Mechanical behaviors at 77K of Zr-modified Al 7075 alloy printed by L-PBF

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Abstract

Decreasing the mass of structure is the main goal of aeronautic and aerospace industries. One solution to do so is to remove all unnecessary parts when designing them. However, classical fabrication methods do not allow such new designs to be easily implemented. The recent development of additive manufacturing technologies has opened the path towards huge mass reduction in those industries. Optimization of printing strategies for different alloys has been of great importance in recent research (1–3).
Recent works of our team focuses on the development of printing strategies for Al 7075 series (4–6), a high-strength aluminum alloy, widely used in aerospace industries. As printing strategies are now better understood, it becomes important to determine the mechanical properties of such alloys at their working temperature. Using a home-made tensile device working at cryogenic temperatures, the mechanical characterization of Zr-modified Al7075 alloys has been carried out. The results are promising when compared to classical Al7075-T6. The as-built samples have a yield stress of 415 MPa at RT and 476 MPa at 77K with correct elongation values ($> 14\%$ at both temperatures) while T6 samples presents values of 550MPa and 650MPa at those temperature respectively. However, through optimized thermal treatment, we achieve stress levels of 526MPa and 668MPa at both RT and cryogenic temperatures for the printed samples. X-ray tomography analysis and Scanning Electron Microscopy characterization have been carried out to understand the deformation mechanisms taking place at cryogenic temperature compared to room temperature for this material.

References

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