

## metal JOINing

### K-Projekt Network of Excellence for Metal JOINing

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## an atmospherical plasma sprayed interlayer

Welding of thick walled copper elements is challenging researchers due to several material caused phenomena. Applying a local filler metal by using an atmospheric plasma spraying technology, welding defects could be eliminated and results in a high quality weld.



### Challenges and Solutions

Due to physical properties of pure copper, like a high thermal conduction and a defined melting point, are in general difficult to realise. Taking the high heat introduction during the electron beam welding into account this welding process has a high potential for such applications. By processing thick-walled elements (>30mm) without any filler, defects like cracks or root defects are occurred. By applying filler material into the fusion zone, the pure-substance caused problem could be eliminated, and ended up in the below described successful solution.



**Fig. 1: Defects in the weld seam (Enzinger et al. Science and Technology of Welding and Joining)**

A copper-tin alloy showed the best performance in preliminary tests. Compared to

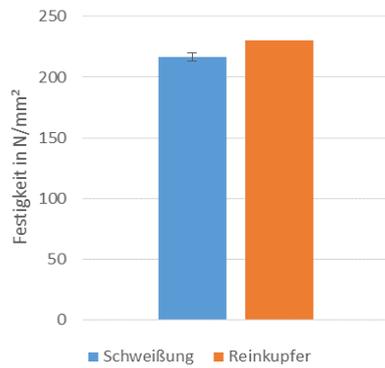
pure copper the copper tin alloy extends the solidification range significantly and results in a better behaviour during the welding process. The question at this point was how to apply the filler material into the fusion zone. To fulfil all the requirements for practical implementation like variability, reproducibility as well as economic efficiency a suitable process was needed. By using atmospheric plasma spraying a local tin coating was applied to the fusion zone. An only 15µm thick tin coating was enough to achieve very well welding results which met all requirements for practical implementation.



### A weld seam which fits...

Final characterisation showed excellent properties of the weld seam. Strength- and ductility values of the weld seam could be increased to the scale of the base material (pure copper). In the course of metallographic investigations, tin-traces could only be found in the root area of the weld. Also electrical conductivity measurements have also been performed and showed a high potential for electro technical applications.





**Fig. 2: Strength comparison - weld seam (blue) vs. pure copper (orange)**

### Impact and effects

Through applying a thin tin coating by atmospheric plasma spraying a defectless and high quality weld result of thick-walled copper elements could be achieved. The investigations showed that thin interlayers are enough to gain a high quality weld which complies with the high requirements. Based on these research findings different technical applications like for example “welding of moulds” are imaginable.

#### Contact and information

K-Project metal JOINing  
 Institute of Materials Science, Joining and Forming  
 Kopernikusgasse 24/1  
 T +43 316 873 7181  
 E [office@iws.tugraz.at](mailto:office@iws.tugraz.at), [www.iws.tugraz.at](http://www.iws.tugraz.at)

#### Project coordinator

Assoc. Prof. Dr. N. Enzinger

#### Project partners

Organisation	Country
IMAT, TU Graz	Austria
Inocon Technologie GmbH	Austria
Eckart GmbH	Germany
Air Liquide Austria	Austria

**Further information on COMET – Competence Centers for Excellent Technologies:** [www.ffg.at/comet](http://www.ffg.at/comet)

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