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Investigation of the healing ability of a newly developed AlMg alloy produced for Laser Powder Bed Fusion (LPBF)

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Aluminium alloys are widely used in aerospace and aeronautic industries because of their excellent strength-to-weight ratio. In these applications, overloads can occur, damage the part and lead to its replacement. In order to increase the part's lifetime, a solution would be to use a material able to heal its damage.

The aim of this research is to **develop and characterize a healable Al alloy produced for Laser Powder Bed Fusion (LPBF)**. To this end, elementary Al and Mg powders are mixed and the parts are manufactured by LPBF to produce a binary AlMg alloy. It is composed of a low melting point magnesium rich phase dispersed in a higher melting point aluminium matrix. The idea is that, after damage of the material, a heat treatment triggers the melting of this low melting point Mg-rich phase, which can therefore flow to the free surfaces of the defects and seal them upon solidification.

The composition was selected thanks to ThermoCalc and Kou model [1] in order to avoid hot tearing while optimising the percentage of low melting point phase. The damage mechanism was highlighted using in-situ tensile tests. X-ray nano-holotomography experiments at ID16B beamline at the ESRF [2] highlighted the filling of the damage sites. A statistical analysis is then used to determine the fraction and the maximum size of the healed damage sites. Finally, the healing microstructure was further investigated with the three-dimensional correlative multiscale imaging approach in order to evidence the healing mechanism. Precisely allocated, based on the nano-holotomography ESRF data, sample sub-volume containing the healed damage, has been further investigated using PFIB-SEM combined with the EDX elemental material composition analysis.

REFERENCES

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