Fully dense Al7075 produced by laser powder bed fusion (L-PBF) undergoing a tailored innovative heat treatment showing high tensile properties and interesting fatigue crack growth behaviour

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Abstract

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 crack growth 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, a tailored heat treatment is applied to this alloy to enhance its mechanical performances and reach a yield strength of 515MPa by controlling Cu, Mg, Zn and Zr precipitation. Finally, fatigue crack growth behaviour is compared in as built and heat-treated condition. First insights into the damage.

Keywords: L-PBF; Al7075; Fatigue crack growth; Heat treatment;