

Modeling Pore Closure in the Hot Isostatic Pressing of Additively Manufactured Inconel 718 Samples

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Additive manufacturing provides opportunity for a new world of possibilities for metallic component design and fabrication; however, as-built part quality is notoriously variable, anisotropic, and degraded by porous defects. To improve quality, parts are commonly post processed using a variety of techniques including hot isostatic pressing (HIP). During HIP, high temperature and pressure is employed to improve microstructure and reduce pore volume by inducing visco-plastic deformation in the metallic substrate.

Validated computational capabilities can provide predictions to guide the selection of processing condition, expected pore reduction, and the effects of varying entrapped gas in the pores. This discussion describes a micro-scale finite element structural model developed to predict pore closure due to HIP in as-built additively manufactured Inconel 718 samples produced by the laser powder bed fusion process. The model accounts for plastic deformation, creep, and internal pressure for a single pore. Pores are characterized in physical samples before and after HIP, and model predictions are compared to this measured data.