Strategizing with Hot Isostatic Pressing Treatments to Significantly Reduce Post-Processing Time of L-PBF Inconel 718 Parts

Andrew Cassese, Chad Beamer
Quintus Technologies, LLC
Lewis Center, OH

James Shipley
Quintus Technologies AB
Västerås, Sweden

ABSTRACT

Hot isostatic pressing (HIP) treatments are typically applied to additively manufactured (AM) parts to seal internal porosity and improve performance and reliability of the component. Nickel-based superalloys require multiple heat treatments including stress relief, HIP, solution anneal, and two-step age to produce a microstructure that can withstand demanding environments. AM offers many advantages over conventional manufacturing techniques, but multiple post-processing steps often make the commercial case prohibitive. As such there is an ongoing demand within AM to simplify and consolidate the process chain to aid in driving adoption.

In this work, Inconel 718 parts were manufactured by laser powder-bed fusion (L-PBF), subjected to a range of HIP and heat treatments, and machined into a geometry that allows for high through-put tension testing thereby removing the variables of surface roughness and contour microstructures. The goal of this study is to simplify heat treatment routes while maintaining satisfactory tensile performance by leveraging modern HIP technology. Recent advancements in HIP equipment now offer the ability to integrate HIP and heat treatment in the HIP furnace with the aid of controllable high-speed cooling and in-HIP quenching and is referred to as High Pressure Heat Treatment™. The tailored heat treatment avenues will attempt to accomplish the following: Avoiding separate heat treatment steps such as stress relief and solution anneal by consolidating in the HIP, minimizing the number of aging steps, minimizing grain growth, sealing porosity with a minimum HIP pressure, and avoiding recrystallization to retain dislocation cell networks for optimum productivity and performance. Preliminary experiments will be shared capturing promising results.