POSTER ABSTRACT
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Study of Sintering Behaviour and Material Characterization of CoCrMo parts manufactured by Binder Jetting

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Abstract

Additive manufacturing (AM) produces complex geometric parts layer-by-layer from CAD files, and has the potential to reduce cost, energy, material utilization, chemical waste, steps in a process, and human resources. In comparison to the available fusion-based additive manufacturing techniques, binder jetting is still in an earlier phase of development and technology readiness. Binder jetting, often known as binder jet 3D printing, is an AM process in which metal powder is first forms a powder bed and then, in each layer, binder, a polymeric liquid, is used to link the layers specifically. CoCrMo is an alloy, which is frequently used in gas turbines, dental implants and orthopedic implants because it has a remarkably high specific strength. CoCrMo alloys have high temperature sustenance, corrosion resistance and are regarded as biocompatible. It is e.g., a standard material for dentures. Hence, a CoCrMo alloy composed of Cr-28.44 %, Mo-6.01 % and balanced cobalt, was used for this study to investigate binder jetting as a route to manufacture this alloy. The microstructure and mechanical properties of an alloy are influenced by the sinter process and subsequent heat treatment it undergoes. These properties can be tailored according to application requirements. The aim of this study was to investigate the changes in microstructural and mechanical properties. Also, it intends to study the effect of variable sintering profiles on the porosity of Binder jetted samples of CoCrMo. Samples were sintered within a range of 1280 °C to 1345 °C with 1 hr hold time at final sintering temperature for each profile. The metallographic analysis was done to observe grain size and porosity using optical microscope. SEM analysis was performed to observe the precipitation along the grain boundaries. Samples sintered at 1345 °C had the least porosity of about 0.2 %. Mechanical testing included microhardness testing and tensile strength testing. The microhardness achieved in the least porous sample was of 336 HV0.05 and it showed a yield and tensile strength of 350 MPa and 718 MPa respectively with 8.1 % total elongation. Further, a post heat treatment was performed on selected optimal sintering cycle to increase homogeneity of the microstructure. This resulted in increase of total elongation of the material from 8 % to 23 %. These results were also compared with casted CoCrMo alloy currently used in market and Laser processed CoCrMo alloy. The performed research shows the potential of binder jetting and a tailored heat treatment for dental applications.