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Using Laser Shock Peening to Enhance Metallic Additive Manufacturing Alloys

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Introduction

Additive Manufacturing (AM) technology has brought numerous benefits to mankind and considering the benefits of the technology such as manufacturing of complex shapes and lightweight parts, easy customization, design freedom, etc., it is expected that this technology will be a more vital part of the manufacturing processes in the coming years. Even this technology has found its place in many industries and it's regularly used nowadays, there are still areas where additive manufacturing cannot be applied because of certain limitations. These limitations are not allowing additive manufacturing to be used for critical parts, either because of technical or safety reasons. By employing Laser Shock Peening (LSP), many of these limitations can be overcome, mitigated, or even completely eliminated. Laser Shock Peening can significantly improve the mechanical properties of the AM parts and bring AM technology into the most demanding applications and industries.

Objectives

In this article, we will present how LSP improves mechanical properties of the AM, such as surface roughness, surface integrity, fatigue life, and how the microstructure is refined by LSP for different types of metallic alloys.

Methodology

LSP processing has been applied to different types of metallic alloys such as Ti6Al4V, SS 304L, 316L, AlMg10Si. The As-Built samples that are taken as a reference in the study, were heat-treated after the printing and/or polished after the heat treatment was finished, were treated by LSP. The samples were evaluated by residual stress measurements, surface roughness measurements, microstructure SEM evaluation, and/or fatigue life testing. All the measurements/testings were carried out on the As-Built and LSP treated samples and the results were compared.

Results

By applying the Laser Shock Peening it is possible to change the state of residual stresses from tensile or stress released state to compressive state of residual stresses, improve the surface roughness, and refine the microstructure. These improvements lead to a significant improvement in fatigue life and we will show that in some cases that improvement was more than 100 times.