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The effect of part orientation on achieving minimum lattice thickness in selective laser melting additive processing

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Abstract

The widespread introduction of additive manufacturing has led to the possibility of the use of lattice-based structures within manufactured parts. Such lattice structures are used in many applications for functions as wide as light weighting, vibration damping and osteointegration. Achieving lattice thickness of circa 100 µm is challenging given standard powder sizes (15-45 µm) and laser spot size (70µm).
The present paper seeks to present the effect of part orientation on the production of sub 100 µm lattice spar thicknesses when using SLM. A Renishaw AM 400 is used for the present work with stainless steel SS316L powder of 15-45 µm size distribution. In addition, within this work several parts are produced using the Reduced build volume (RBV) attachment available on the Renishaw AM 400. Part analysis is carried out using A Nikon MXCT 225.

Using optimised manufacturing settings, it is possible to achieve sub 100 µm lattice spar diameters. However, to consistently achieve such spar sizes the location of parts within the build volume seems to be critical. In the present work 4 orientations were tested both using the standard build volume and using the MBV. Using x-ray computer tomography, the results show consistently poorer lattice quality (incomplete spar builds) in the direction perpendicular to the exhausting Ar gas flow and even poorer where the parts are placed nearer the gas inlet side of the build plate. Interestingly when using the RBV the lattice build quality improves significantly. The RBV attachment geometry baffles the direct flow of gas across the build plane and as such it is considered that this interrupted gas flow may play a role in improved lattice quality.

Keywords: Additive Manufacturing, SLM, Powder Bed Fusion, XCT, lattice, gas flow

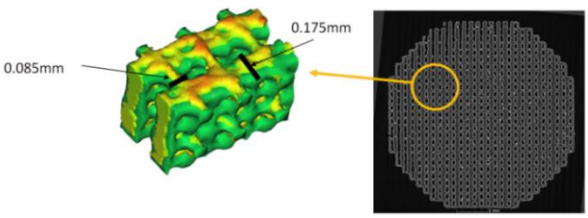

Figure 1 XCT image of AM lattice with approx. 85µm spar diameters