Anisotropy of mechanical properties in L-PBF nickel samples with $< 011 >$ fiber texture

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Abstract

In additive manufacturing, texture development can be controlled by changing the laser scanning strategy. As the growth preference of columnar cells is along the direction with the largest temperature gradient, the texture can also be controlled by changing the shape of the melt bath which mainly depends on the laser scanning power and speed. The study examines how processing parameters affect the texture development of nickel samples and their influence on the anisotropy of mechanical properties.
The growth of the columnar cells preferentially occurs in the direction. Under some conditions, the columnar cells in the melt-pool were inclined approximately 45◦ toward the center, and only a few columnar cells in the central position grew along the build direction. As a consequence, with a 67◦ rotation between each layer, a sharp fiber texture along the building direction is generated. An elasto-plastic self-consistent model is used to simulate the elastic behavior and the yield stress under different tensile directions using a set of crystallographic orientations to represent the experimental texture.
The mechanical properties of homogeneous specimens with controlled textures are then experimentally measured under tensile loadings. Tensile deformation and damage evolution are quantified via clip-on gauge extensometers. The measured anisotropic properties are then compared with the predictions of the self-consistent model and confirm that the sharp fiber texture induces low anisotropy of the mechanical properties.

Keywords: additive manufacturing, L PBF, anisotropy, self consistent model

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