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# Fatigue performance at 550°C of shot peened Inconel 718 additively manufactured by Laser-Powder Bed Fusion (L-PBF)

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## Introduction

Metal additive manufacturing is a disruptive technology that is likely to replace some traditional manufacturing processes. However, this process creates undesirable high surface roughness [1], porosity [2], and tensile residual stress [3]. These side effects imply that as-built (AB) test pieces have drastic inferior fatigue life in comparison with that of the conventional counterparts [1, 4]. Consequently, additive manufactured parts must undergo surface finish to increase their fatigue life. Shot peening is a process used to increase fatigue life. Bagherifard et al., 2018 [5] showed for the AlSi10Mg alloy that the roughness of the AB parts decreased after shot peening, which consequently increased the fatigue strength by 270% in comparison with the AB condition. However, the effect of shot peening on fatigue life of IN718 additively manufactured is yet to be studied at elevated temperature.

## Objectives

The objective of the present study is to evaluate fatigue properties enhancement by shot peening of the IN718 manufactured by Laser-Powder Bed Fusion (L-PBF) and to understand the close interaction between surface treatments and oxidation.

## Methodology

For this purpose, fatigue tests at 550°C will be conducted on as-built, shot peened, and shot peened + oxidized samples of the IN718 manufactured by L-PBF. Similar fatigue tests will be performed on samples machined after additive manufacturing to evaluate the benefit of machining versus shot peening on the fatigue resistance. Moreover, in order to understand the fracture and oxidation mechanisms, fractographic and metallographic analyses will complete this work.

## (Expected) Results

Fatigue performance of the as-built surface condition is expected to increase after shot peening as for conventional manufacturing process. The fatigue performance between shot peened as-built samples and shot peened machined samples will be discussed together with fractographic observations to state the possibility to replace the machining process directly by shot peening after additive manufacturing. Material oxidation on the surface of the part tends to decrease the fatigue life. The impact of the surface treatment will be also analyzed to picture any beneficial effect of shot peening.

## References

[1] Balachandramurthi, et al., Influence of defects and as-built surface roughness on fatigue properties of additively manufactured Alloy 718, *Materials Science and Engineering: A* 735 (2018) 463-474. [2] E. Hosseini, V. Popovich, A review of mechanical properties of additively manufactured inconel 718, *Additive manufacturing* 30 (2019) 100877. [3] Sidhu, et al., Residual stress enhancement in 3D printed Inconel 718 superalloy treated by ultrasonic nano-crystal surface modification, (2017) ASME. [4] T. M. Mower, M. J. Long, Mechanical behavior of additive manufactured, powder-bed laser-fused materials, *Materials Science and Engineering: A* 651 (2016) 198-213. [5] Bagherifard, et al., On the fatigue strength enhancement of additive manufactured AlSi10Mg parts by mechanical and thermal post-processing