Tensile and Fatigue Behaviors of Additively Manufactured AlSi10Mg: Effect of Solutionizing and Aging Heat Treatments

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Abstract

The effects of various heat treatments on the microstructure and mechanical properties of laser beam powder bed fused AlSi10Mg were investigated. Specimens were solutionized at three different temperatures of 425, 475 and 525 °C followed by natural aging (T4) prior to microstructural and mechanical characterization. In addition, the effect of aging was studied by artificially aging (i.e., T7) some of the solutionized specimens at 165 °C. Solutionizing at all temperatures was observed to fully dissolve the additive manufacturing (AM) induced dendritic microstructure, leaving bulky Si and needle-shaped β-AlFeSi precipitates in the grain interiors and boundaries. Tensile results revealed that T4 specimens exhibited more ductility, while T7 specimens showed substantially higher strengths with slightly reduced ductility. Interestingly, no significant effect of heat treatment on strain-life fatigue behavior was observed. Fractography found the Si-particles to be responsible for tensile fracture, while AM volumetric defects were the main initiators of fatigue cracks.

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