Improving Surface Finish of Stainless Steel AM Parts using a Remelt Strategy

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Abstract

There is an continuing drive to push the limits of metal additive manufacturing to ever more complex geometry parts with tighter tolerances and stricter specifications on surface roughness. The expanding application filed for AM parts has meant that post processing of the inherently rough metal AM surfaces will increasingly become a key part of the process chain for metal additive manufacturing.

For surfaces produced through additive means, the subsequent surface finish is highly dependent upon the part orientation within the build volume and therefore can vary across the part [1], as well as a huge number of physics based constraints [2]. Consequently, AM surface roughness is recognised to be significantly inferior to more traditional subtractive machining processes. In some cases, this precludes the direct use of AM parts or necessitates additional surface finishing processes.

Unfortunately, post processing can be an added expense to the manufacturing costs of an AM part. Such process, by their nature, are a global approach to surface smoothing employing manual or chemical process that, unless careful masking is used, affect the whole part. Additionally for areas of the printed part that are in accessible these processes are sub optimal or not an option at all. Such component could include channels for fluid or gas flow and excessive surface roughness could significantly affect part function.

For the present study a strategy of remelting the previously deposited layer with specified energy densities is adopted for improving part surface roughness. In this study a series of stainless steel test pieces produced on a Renishaw AM400 AM (powder size 15-45um) were manufactured using x6 different remelting strategies. The surface topography produced by each strategy was compared with a baseline stainless steel printing strategy using standard energy densities as recommended by the AM machine manufacturer of circa 36J/mm^3. Focus variation microscopy (FVM) (Alicona G5 Infinite Focus) was utilised to quantitatively assess the surface roughness on both the top and side faces.

Additionally Scanning electron microscopy was implemented to assess qualitative improvements in roughness.

The results, figure 1, indicated that combining higher laser power with higher scanning speed produced the lowest remelted roughness along with a good repeatability of roughness values across the parts giving a repeatable 40% reduction in the areal roughness Sa.

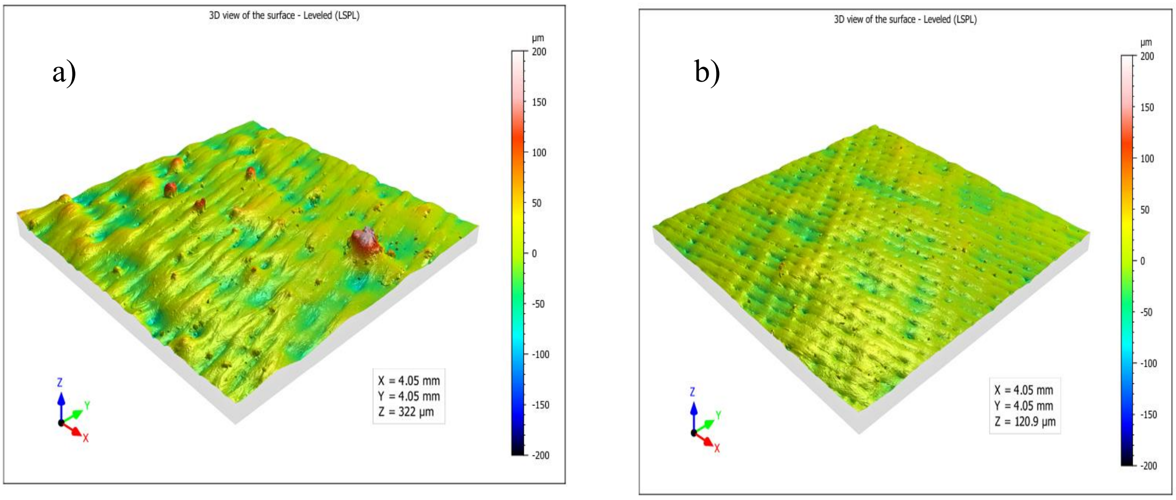

Figure 1 remelt strategy; a) baseline standard roughness (top skin) b) remelted surface (topskin)

References

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