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Gas Tungsten Arc Welding of a multiphase CoCuFeMnNi high-entropy alloy

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INTRODUCTION & AIM

High-entropy alloys (HEAs) offer exceptional properties due to their complex compositions, making them potential alternatives to conventional alloys.

Problem

For practical applications, especially in structural uses, understanding HEA weldability is essential and Gas tungsten arc welding (GTAW) is an industrial technique suitable for evaluating the processability of HEAs.

Aim: *To evaluate the feasibility of gas tungsten arc welding on the CoCuFeMnNi high-entropy alloy by analyzing its microstructure and mechanical performance across the welded joint.*

METHOD

→ The welded joints microstructure was inspected using **electron backscattered diffraction**, revealing phase distribution and local textures;

→ **Microhardness mapping** with regular spacing assessed hardness variations across and along the weld zone;

→ **Uniaxial tensile tests** evaluated the global mechanical behavior, highlighting differences in ductility and strength between the base material and the welded joint while **digital image correlation** was used to map local strain fields during the test;

→ **Synchrotron X-ray Diffraction** enabled high-resolution, non-destructive analysis of phase composition and residual stresses across the fusion zone.

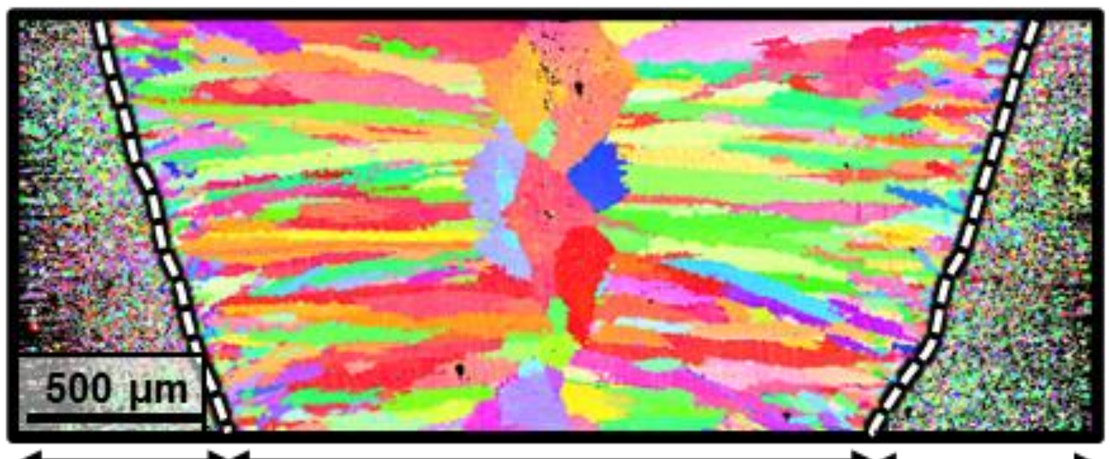
FUTURE WORK / REFERENCES

Future work should focus on post-weld heat treatments to refine the microstructure, aiming to enhance the mechanical performance of the welded joints.

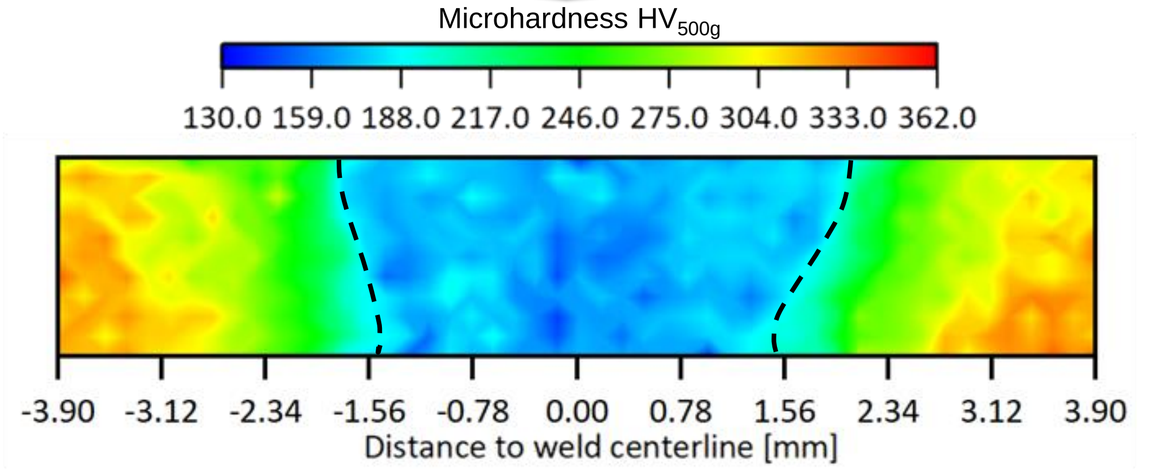
The data presented in this poster has been published in "Gas tungsten arc welding of a multiphase CoCuxFeMnNi (x=20,30) high entropy alloy system: microstructural differences and their consequences on mechanical performance". Intermetallics (2024): https://doi.org/10.1016/j.intermet.2024.108439.

RESULTS & DISCUSSION

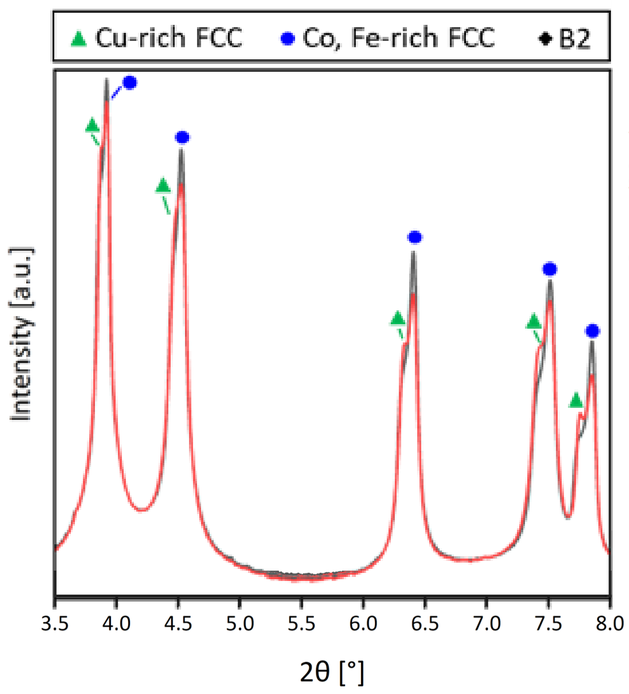
Welded joint microstructure via electron backscattered diffraction:



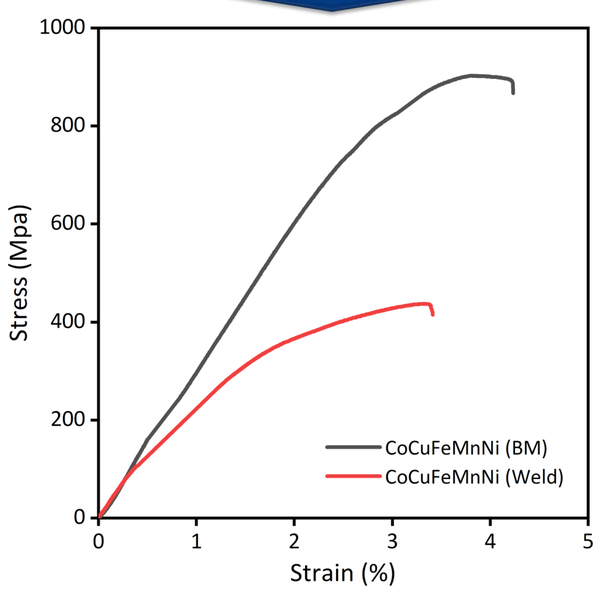
Microhardness distribution



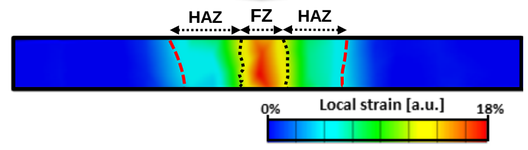
Synchrotron x-ray diffraction



Tensile testing



Digital image correlation



CONCLUSION

GTAW on the CoCuFeMnNi HEA produced defect-free joints with good integrity, though degradation on mechanical performance was observed. Nevertheless, the weld maintained acceptable quality, with phase analysis confirming stable FCC structures and limited B2 BCC formation in the HAZ.