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Abstract

Study of Material Densification of In718 in the Higher Throughput Parameter Regime

Selective Laser Melting (SLM) is a powder bed fusion additive manufacturing process used increasingly in the aerospace industry to reduce the cost, weight, and fabrication time for complex propulsion components. Previous optimization studies for SLM using the Concept Laser M1 and M2 machines at NASA Marshall Space Flight Center have centered on machine default parameters. The objective of this project is to characterize how heat treatment affects density and porosity from a microscopic point of view. This is performs using higher throughput parameters (a previously unexplored region of the manufacturing operating envelope for this application) on material consolidation. Density blocks were analyzed to explore the relationship between build parameters (laser power, scan speed, and hatch spacing) and material consolidation (assessed in terms of density and porosity). The study also considers the impact of post-processing, specifically hot isostatic pressing and heat treatment, as well as deposition pattern on material consolidation in the higher energy parameter regime. Metallurgical evaluation of specimens will also be presented. This work will contribute to creating a knowledge base (understanding material behavior in all ranges of the AM equipment operating envelope) that is critical to transitioning AM from the custom low rate production sphere it currently occupies to the world of mass high rate production, where parts are fabricated at a rapid rate with confidence that they will meet or exceed all stringent functional requirements for spaceflight hardware. These studies will also provide important data on the sensitivity of material consolidation to process parameters that will inform the design and development of future flight articles using SLM.