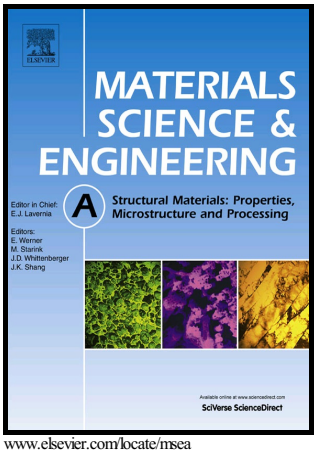

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PII: S0921-5093(18)30832-3
DOI: https://doi.org/10.1016/j.msea.2018.06.049
Reference: MSA36604

To appear in: *Materials Science & Engineering A*

Received date: 6 February 2018
Revised date: 12 May 2018
Accepted date: 13 June 2018

Cite this article as: Yunjia Shi, Kun Yang, Shravan K. Kairy, Frank Palm, Xinhua Wu and Paul A. Rometsch, Effect of platform temperature on the porosity, microstructure and mechanical properties of an Al–Mg–Sc–Zr alloy fabricated by selective laser melting, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.06.049

Effect of platform temperature on the porosity, microstructure and mechanical properties of an Al−Mg−Sc−Zr alloy fabricated by selective laser melting

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Abstract

In this work, an Al−Mg−Sc−Zr alloy was manufactured using selective laser melting (SLM) at platform temperatures of both 35 °C and 200 °C. The effects of platform temperature and applied energy density (E) on porosity characteristics were studied by image analysis. The results show that 60−70 J/mm^3 is the minimum applied energy density threshold to build high density parts (>99.7%), and that the number density and size of pores follow similar trends for both platform temperatures even though the number density of pores is consistently lower at the 200 °C platform temperature. The optimum processing condition of E = 77 J/mm^3 was selected for building thin plates to evaluate the tensile properties based on the lowest porosity and highest hardness results. Tensile results indicate that 35 °C fabricated specimens have a low anisotropy, while 200 °C fabricated specimens have higher as-fabricated strengths but inhomogeneous properties from bottom to top. After peak aging, all samples achieve very similar tensile properties with yield strengths of close to 460 MPa, though the elongation for the 200 °C fabricated specimens still presents a gradual decrease from top to bottom of the plate. The microstructure and property evolution was explained in terms of thermal history effects on the different types of grains and precipitates in this alloy.

Keywords: Selective laser melting; Aluminum alloys; Scandium; Microstructure; Tensile properties