Contribution ID : **50** Type : **Oral Presentation**

Effect of Hot Isostatic Pressing (HIP) on additively manufactured Ti6Al4V microlattice structures

Wednesday, 6 December 2017 14:00 (25)

The quality of additively manufactured metallic microlattice materials is reported to be dependent on process parameters. These fabricated structures have inherent defects such as micro-voids. The build angle of the part is likely to affect its microstructure and mechanical properties due to the stacking-layered-fused nature of the metal powder in Powder Bed Fusion (PBF) process, which is essentially a vertical building paradigm. In this study, two Ti6Al4V microlattice structures, one with Body Centered Cubic (BCC) and another with additional vertical pillar (BCC-Z) unit cell, were manufactured using Electron Beam Melting (EBM) method. The initial structures were examined using the Neutron imaging instrument DINGO at ANSTO, in order to detect large internal defects if possible. While the effects of build angle may be avoided only with great difficulty, Hot Isostatic Pressing (HIP) was conducted as a suitable post-processing step to mitigate these effects by removing porosity. Since both the structures are made up by interconnecting struts, representative strut-length samples were extracted before and after the HIP process and were subjected to Scanning Electron Microscopy (SEM), Energy Dispersive Spectroscopy (EDS) and Electron Backscatter Diffraction (EBSD). It is observed that the HIP process was able to remove significant amount of porosity and resulted in overall coarsening of the titanium alloy microstructure.

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Materials

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Session Classification : Materials

Track Classification : Materials