Digital Image Correlation and Neutron Diffraction Studies on Residual Stress Behavior in Powder Bed Fusion Metals

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The development and optimization of additive manufacturing (AM) processes is driven by their ability to produce net-shape, complex, 3-D structures in a single step process with minimal material waste. Unfortunately, these benefits are diminished by residual stresses and microstructural inhomogeneities resulting from the rapid heating and nonuniform thermal gradients which arise during processing. Understanding the coupled effects of material behavior and processing parameters/conditions on residual stress evolution is a nontrivial matter. Here, we expand our prior efforts in deciphering the role of processing parameters on residual stress development in 316L stainless steel to consider complex material behavior. Specifically, we experimentally investigate the role of thermoelastic phase transformations in a shape memory alloy using neutron diffraction in an effort to deconvolute the effects of AM processing on mechanical and residual stress behavior.

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