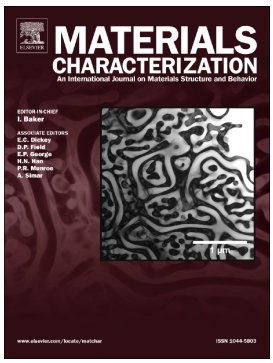

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Effect of build geometry on the microstructural development of 316L parts produced by additive manufacturing

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Abstract

Additive manufacturing (AM) technology has shown great potential in manufacturing complex products, such as lattice structures without extensive tooling. The focus of this study was to understand the effect of the part geometry on the resulting microstructure. Direct metal laser sintering was used for fabrication of ribs with thicknesses varying between 0.2 and 3.0 mm as well as inclined ribs the with build angles of 30° and 45°. The investigation showed that grains were growing in an epitaxial manner parallel to the building direction. The large elongated grains had a preferential <101> orientation, resulting from the temperature gradient. Additionally, it was found that small grains had formed close to the part surface which were inclined towards the center of the rib. In contrast to the elongated grains, they had a random orientations. The results also indicated that at build angles below 45°, the formed microstructure consisted of the large grains elongated in the building direction. For the used process parameters, the critical part thickness to avoid large elongated grains was found to be about 0.4 mm. These findings allowed us to establish the basics for design rules when it comes to thin wall structures.