

MULTI-MATERIAL LASER POWDER BED FUSION: THE EFFECT OF CROSS-CONTAMINATIONS OF CU AND AL PARTICLES IN ALSI10MG AND CUCR1ZR FEEDSTOCK ON THE MECHANICAL PROPERTIES OF THE PART

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Abstract

Multi-material laser-based powder bed fusion (PBF-LB/MM) is gaining ground to address the continuous increasing demands for precision manufacturing of metallic components with reduced process lead time and increased sustainability. The metal powder cross-contamination is probably one of the most important constraints for the wide exploitation of the novel manufacturing technology. Additive manufacturing of bi-metals is extremely challenging in the automotive industry, where printing aluminium alloys on copper alloys or vice versa represents most of the use-cases in this field. In the present work, a preliminary investigation will be performed to assess the effect of cross-contaminations of the powder feedstock and corresponding AM parts. Two different scenarios will be considered: (a) the effect of CuCr1Zr foreign particles in AlSi10Mg feedstock and (b) the effect of AlSi10Mg foreign particles in CuCr1Zr feedstock, respectively. Several powder contamination grades ranging from 0.5 to 5.0 weight percent will be processed and compared with uncontaminated powder feedstock for both cases. Parameters as powder flowability, PSD, crystalline phase and chemical composition will be studied.

The PBF-LB/MM samples showed different microstructures, physical and mechanical properties, confirming the differences due to the foreign particle concentrations [1]. The decrease in the mechanical properties for both cases, was quantified and reported in terms of foreign particles concentration and scanning electron microscopy investigations of the fracture surfaces of the tensile samples. The tensile mechanical properties were used as an input to calculate the “quality” of the printed samples with different levels of cross-contamination. The damage tolerance quality index Q_D was exploited from the casting industry of aluminium alloys [2] to assess the printing quality of the PBF-LB/MM samples. The quality index comprises of both, strength and ductility capabilities of the samples and it was associated with the investigated contamination levels. Diagrams of quality level [3] along with the desired mechanical properties were plotted and discussion over the contamination levels and appropriate quality is performed.

Keywords: laser powder bed fusion; multi-material solutions; powder quality; contamination

Acknowledgements. The authors gratefully acknowledge the financial support of the HORIZON Research and Innovation Actions, European Health and Digital Executive Agency for the implementation of the project «MULTI-MATERIAL DESIGN USING 3D PRINTING» having an acronym “MADE-3D” of the act HORIZON-CL4-2022-RESILIENCE-01 with Grant Agreement code 101091911.

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