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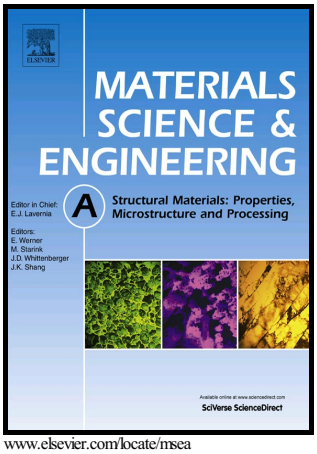


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# In Situ Tensile Study of PM-HIP and Wrought 316L Stainless Steel and Inconel 625 Alloys with High Energy Diffraction Microscopy

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**Abstract**

High-Energy Diffraction Microscopy (HEDM) was employed to measure and compare the evolving micromechanical state of two alloys, an austenitic stainless steel (316L) and nickel-based alloy (Inconel 625) fabricated by both conventional methods and powder metallurgy with hot isostatic pressing (PM-HIP) during *in situ* uniaxial tensile testing. Each of the four materials was tested through the elastic regime to just beyond yield. HEDM was performed at room temperature in the far-field (ff) configuration at the Cornell High Energy Synchrotron Source to measure grain-average elastic strains and subsequently derive stress tensors. The evolution of the normal stress component along the loading direction in individual grains as a function of macroscopic deformation is presented. Initially, grain-scale stresses in the loading direction are more heterogeneous in the wrought alloys than in the PM-HIP alloys. Notably, many peripheral grains in the wrought specimens are near yield even before load is applied. With increased loading, grain-scale stresses tend to homogenize in all specimens. Orientation fields measured using electron back scatter diffraction (EBSD) are used to determine grain morphologies and interpret the ff-HEDM data. The PM-HIP grains tend to be finer and rounder in shape than the wrought grains, potentially explaining the grain-scale stress distributions. Finally, yield strength and modulus of elasticity are measured for the four alloys and correlated to the resultant grain size and morphology from the fabrication processes.

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