On the use of laser-material interaction parameters to drive design and control of thin-wall architectures made of AlSi10Mg alloy by laser powder-bed-fusion (L-PBF)

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The effect of the power factor (P_F) and specific point energy (E_{SP}) have been previously presented as viable design parameters for L-PBF process optimisation in AlSi10Mg alloy. In the present research, thin-wall architectures have been manufactured using two different L-PBF machines featuring laser spot diameters a) 25 µm and b) 75 µm respectively. The laser power and exposure time have been varied and replicated in both machines to investigate the effect of P_F and E_{SP} in surface roughness, relative density and wall thickness of single-track scans. The effect of different P_F ranges promoted by two different laser spot diameters has been characterised and a machine comparison is presented. It was observed that the laser-material interaction parameters (i.e. laser power and exposure time), controlled the properties and characteristics of the thin-wall components. Different thin-wall geometries were investigated, namely: lineal vertical, wavy vertical, lineal 30˚ and 45˚ build angles from base plate. Optimal parameters were identified which can be used to manufacture heat exchanger architectures with a more controlled design. It is proposed to use the laser-material interaction parameters with CAD Surface geometries to drive and control thin-wall components.

[1] M. Zavala-Arredondo, T. London, M. Allen, T. Maccio, S. Ward, D. Griffiths, A. Allison, P. Goodwin, C. Hauser (2019) Use of power factor and specific point energy as design parameters in laser powder-bed-fusion of AlSi10Mg alloy, Materials & Design, vol. 182