International Journal of Advanced Manufacturing Technology

The effect of porosity on the mechanical properties of Ti-6Al-4V components manufactured by high-power selective laser melting

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https://doi.org/10.1007/s00170-021-07326-6

Abstract

Metal powder bed fusion in additive manufacturing is gaining interest as a manufacturing technique for complex metal parts in the aerospace, rail, and automotive industries. This has led to an emergence of 3D printers in the market to accelerate the diffusion of this technology as an industrial manufacturing technique. The Aeroswift is an additive manufacturing machine developed with the purpose of using high laser powers for high-speed production of structurally dense parts at accelerated consolidation rates. The work in this paper focuses on the 3D printing of Ti-6Al-4V tensile specimens with the aim of determining the effect of fast cooling rate and porosity on the ductility of the specimen. The mechanical properties of the parts depend on the energy input; in order to obtain optimum melting of powder and desirable properties, an exponential decay relationship was observed where, as porosity increased, the elongation dropped. The level of porosity at low energy density is attributed to lack of fusion from low heat input, while high energy inputs showed low porosity.