Effect of Energy Density on Properties of Additive Manufactured Ti6Al4V via SLM

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ABSTRACT

High performance of final products in terms of physical and mechanical properties are highly desired in any processes. Selective Laser Melting (SLM) is a joining process of metals that builds a product based on the computer aided design (CAD) or any 3D data. SLM uses a laser beam to melt metal powder and rapidly build any parts that may have complex and intrinsic internal structures and external features. However, the performance of final parts is greatly depending on the processing parameters. In SLM, there are four main processing parameters which are laser power (W), scanning speed (mm/s), layer height (mm) and hatching distance (mm). In past, many researchers only focused on the influence of a single or two processing parameters on the properties of final parts. Such approach seems biased and not equal since all four processing parameters sums the energy density (J/mm^3) of a printing process. Therefore, the aim of this work is to investigate the effect of all four processing parameters and its energy density on the physical and mechanical properties of additive manufactured titanium alloy (Ti6Al4V) via SLM. Nine different sets of parameters were employed to produce cubic specimens (1 cm^3) of Ti6Al4V based on Taguchi L_9 method. It was found that the surface roughness, Ra for all cubic specimens ranges less than 20 µm. For microhardness, it was found that P9, P7 and P6 cubic specimens gave the lowest (378.22 HV), average (422.23 HV) and highest (477.22 HV) microhardness values. Such finding may be influenced by the energy density that is gradually increasing from P9, P7 and P6. However, as the energy density exceeded 90 J/mm^3, the microhardness is deteriorated due to large amount of melting that resulted to incomplete bonding. The