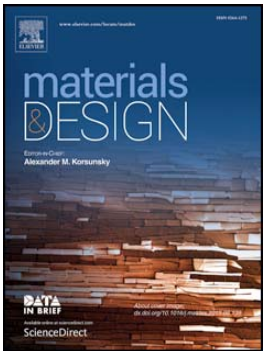

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Improving the surface quality and mechanical properties by shot-peening of 17-4 stainless steel fabricated by additive manufacturing

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Abstract

Direct metal laser sintering (DMLS), a type of additive manufacturing (AM) process, is currently used for the direct fabrication of powder-based functional metallic objects. The main concern in industrial application of DMLS is the range of materials that can be processed while ensuring that the resulting surface roughness and mechanical properties are equivalent to or better than those of wrought materials. This paper presents an attempt at inducing grain refinements through a shot-peening (SP) process creating severe plastic deformation at the outer surface layers to improve the physical and mechanical properties of 17-4 stainless steel components produced by DMLS. The as-built sample had a high content of retained austenite that is transformed to martensitic phase by SP treatment, thereby significantly increasing the micro-strain and compressive residual stress. The shot-peened sample also exhibited a refined surface microstructure, which produced a more favorable roughness, hardness, compressive yield strength, and wear resistance. It is believed that this use of SP technology should greatly increase the performance of AM materials in a wide range of potential applications, thereby demonstrating the practical efficiency and applicability of SP treatment.

Keywords: Direct metal laser sintering, severe plastic deformation, grain refinement, shot peening, work-hardening.

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