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Comparison of PM-HIP to Cast Alloy 625 for Nuclear Applications

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ABSTRACT

PM-HIP, or Powder Metallurgy and Hot Isostatic Pressing, metals have been a low cost alternative to forged and cast structural metals within various industries. The nuclear industry has recently developed interest in PM-HIP alloys, but further research needs to be done to quantify their mechanical properties and characterize the microstructure. Specifically, we must understand the mechanical and microstructural evolution of PM-HIP materials after long-term operation at the elevated temperatures that PM-HIP components will experience in service. We focus on Ni-base alloy Inconel 625, and compare the PM-HIP version to the cast version. Our methodology consists of annealing samples to various temperatures, 400,600, and 800 °C, at various times, 100, 1,000, and 10,000 hours, to see the temperature and time effect on these alloys. We conduct microhardness testing and optical microscopy to evaluate the strength and grain size, respectively. We have found that average grain size in PM-HIP 625 samples are consistently smaller than that in cast 625, and this grain size difference persists with heat treatment. Future work will involve scanning electron microscopy (SEM) imaging and tensile testing of the annealed specimens, as well as irradiation exposure.

KEYWORDS

Powder Metallurgy, Nuclear Reactor, Inconel, Structural Materials, Materials Processing, Nuclear