Effect of scanning strategy and laser parameters on roughness, porosities and hardness of SLM AlSi10Mg thin-walls

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Abstract

In aeronautics, selective laser melting (SLM) brings a new field of topological optimization allowing a reduction of the weight and an improvement of the efficiency of aircraft parts like heat exchangers. Moreover, the size-resolution of this technique allows to build large bulk parts as well as very small complex parts (such as winglets in heat exchangers). However, the fatigue life of SLM AlSi10Mg does not reach the performances met by wrought aluminium alloys. The low fatigue resistance is attributed to residual stresses, surface roughness and remaining large porosities. In this context, this work shows how laser parameters and scan strategies have an impact on surface roughness and sub-surface porosities of thin structures (typically a couple of 100th of µm). More particularly, it is shown that the contouring strategy plays a dominant role on roughness and sub-surface porosities compared with the main laser parameters.

AlSi10Mg 3D-Printed thin walls (600 µm-thick) were fabricated with a set of varying parameters such as the laser power, the scan speed and scan strategy. Roughness has been recorded by white light interferometry. Melted Pool geometrical analyses was performed on each sample in order to isolate the effect of each parameter. Finally, the sub-surface porosities were studied by 3D laboratory X-ray tomography. Further analysis is under way to study the impact of the roughness and sub-surface porosities on fatigue behaviour.