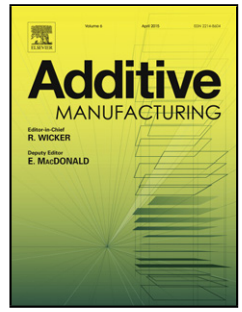

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Finite Element Simulation and Experimental Validation of Distortion and Cracking Failure Phenomena in Direct Metal Laser Sintering Fabricated Component

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Abstract

A new one-way coupled thermal-mechanical finite element based model of direct metal laser sintering (DMLS) is developed to simulate the process, and predict distortion and cracking failure location in the fabricated components. The model takes into account the layer-by-layer additive manufacturing features, solidification and melting phenomena. The model is first validated using experimental data, then model is applied to a DMLS fabricated component. The study shows how the stress distribution at the support-solid interface is critical to contributing to cracking and distortion. During the DMLS process, thermal stress at the support-solid interface reaches its maximum during the printing process, particularly when the first solid layer is built above the support layer. This result suggests that cracking at the interface may occur during the printing process, which is consistent with experimental observation. Using a design parametric study, a thick and low-density porous layer is found to reduce residual stress and distortion in the built component. The developed finite element model can be used to future design and optimize DMLS process.