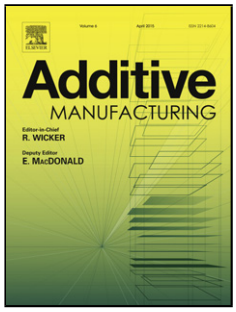

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Repercussions of powder contamination on the fatigue life of additive manufactured maraging steel

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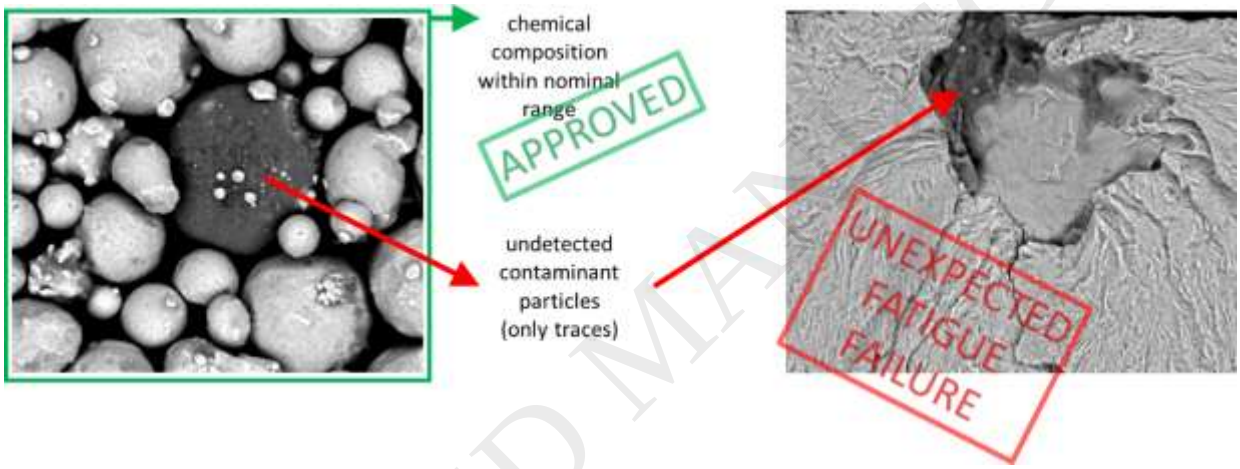
Graphical Abstract



Abstract

A wide range of materials is suitable for processing by powder bed fusion (PBF) techniques. Among the latest formulations, maraging steel 18Ni-300, which is a martensite-hardenable alloy, is often used when both high fracture toughness and high strength are required, or if dimensional changes need to be minimised. In direct tooling, 18Ni-300 can be successfully employed in numerous applications, for example in the production of dies for injection moulding and for casting of aluminium alloys; moreover, it is particularly valuable for high-performance engineering parts.

Even though bibliographic data are available on the effects that parameters, employed in PBF processes, have on the obtained density, roughness, hardness and microstructure of 18Ni-300, there is still a lack of knowledge on the fatigue life of PBF manufactured parts. This paper describes the fatigue behaviour of 18Ni-300 steel manufactured by PBF, as compared by forging. Relevant negative effects of the cross-contamination of the raw material are originally identified in this paper, which emphasizes the inadequacy of current acceptability protocols for PBF powders. In the absence of contamination, endurance achieved by PBF is found equal to that by forging and consistent with tooling requirements as set out by industrial partners, based on injection moulding process modelling.

Keywords: maraging; 18Ni-300; fatigue life; powder bed fusion; cross-contamination.

1. Introduction

Maraging steels are renowned for their ability to put together different important properties of the material: they show both high strength and toughness and, at the same time, they are easily weldable and dimensionally stable while ageing by heat treatment. As an example, 18Ni-350 has strength up