

Fatigue life improvement of 7075 aluminium alloy 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®. Moreover, this alloy uses Scandium as an alloying element which should be avoided due to its very high price. The production of parts using more conventional 7xxx aluminium alloys with the L-PBF technology is not yet fully controlled.

In this study, static mechanical properties as well as fatigue performances of an Al7075 modified to avoid hot cracking manufactured by L-PBF will be analysed. First, ZrH₂ addition to the Al7075 powder allows obtaining nearly fully dense parts without cracking: 99.9% relative density computed using X-Ray tomography. Afterwards, an optimised heat treatment is applied to this alloy to enhance its mechanical performances and reach a yield strength of 510MPa by controlling Cu, Mg, Zn and Zr precipitation. Finally, as fatigue performances of L-PBF alloys are usually poor, friction stir processing was applied as a post-treatment to suppress the main part of the porosities and improve fatigue performances. 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.