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Original Article

Influence of 17-4 PH stainless steel powder recycling on properties of SLM additive manufactured parts



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ABSTRACT

Metal Additive Manufacturing (AM) processes are developing quickly. These processes have several attractive qualities, however, the quality of manufactured parts still remains a major issue that needs to be addressed if it is to become a prevalent technology in the industry. In some powder bed fusion techniques, such as Selective Laser Melting (SLM), there is a portion of initial powder that does not melt and it can be recycled to ensure the economic and environmental viability of the process. In previous research, we demonstrated the morphological, chemical and microstructural change suffered by 17-4 PH stainless steel powder after reusing it in a SLM manufacturing process. In this work, the properties of 17-4 PH stainless steel parts, printed from powder in different recycling states (virgin powder (P_0) and 20 times reused powder (P_{20})), were evaluated, in order to establish good recycling procedures and optimise the SLM process performance. Analyses of the properties revealed a slight decrease in roughness and pore size with powder recycling. The external porosity of the samples is similar in both powder states; however, internal porosity decreases by increasing the number of reuse cycles. Regarding the microstructural analysis, a slight increase in the γ -phase is observed with the powder recycling, which leads to a slight increase in ductility and decrease in hardness of the samples. Therefore, it is concluded that the 17-4 PH powder recycling process in SLM manufacturing is adequate and recommended to ensure the economic and environmental viability of the process without adversely affecting the properties of the parts.

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1. Introduction

Powder Bed Fusion (PBF) processes produce parts by Additive Manufacturing (AM) (layer by layer) using powder as raw material. For metal part manufacturing, this technique

includes the processes of Direct Metal Laser Deposition (DMLS), Selective Laser Sintering (SLS), Selective Laser Melting (SLM) and Electron Beam Melting (EBM). In these processes, the layer of metal powder deposited on the build-plate is sintered (DMLS and SLS) or melted (SLM and EBM), using a

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