

The International Journal of Advanced Manufacturing Technology, vol. 103(5-8): 2277-2286

The effect of scan speed and hatch distance on prior-beta grain size in laser powder bed fused Ti-6Al-4V

D. F. Louw¹ and P. G. H. Pistorius²

¹ Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa

² University of Pretoria, Pretoria, South Africa

<https://link.springer.com/article/10.1007/s00170-019-03719-w>

Free full-text non-print link: <https://rdcu.be/bOPeS>

Abstract

Ti-6Al-(sub4)V produced by laser powder bed fusion can achieve mechanical properties similar to its wrought counterpart if an appropriate post-process heat treatment is applied. The response of the material to post-process heat treatment depends on the prior-beta grain size in the as-built condition. The current article illustrates that a reduction in hatch distance can cause coarsening of prior-beta grains due to retained heat that reduces the cooling rate. On the other hand, an increase in scan speed refines prior-beta grains. Unfortunately, an increase in scan speed has to be accompanied by a reduction in hatch distance to prevent an increase in porosity and the potential grain refinement is then cancelled out. The use of a faster scan speed in combination with a smaller hatch distance significantly improves roughness of the top surface. EBSD in combination with reconstruction of prior-beta grains is an effective technique to quantify prior-beta grain size. Furthermore, the use of Rosenthal's equations allows quick calculation of cooling rate that can be used to predict the dependence of priorbeta grain size on process parameters.