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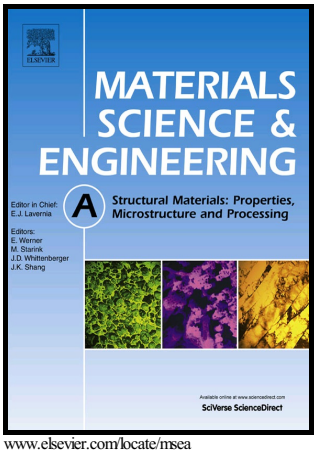

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Enhancement in mechanical properties of selectively laser-melted AlSi10Mg aluminum alloys by T6-like heat treatment

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Abstract

This work proposes a T6-like heat treatment, including solid-solution treatment at 535 ºC and an artificial aging treatment for 10 h at 158 ºC, to control the mechanical behavior of selective-laser-melting (SLM)-produced AlSi10Mg alloys. The mechanical properties of the AlSi10Mg alloys, such as densification, hardness, and tensile/bending strength, were investigated, and the microstructure of the alloys was analyzed. The results reveal that the tensile strength of the heat-treated samples slightly decreased by 19.97% (from 334 MPa to 267.3 MPa of the as-fabricated samples), while the elongation showed a remarkabe increase by up to 155% (from 3.64% to 9.28%). Likewise, the bending strength slightly decreased by 6.1%, while the fracture deflection dramatically increased by up to 122.9 % after T6 heat treatment. Thus, the T6 heat treatment can critically enhance plasticity/ductility without any significant loss in the tensile/bending strength of the alloy. The corresponding mechanism is also elucidated based on the spheroidization and diffusion of silicon precipitation during the T6 heat treatment. The results of this study offer an intriguing insight to tailor the mechanical properties of SLM-fabricated AlSi10Mg alloys using suitable solid solutions and artificial aging treatment.

Keywords: Selective laser melting; Aluminum alloy; T6 heat treatment; Mechanical properties; Microstructure.