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Ptychography in Ti64 alloy at the Diamond Light Source

We have studied a Ti6Al4V made by metal injection molding (MIM) using synchrotron X-ray imaging techniques. This alloy has superior mechanical properties compared with other titanium alloys [1]. We have managed to determine the porosity, defects, and the morphology using Computed Tomography and Ptychography.

Fabrication of the alloy was carried out at the Council for Scientific and Industrial Research (CSIR) in South Africa [2]. The MIM is a near-net shaping process that offers a unique ability to manufacture components with a wide range of porosity level which can provide useful scope to exploit various industrial applications [2].

Tomography was carried out at the European Synchrotron Radiation Facility, BM05 at a pixel sizes of 2.5 µm at an energy centered around 97 keV using a combination of aluminium and molybdenum filters and at 73 keV with 40 mm of SiO2 and 2.3 mm of Al as filters. A full volume reconstruction was carried out using PyHST2 software. According to these measurements, the porosity decreases as we move from the top of the specimen to the bottom. The inline phase contrast also shows that the elements are not uniformly distributed.

We have also carried out ptychography tomography measurements on the Ti6Al4V samples at the i13-1 Coherence beamline at the Diamond Light Source [3]. Two samples of cylindrical shape with a 10 µm radius were extracted using a focused ion beam (FIB). A monochromatic beam was used with a Fresnel zone plate lens to obtain the required probe size at the sample. Reconstruction of the projections was carried out using the ePIE algorithm implemented in PtyREX [4] and the reconstruction of the 3D volumes using TomoPy [5]. We will present the results obtained at nanometer resolution and the analysis.

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