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Fatigue life improvement of high strength aluminium alloys produced by laser powder bed fusion (L-PBF).

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One of the main drawbacks of Laser Powder Bed Fusion (L-PBF) is the limited material palette currently available and the often poor fatigue performance of the resulting parts. Currently, the only high-performance aluminium alloy manufacturable by L-PBF and adapted for the aerospace industry is Scalmalloy®. The production of parts using more conventional 7xxx aluminium alloys with the L-PBF technology is not yet fully controlled.

In this study, we will compare the microstructure, the static mechanical properties as well as the fatigue performances of three different alloys. The first one is AlSi10Mg, a common casting aluminium alloy easy to process with L-PBF, and serves as a reference for the two others. The second one is Scalmalloy® which is a modified 5xxx Al alloy developed by Airbus APWorks©. It uses Sc and Zr additions to suppress hot cracking during the L-PBF process. Finally, the third one is the classical Al7075 alloy modified to avoid hot cracking. ZrH_2 addition to the Al7075 powder allows obtaining nearly fully dense parts without cracking. Optimised heat treatments are applied to both high strength aluminium alloys to enhance their mechanical performances. Finally, improvements of the fatigue life of these L-PBF alloys by using friction stir processing as a post-treatment will be presented. Indeed, friction stir processing has been proven as a very successful post-processing method to increase the fatigue life of AlSi10Mg by a factor of 100 [1].

REFERENCES

[1] Santos Macias et al., “Fatigue crack nucleation and growth in laser powder bed fusion AlSi10Mg under as built and post-treated conditions.”, Materials & Design, 2021.