

**Electromagnetic pulse technology:
atomic bonding of dissimilar metals and
superconductors**



Dr. Ralph Schäfer, PSTproducts GmbH

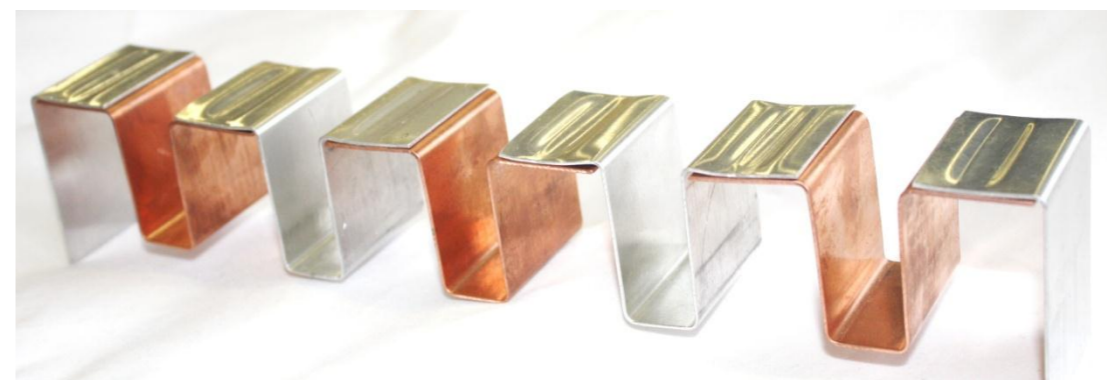
Wir fügen anders ...

We join differently ...



Motivation

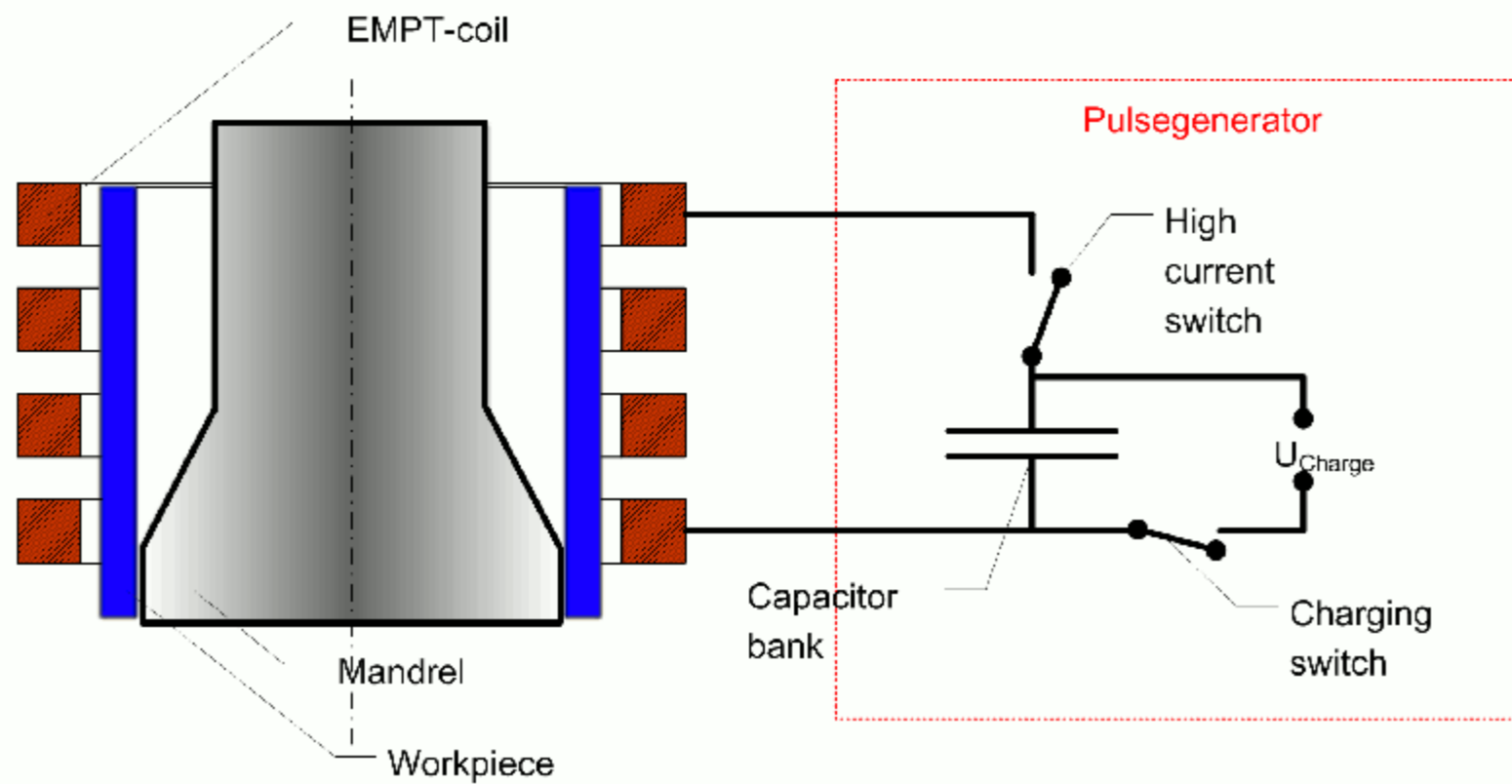
- Do you want to **create high strength joints** without any heat input?
- Do you want to create **real dissimilar joints** like aluminium with steel or metals with non-metals like plastic or glass?
- Do you want to weld **thin walled- helium tight tube** connections?
- Do you want to join **high power cables**?
- Do you want to join **super conductors**?



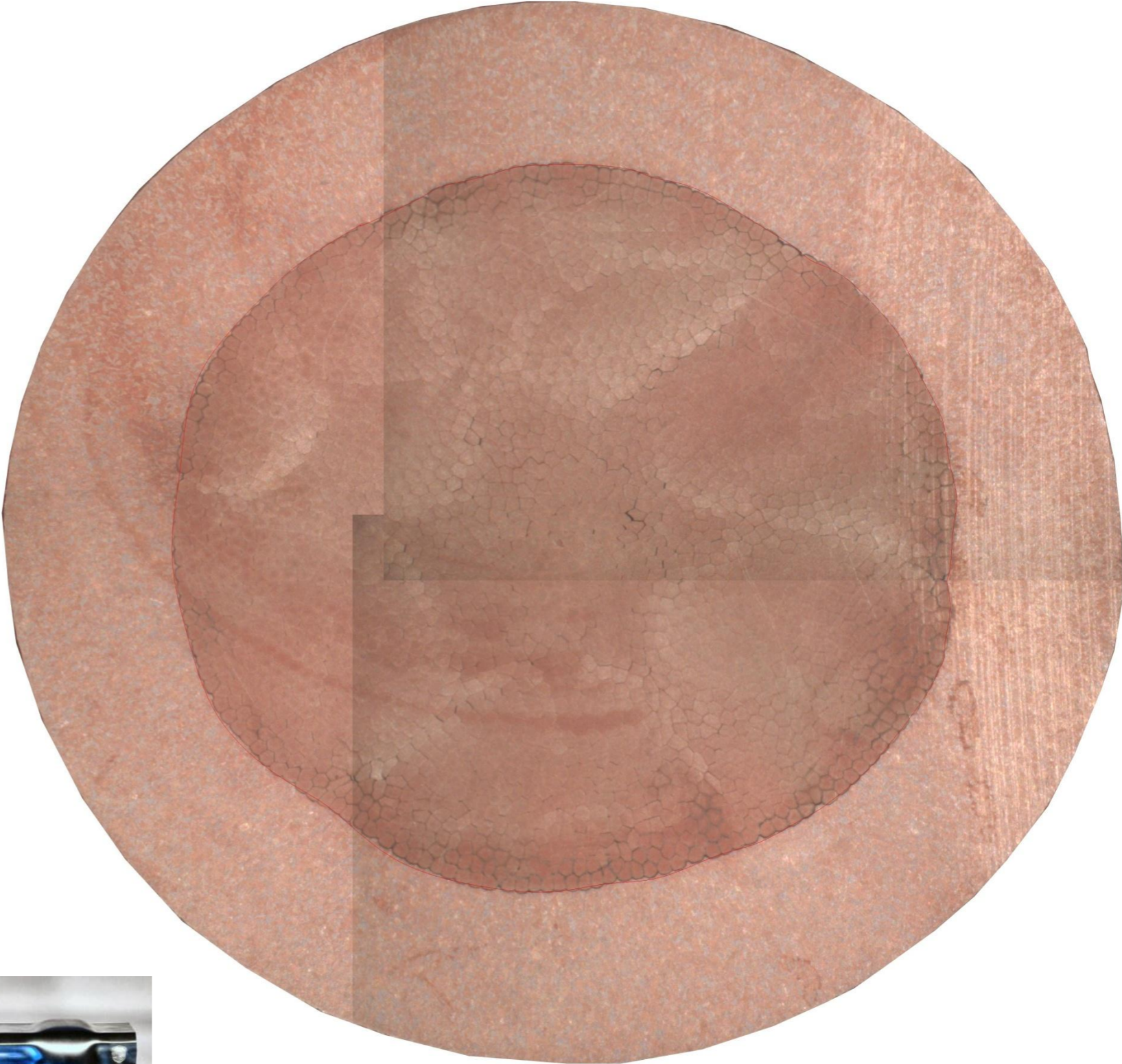
Then follow us for the next minutes



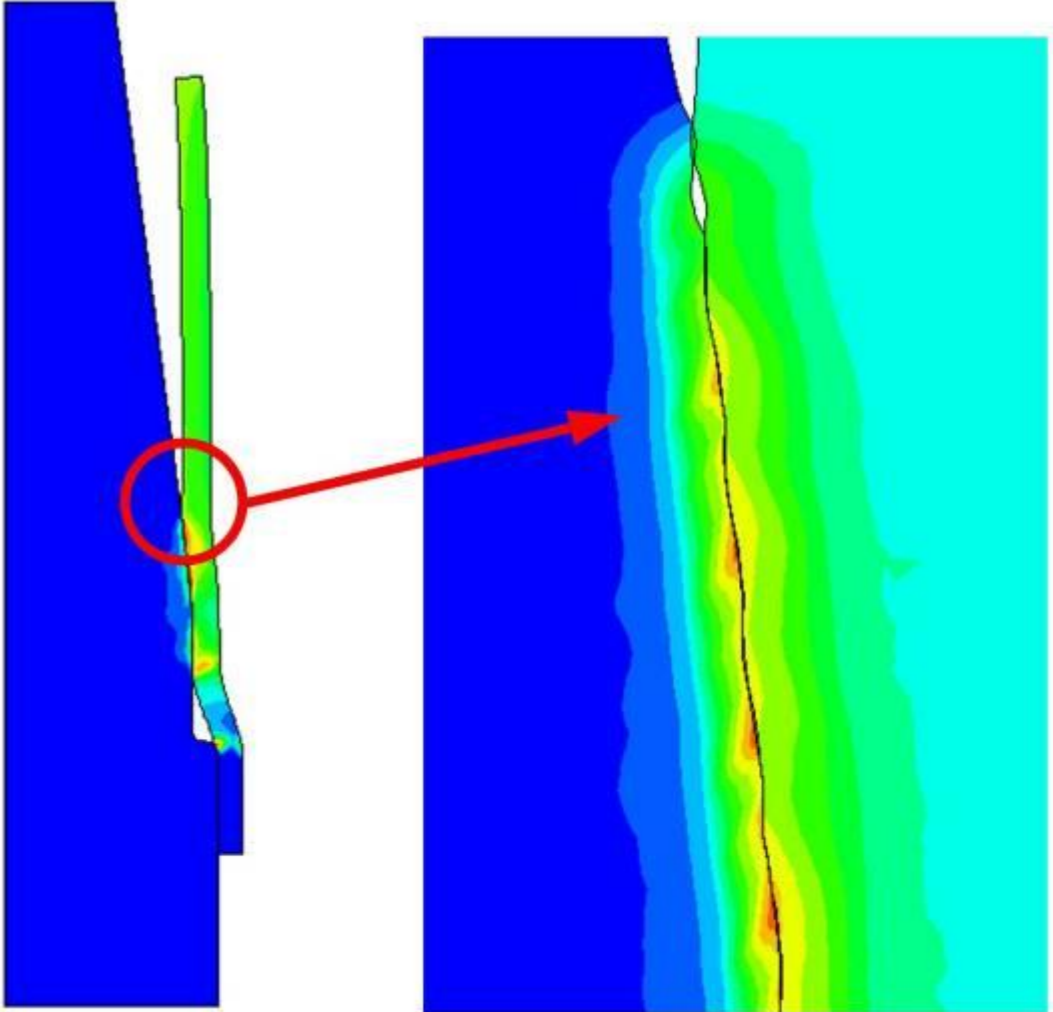
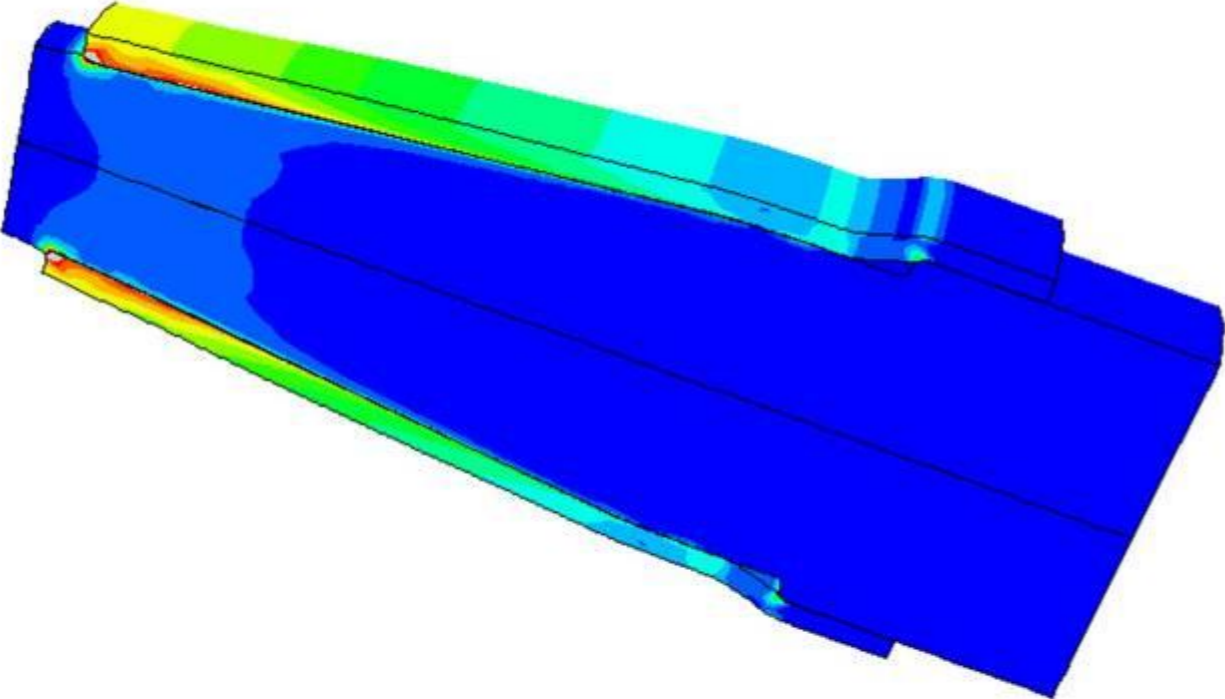
Electromagnetic Pulse Technology (EMPT)



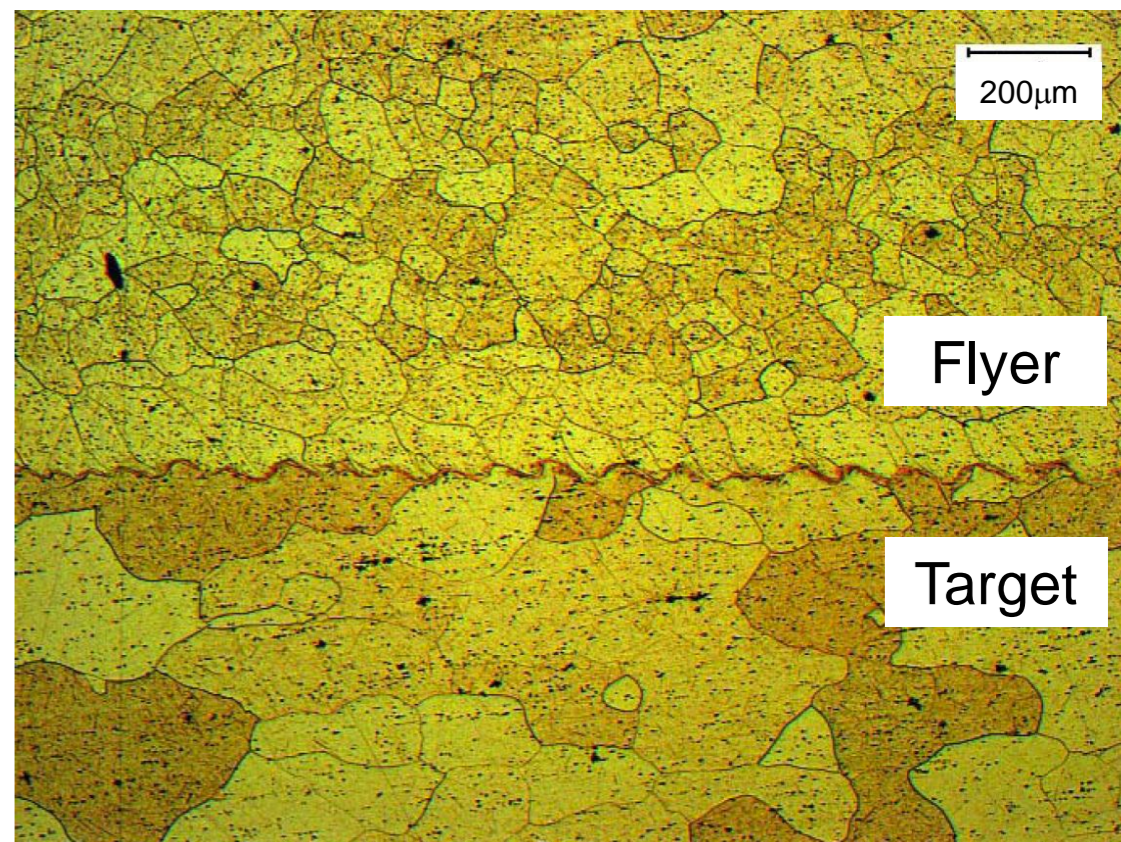
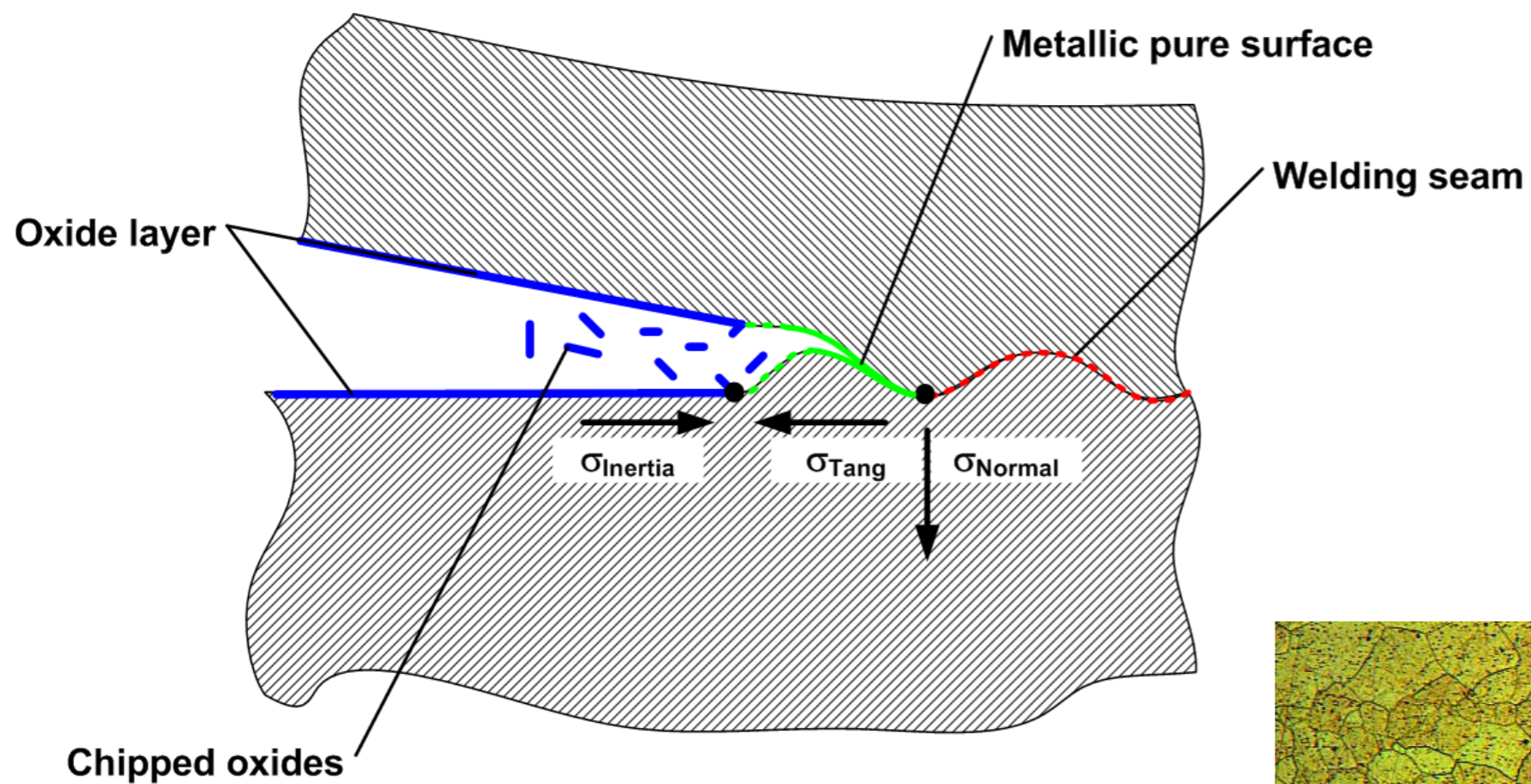
EMPT Cable Crimping



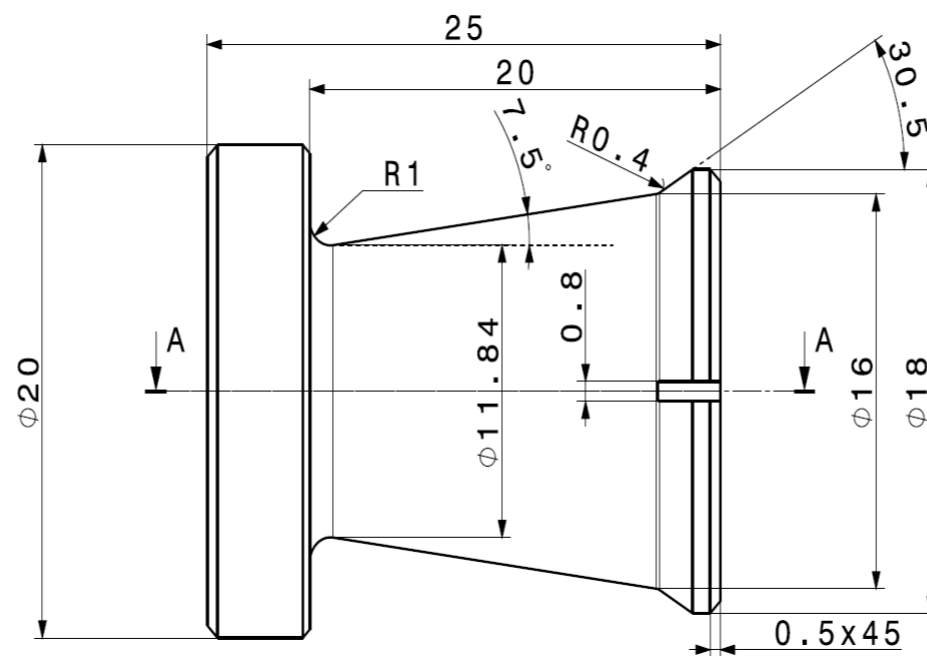
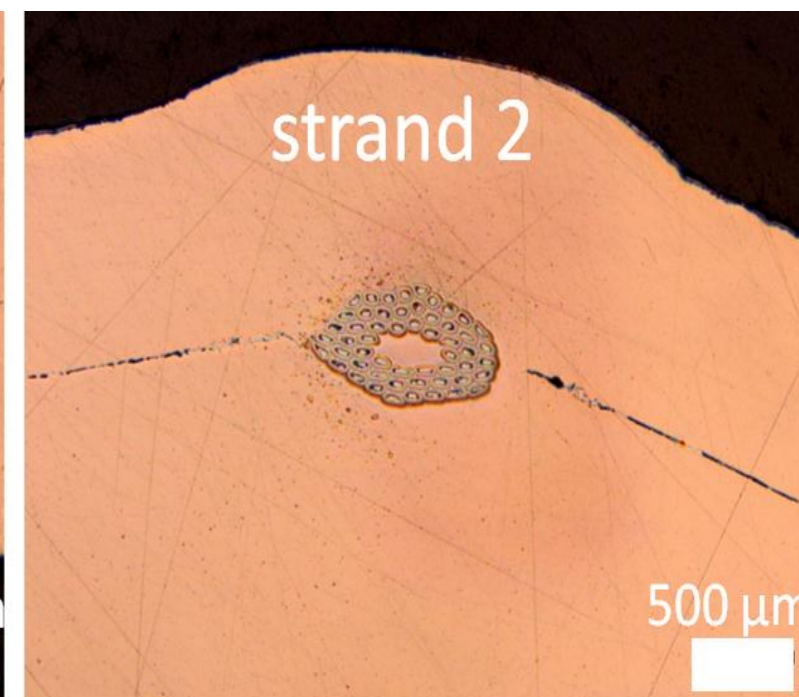
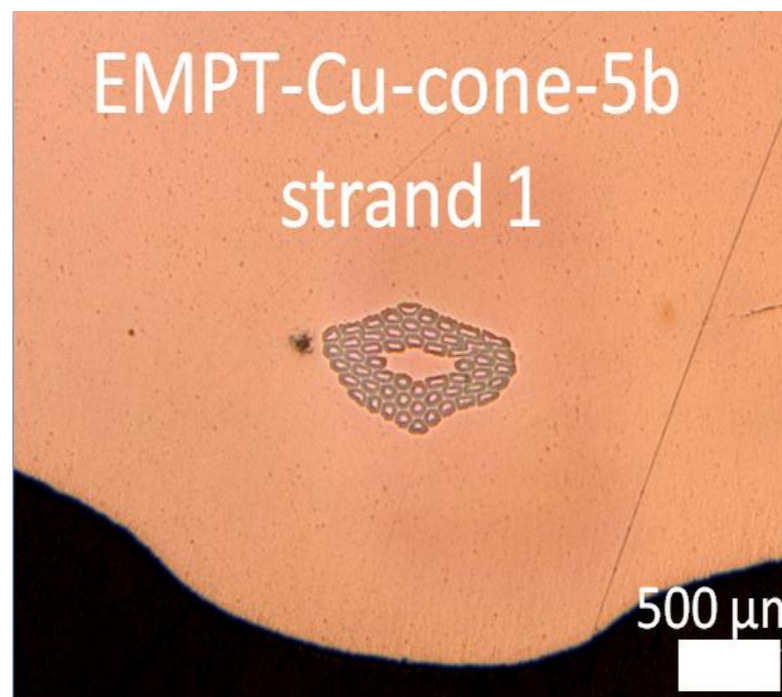
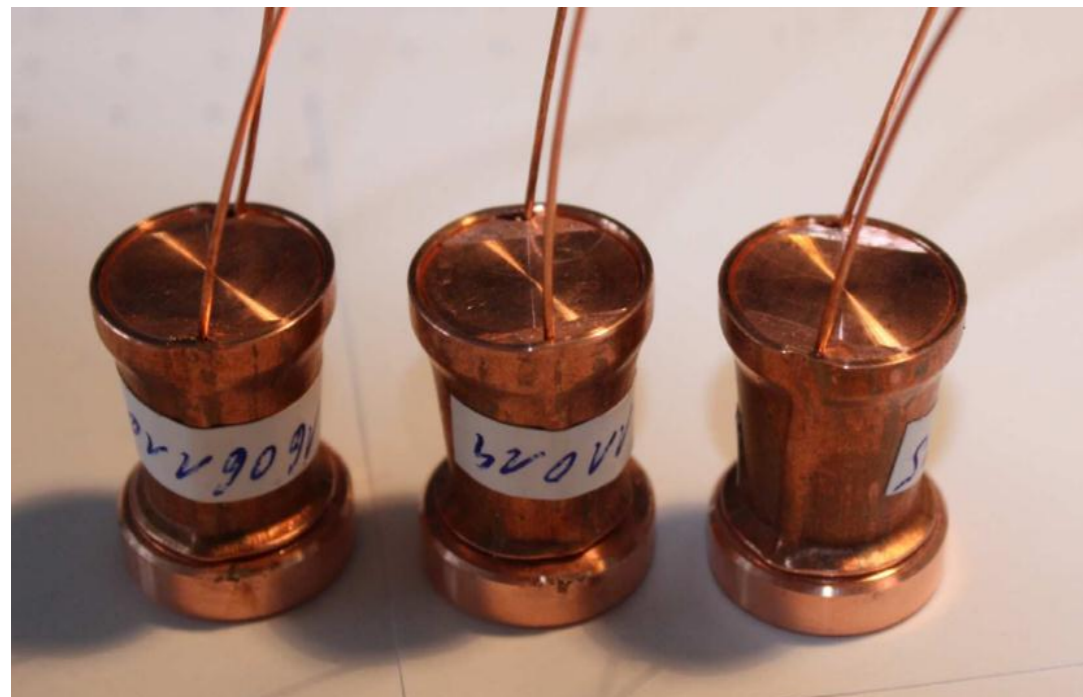
Fundamentals of EMPT welding



Fundamentals of EMPT welding

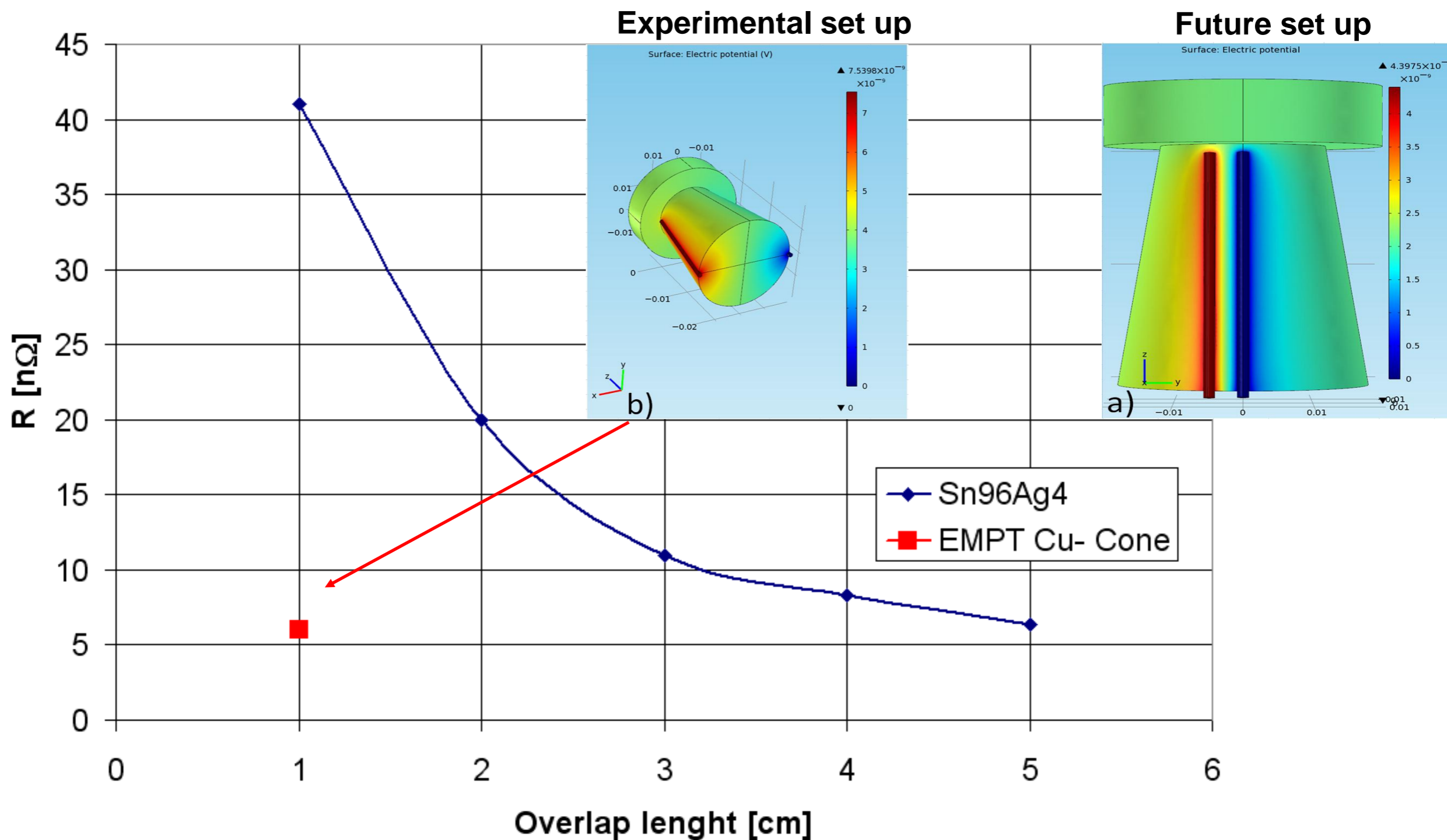


EMPT Nb₃Sn Superconductor welding



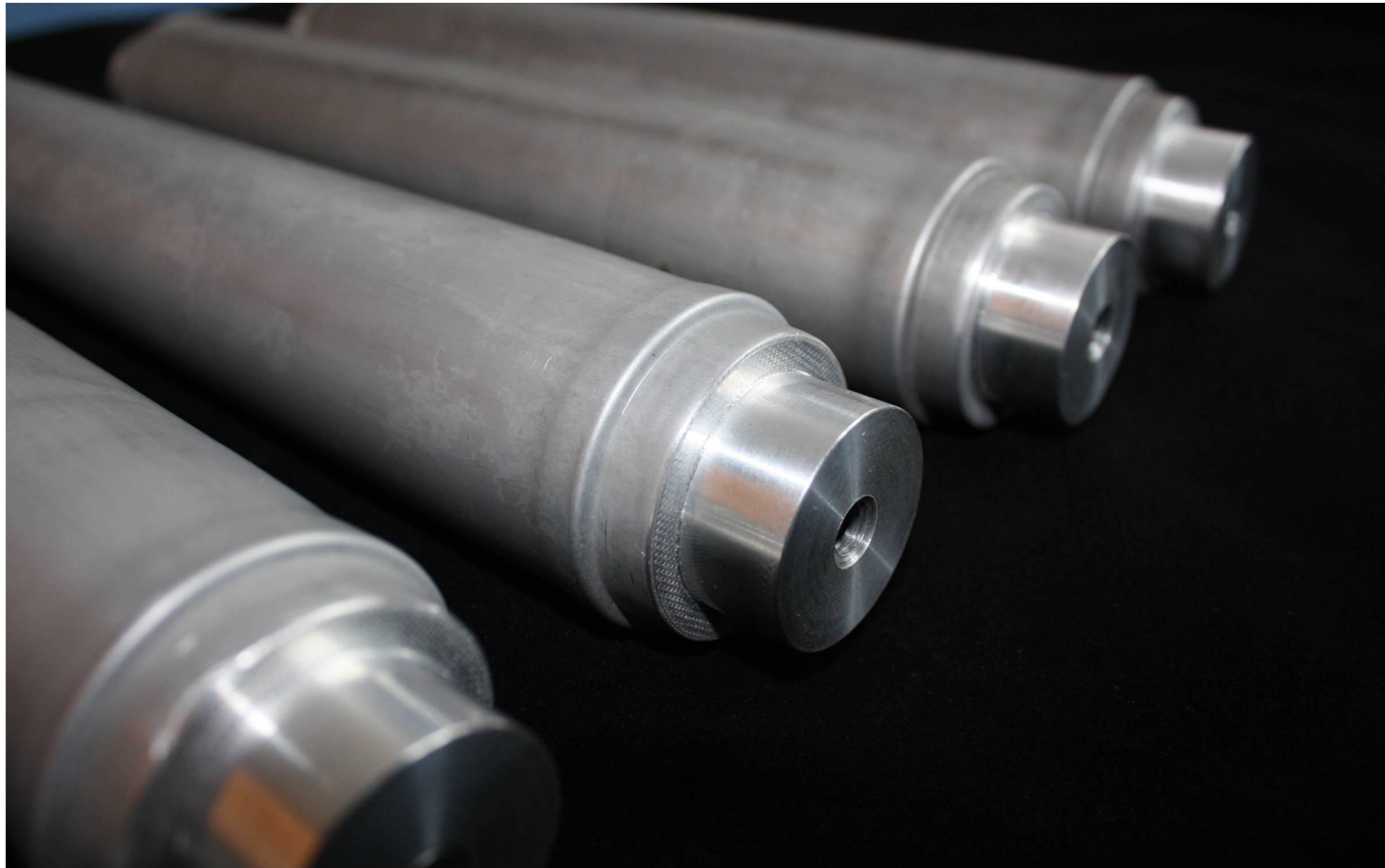
Source:
D. Schoerling¹, S. Heck¹, C. Scheuerlein¹, S. Atieh¹ and R. Schaefer²:
Electrical resistance of Nb₃Sn/Cu splices produced by electromagnetic pulse technology and soft soldering. Superconductor Science and Technology Volume 25 Number 2

EMPT Nb₃Sn Superconductor welding

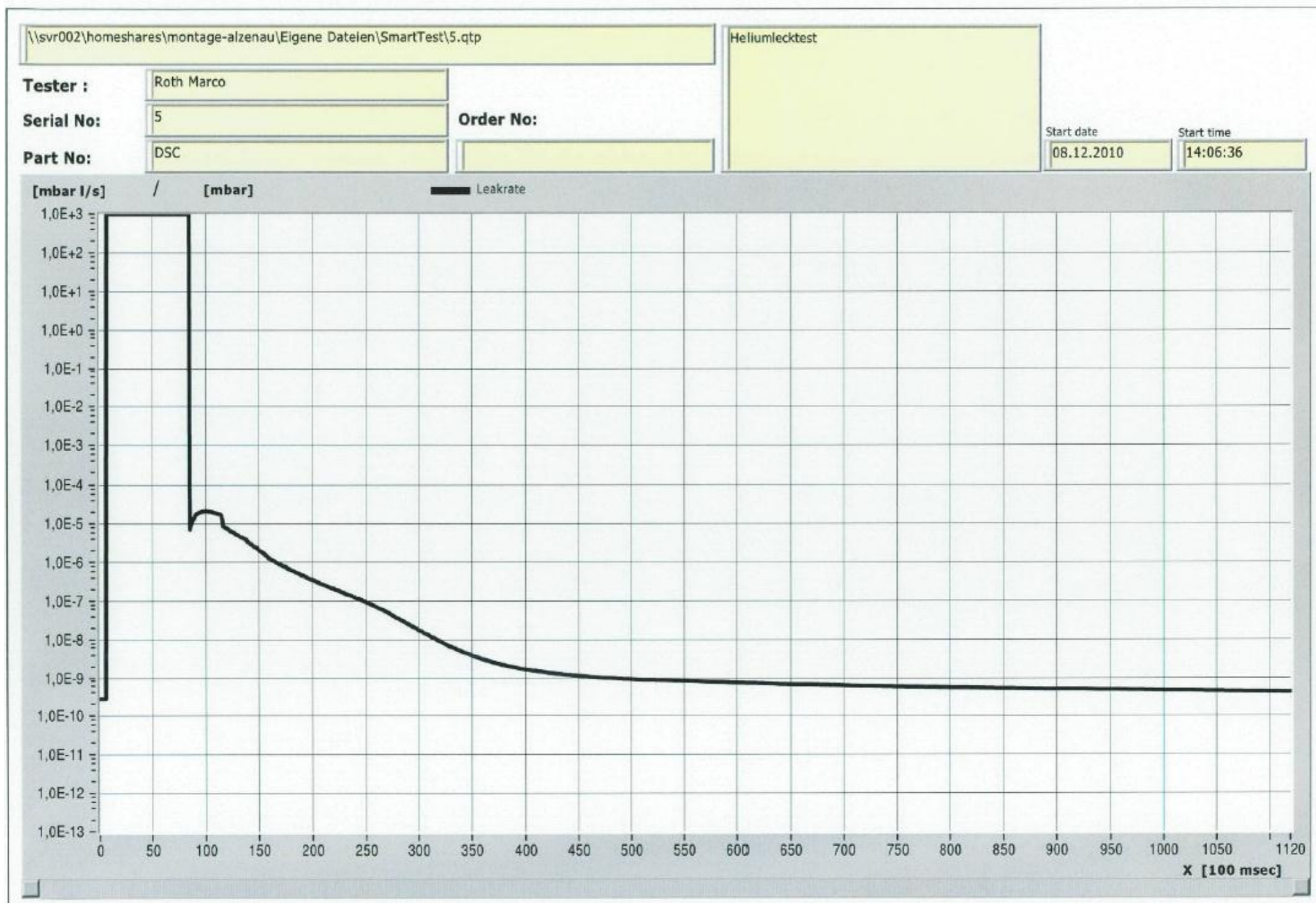


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EMPT welding of pressure vessels



Heliumleakage test of EMPT welded vessel



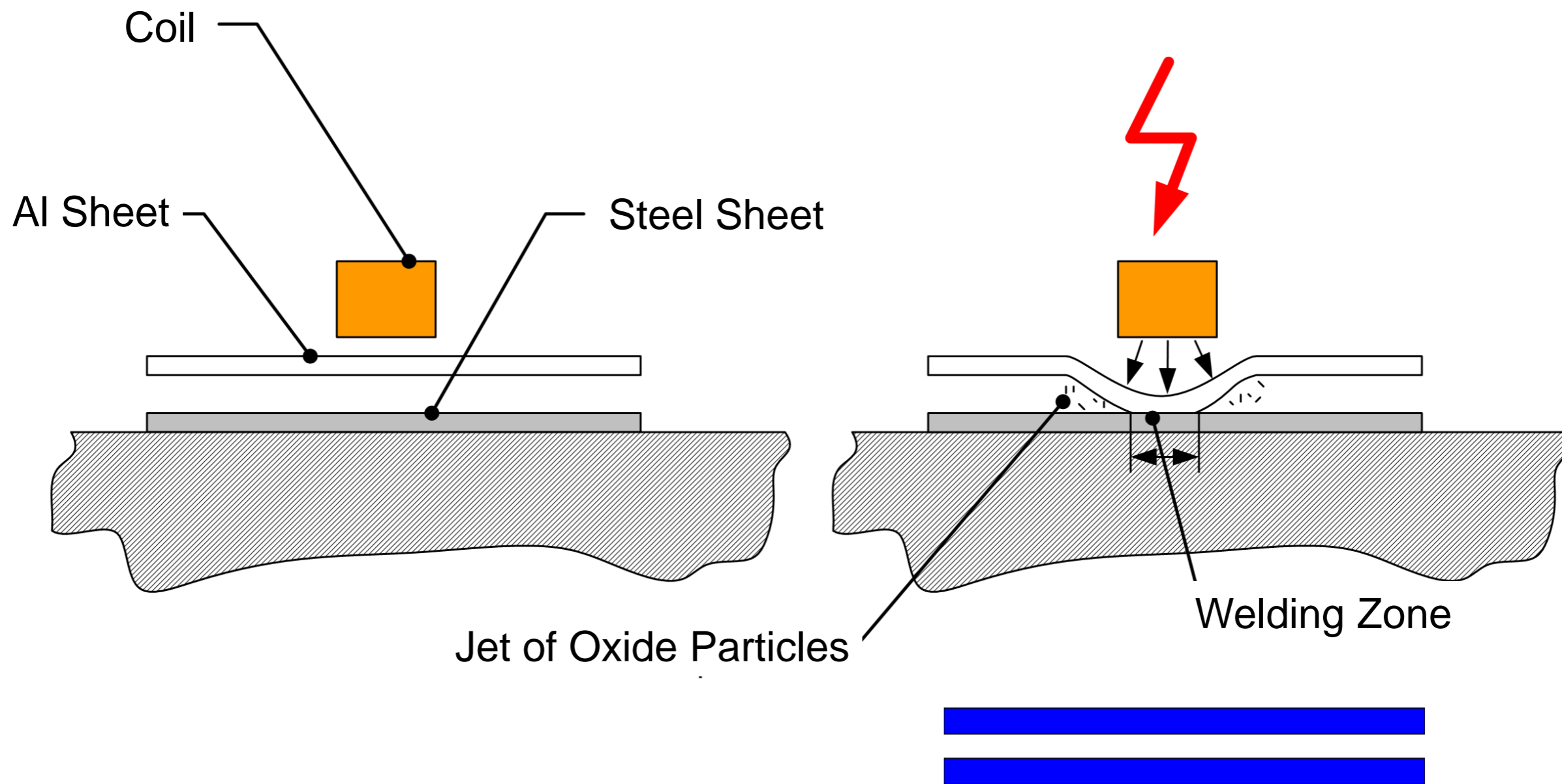


Characteristics

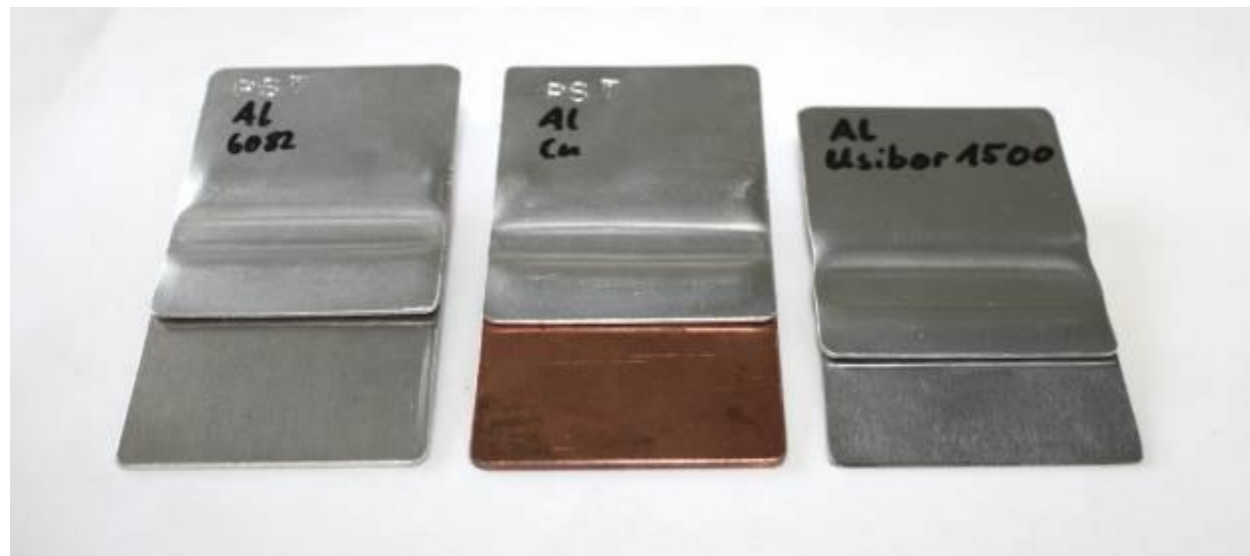
- 20 μ s processing time
- No Heat Affected Zone (HAZ)
- No thermal distortion
- Atomic bonding (solid phase weld)
- No metallurgical changes in the weld area
- No inter-metallic phases
- Contact less
- No shielding gases



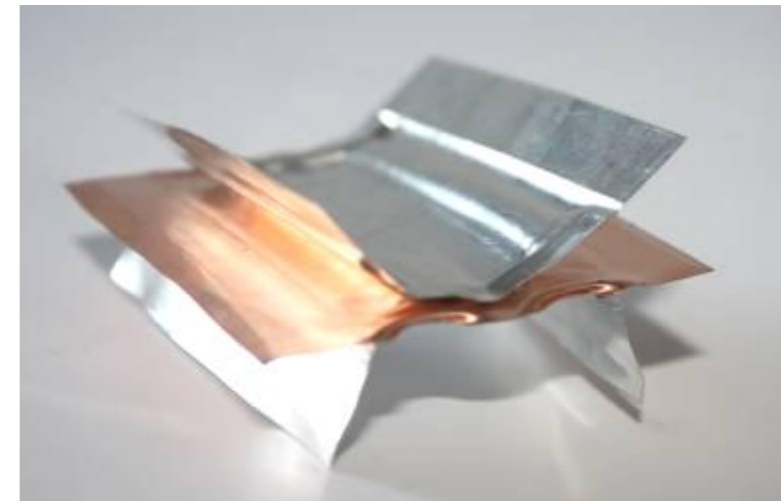
EMPT Welding of Sheets



EMPT Sheet Welding



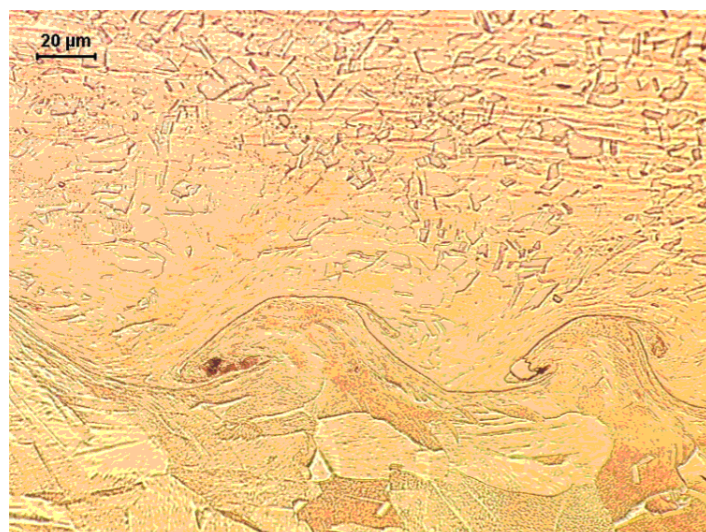
Dissimilar material combinations



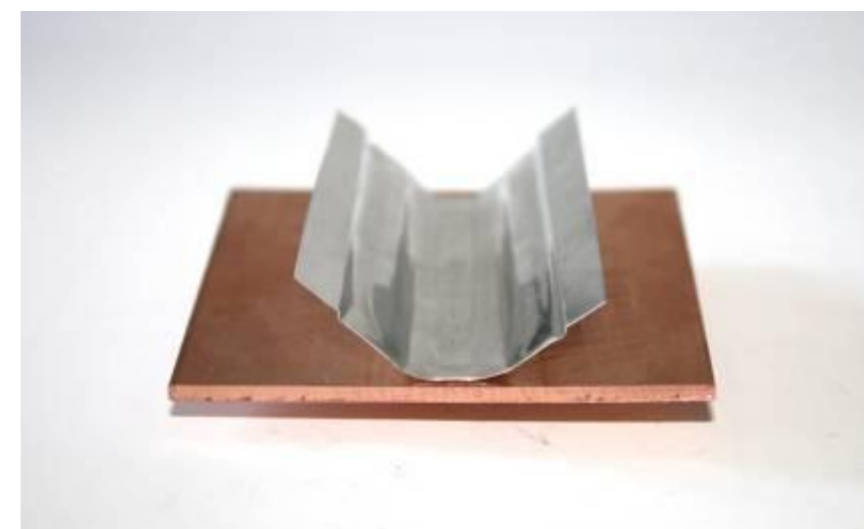
Three layers 280µm Al, 200 µm Cu



EMPT welding of foil stacks: 10 x 250 µm Cu



Metallography: No heat affected zone



280 µm aluminium, 2mm copper



EMPT Sheet Welding

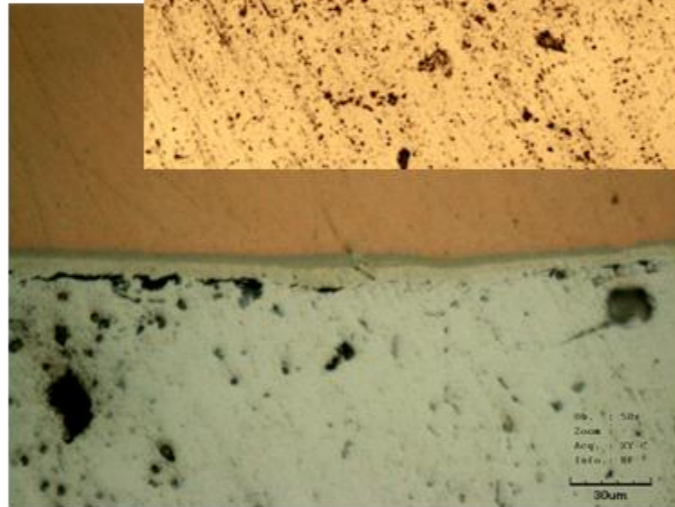
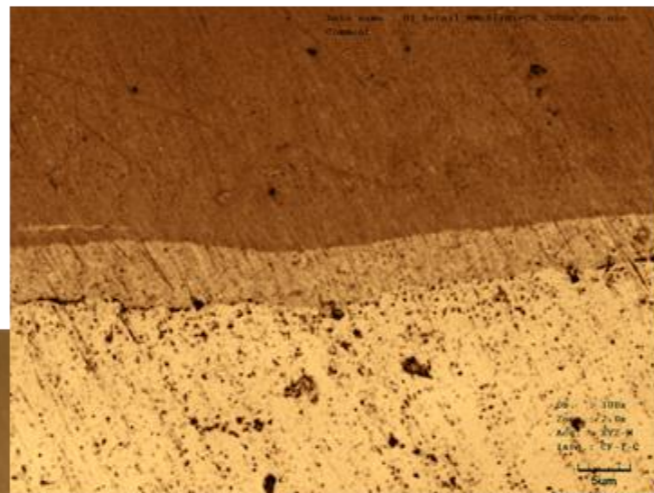


EMPT Sheet Welding



Aluminium

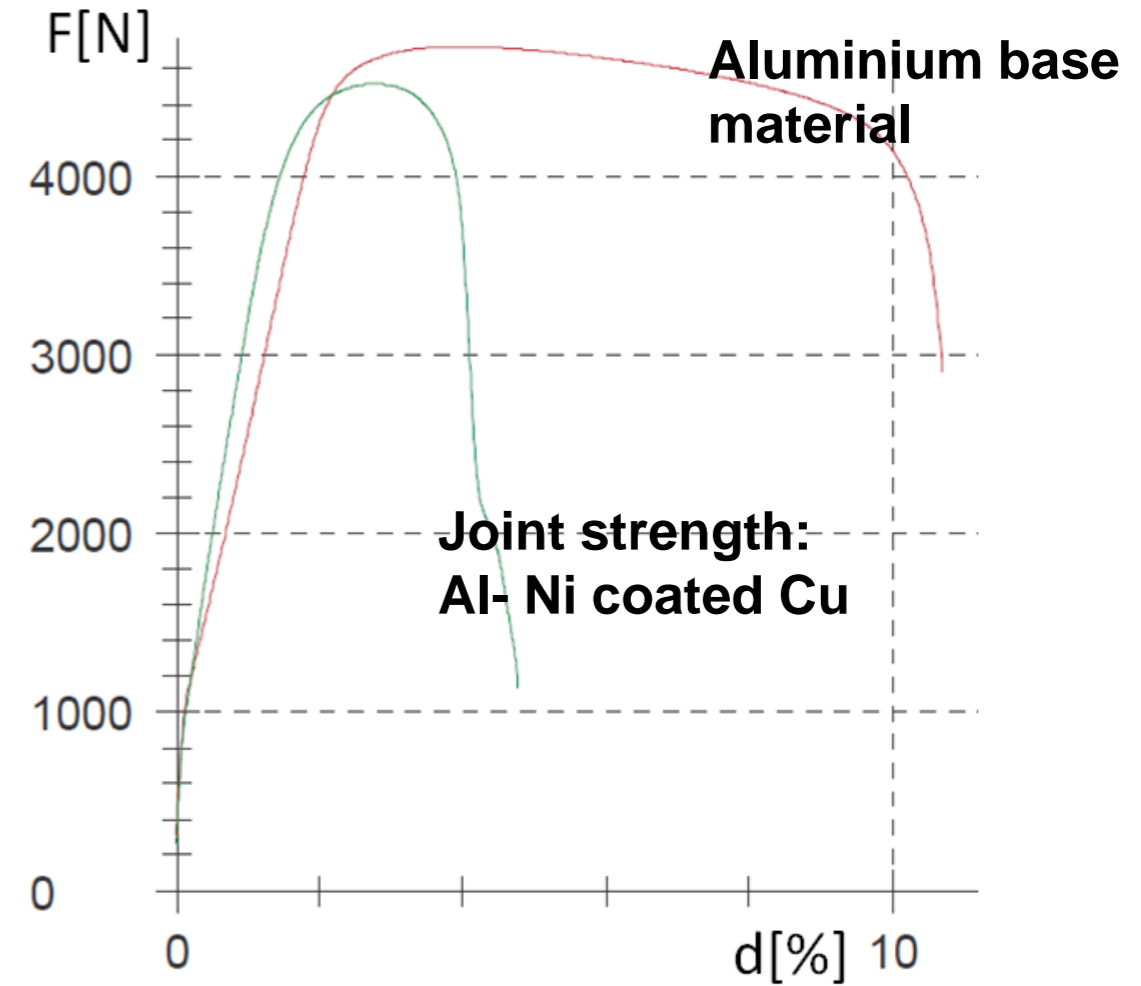
Ni coated Cu



Al base material:

$F_{max} = 4720 \text{ N}$

Weld strength: $F_{max} = 4520 \text{ N}$



Thank you!



2. EMPT Konferenz und Anwendertreffen

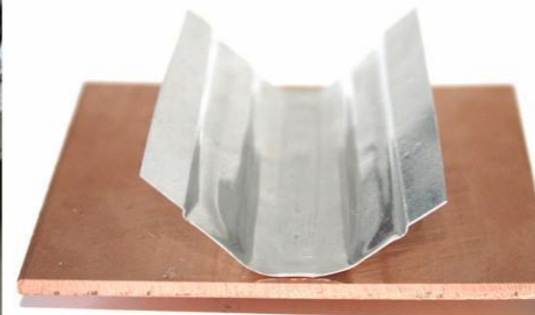
27. Juni 2012, Alzenau

Informationen und Anmeldung:
www.pstproducts.com

2. EMPT Conference and Users Meeting

27 June 2012, Alzenau, Germany

Information and Registration:
www.english.pstproducts.com



www.pstproducts.com