Physical Evaluations of Co-Cr-Mo Parts Processed Using Different Additive Manufacturing Techniques

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Abstract. In recent years, additive manufacturing with highly design customization has gained an important technique for fabrication in aerospace and medical fields. Despite the ability of the process to produce complex components with highly controlled architecture geometrical features, maintaining the part's accuracy, ability to fabricate fully functional high density components and inferior surfaces quality are the major obstacles in producing final parts using additive manufacturing for any selected application. This study aims to evaluate the physical properties of cobalt chrome molybdenum (Co-Cr-Mo) alloys parts fabricated by different additive manufacturing techniques. The full dense Co-Cr-Mo parts were produced by Selective Laser Melting (SLM) and Direct Metal Laser Sintering (DMLS) with default process parameters. The density and relative density of samples were calculated using Archimedes' principle while the surface roughness on the top and side surface was measured using surface profiler. The roughness average (Ra) for top surface for SLM produced parts is 3.4 µm while 2.83 µm for DMLS produced parts. The Ra for side surfaces for SLM produced parts is 4.57 µm while 9.0 µm for DMLS produced parts. The higher Ra values on side surfaces compared to the top faces for both manufacturing techniques was due to the balling effect phenomenon. The yield relative density for both Co-Cr-Mo parts produced by SLM and DMLS are 99.3%. Higher energy density has influence the higher density of produced samples by SLM and DMLS processes. The findings of this work demonstrated that SLM and DMLS process with default process parameters have effectively produced full dense parts of Co-Cr-Mo with high density, good agreement of geometrical accuracy and better surface finish. Despite of both manufacturing process yield that produced components with higher density, the current finding shows that SLM technique could produce components with smoother surface quality compared to DMLS process with default parameters.