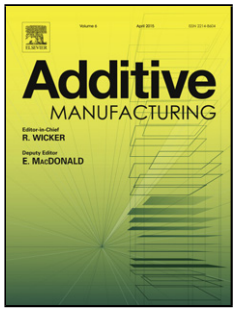

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Process dependent porosity and the influence of shot peening on porosity morphology regarding selective laser melted AlSi10Mg parts

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Abstract

This paper investigates the porosity distribution and morphology of selective laser melted rotation bending test samples before and after shot peening by means of micro-tomography analysis. The as-built samples show porosity clusters close to the surface, which are attributed to the contour-core scan strategy. In the following steps the effect of shot peening on pore size and morphology in dependency of depth was examined. A strong porosity shrinkage could be achieved in near-surface areas ($0-500\mu m$), but also in depths that did not seem accessible via shot peening, leading to an overall relative porosity reduction between 15 – 30%. Furthermore, shot peening led to a pore sphericity increase, especially for large pores. The individual orientation of the pores were compared before and after shot peening, where the former mostly had their longest axis in surface normal direction, while the latter showed a more randomly orientation distribution. X-ray diffractography detected residual compressive stresses for the as-built as well as the shot peened samples. Finally fatigue tests were performed, indicating an increase in low- and high-cycle-fatigue resistance after shot peening by 20 MPa.

Keywords: Selective laser melting, Porosity morphology, Shot peening, micro-computed tomography (μCT)

1. Introduction

1.1. Motivation

Different additive manufacturing technologies like electron beam melting (EBM), fused filament fabrication (FFF) and selective laser melting (SLM) are advancing from their niche application in rapid prototyping to the stage of small batch production. Because of their known lightweight potential, Al alloys are of a major interest for the automotive and aerospace sector. AlSi10Mg is an age-hardenable cast alloy with good specific mechanical properties. As the alloy is close to the eutectic AlSi, the cast- and weldability is good in comparison to other Al alloys.

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