

Influence of processing parameters of selective laser melting on high-cycle and very-high-cycle fatigue behavior of Ti-6Al-4V

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Abstract

Orthogonal experiment design together with the analysis of variance was used to examine the processing parameters (laser power, scan speed, layer thickness and hatch spacing) of selective laser melting (SLM) for superior properties of SLM parts, in which nine groups of specimens of Ti-6Al-4V were fabricated. The porosity for each group was measured and the results clarify that the influence sequence of individual parameter on the porosity is laser power > hatch spacing > layer thickness > scan speed. Ultrasonic fatigue tests (20 kHz) were conducted for the SLMed specimens in high-cycle fatigue (HCF) and very-high-cycle fatigue (VHCF) regimes. The S-N data show that the fatigue strength is greatly affected by the porosity: the group with the smallest porosity percentage having the highest fatigue strength in HCF and VHCF regimes. Moreover, the observations by scanning electron microscopy revealed that fatigue cracks initiate at lack-of-fusion defects in the cases of surface and internal crack initiation.

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