Deformation-induced martensitic transformation at wide range of temperatures (4K, 77K, RT) in austenitic stainless steels fabricated by Fused Deposition Modeling Process (FDM)

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Abstract

Fused Deposition Modeling (FDM), a cost-effective additive manufacturing (AM) process for fabricating austenitic stainless steel components, has garnered significant attention. However, pore chains between filament strands and fabrication-induced ferrite can severely compromise mechanical properties and exacerbate anisotropy. This study investigates the deformation-induced phase transformation in additively manufactured and conventionally produced 316L stainless steel through tensile testing across a wide temperature range, complemented by detailed microstructural analysis (1,2). This study utilizes in-situ optical techniques (Digital Image Correlation), to investigate the evolution of strain fields and dissipative effects at cryogenic temperatures, including liquid helium (4 K) and liquid nitrogen (77 K). By offering a novel approach, the research provides valuable insights into the thermomechanical behaviour of FDM-processed austenitic stainless steels, focusing on deformation-induced phase transformations. These findings highlight the potential of FDM as a low-cost metal AM method capable of achieving mechanical properties comparable to those of other advanced AM processes.

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