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Influence of SLM process parameters on the surface finish, porosity rate and fatigue behavior of as-built Inconel 625 parts

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Abstract

This paper is dedicated to understanding fatigue crack initiation for an Inconel 625 manufactured by SLM, using a hatching + contour procedure. In the first part of the paper, an optimum set of parameters was found to deliver the best surface roughness combined with low porosity. This process optimization, mostly focused on adjusting the volume energy density aimed at finding a compromise between an optimum densification state and a minimum number of contaminating spatters. Secondly, a fatigue test campaign has been conducted on as-built SLM samples or polished samples. The analysis of failure surfaces allowed identifying different heterogeneities at the origin of the fatigue damage for each configuration. The embedded particles on the surface of as-build specimens have been shown to play an important role in fatigue and need to be optimized or taken into account in the fatigue strength design of SLM components.

Keywords: SLM, particle, fatigue, Inconel 625, porosity, surface finish

Introduction

Additive Layer Manufacturing (ALM) currently impacts several industrial sectors, ranging from medical to aerospace and energy. Since 2003, there has been a 42% increase of parts