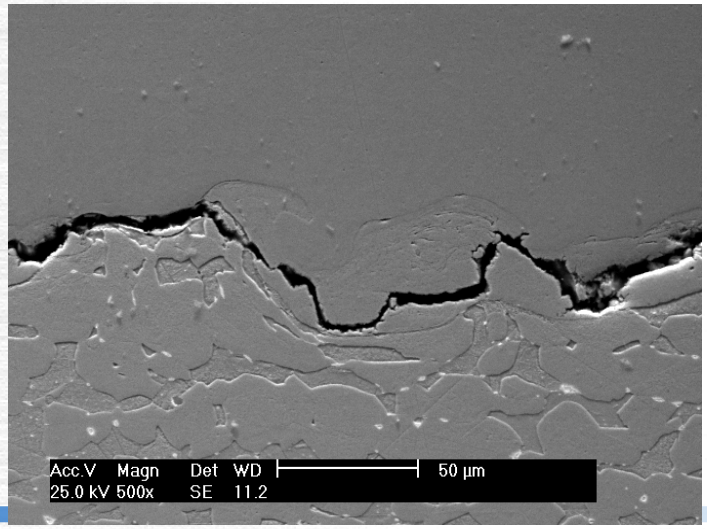

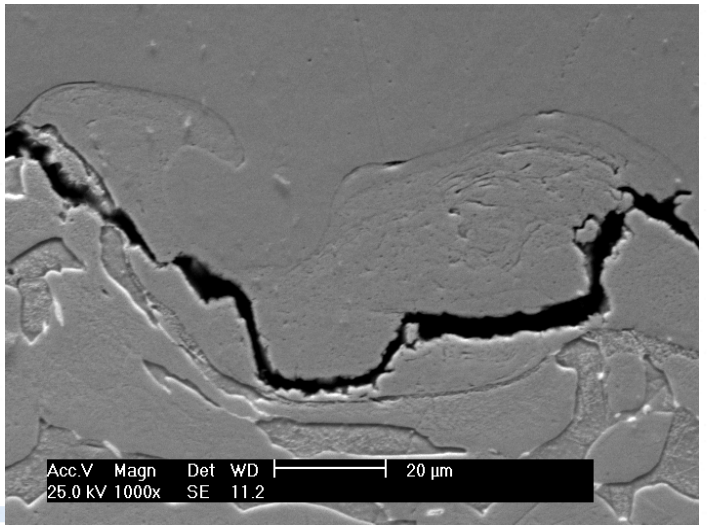

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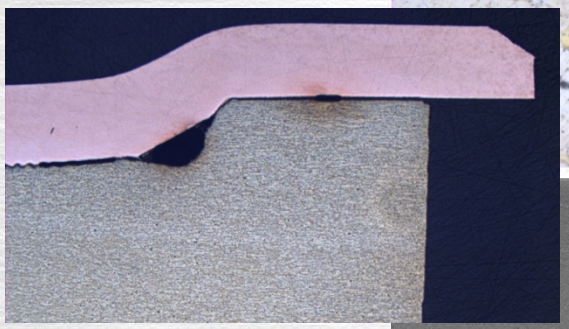
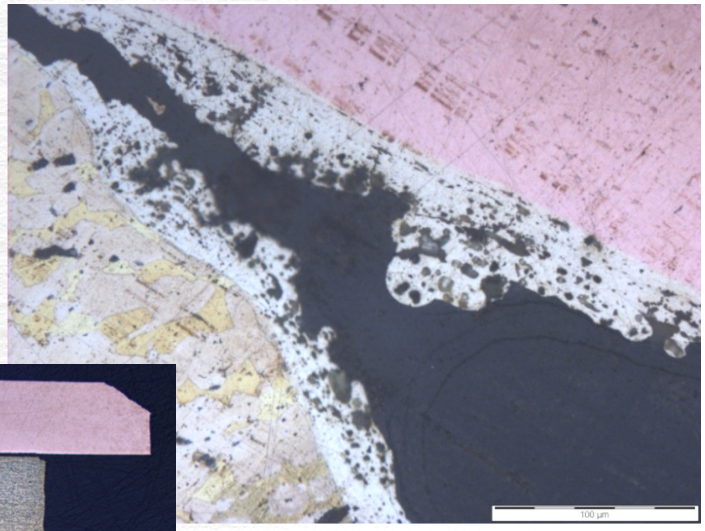
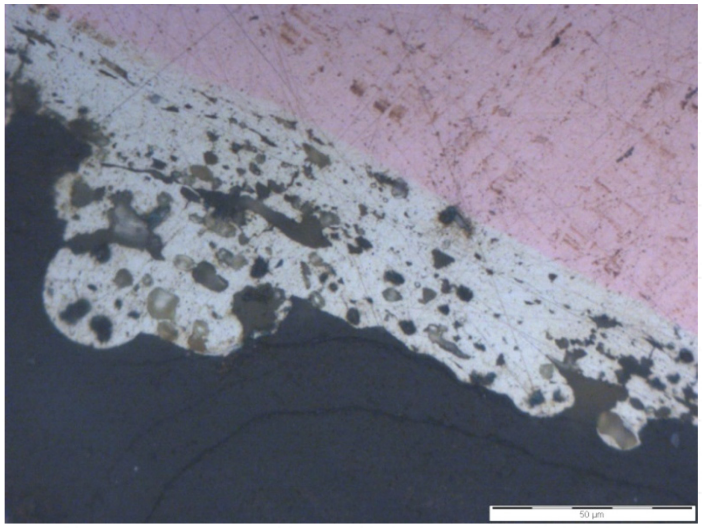
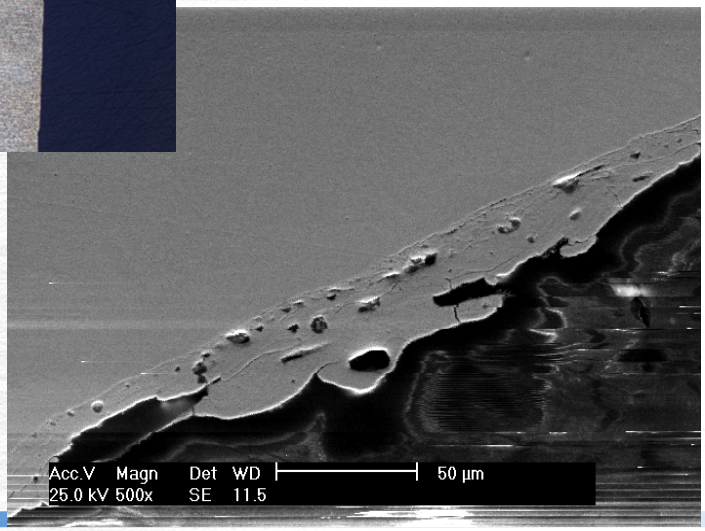
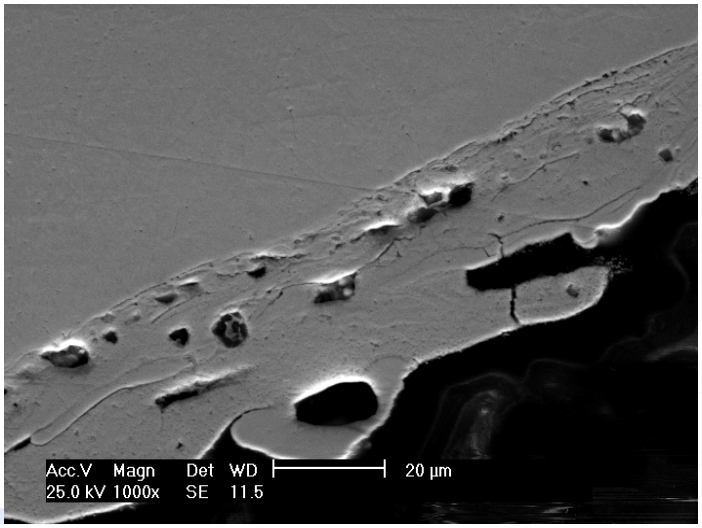


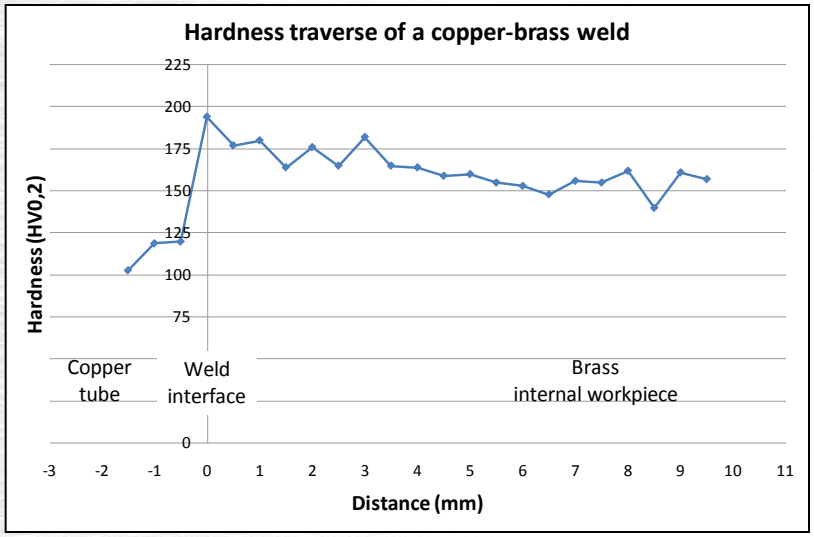


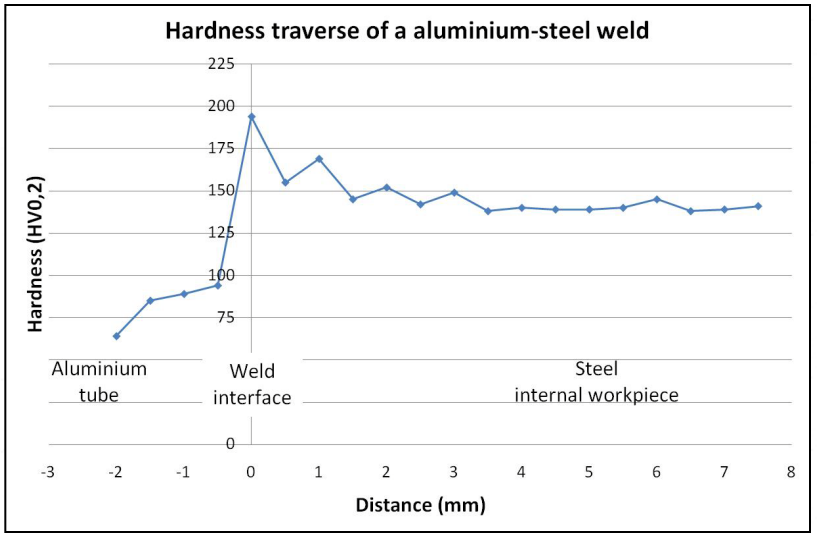






Hardness and leak testing

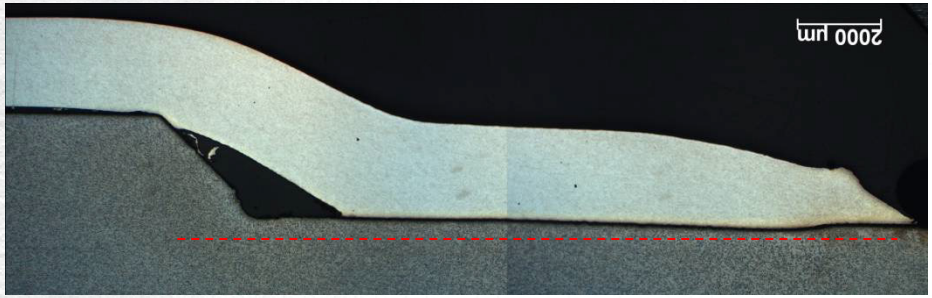


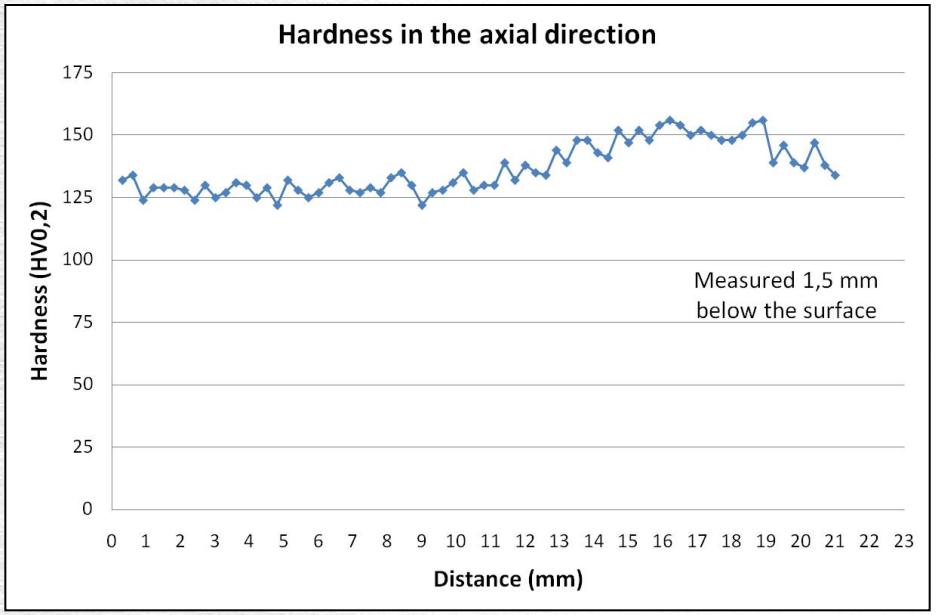


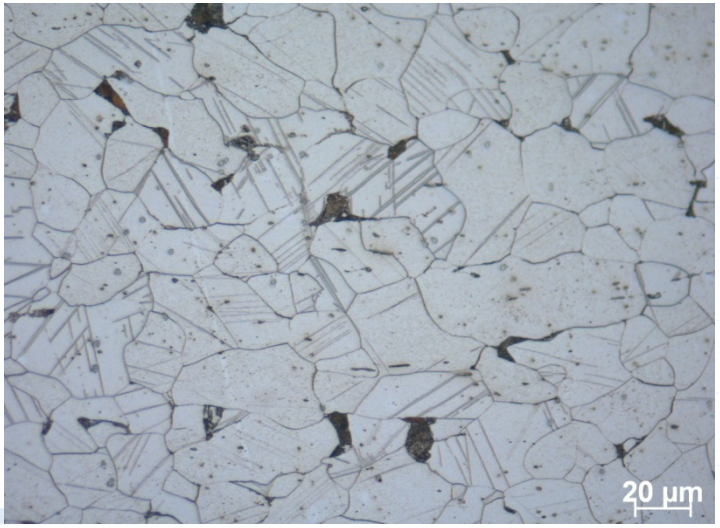
Hardness weld interface				
174	176	185	198	Av. : 183

Hardness weld interface				
144	151	263	317	Av. : 219

Hardness testing







Conclusions & Future research

Conclusions

- Defect free welds
- Intermetallic layers
- Melting phenomena

Future research :

- Repeatability
- Other material combinations