USER MEETING 2016
24-25 NOVEMBER
National Centre for Synchrotron Science

Contribution ID : **165** Type : **Oral**

Investigation of microstructural variations in cold sprayed titanium after heat treatment

Thursday, 24 November 2016 11:00 (15)

Titanium alloys are widely used in aerospace applications due to their unique superiority of low density and high strength. In order to optimize the performance of Ti alloy, prior knowledge of the microstructure-property relationships and microstructural evolution as a result of processing should be studied.
Synchrotron radiation-based X-ray micro-computed tomography (SR μ-CT) has been developed and become a powerful tool for investigating metallic materials, due to its unique capability of non-destructive 3D characterization over various techniques such as optical microscopy, SEM and TEM. However, it is difficult to quantitatively identify compositional distribution in some fine structures that are smaller than the pixel size. In this article, data-constrained modelling (DCM) [1] based on SR has been applied for the purpose of resolving the partial distribution of multiple compositions in single voxel more accurately of a cold sprayed Ti sample before and after heat treatment. SR μ-CT experiments were performed on imaging and medical beamline (IMBL) at Australian Synchrotron (AS). Projections with effective pixel size of 0.65μm were processed by X-Tract [2] for background correction, image normalization, phase retrieval, ring artefact correction and CT reconstruction.
A cubic grid of N = 580 × 590 × 150 voxels was imported into DCM software for compositional analysis, cluster computation, quantitative characterization, and 3D visualization [3]. Although the porosity is 5.1% before annealing and 4.5% after annealing, the total number of voids cluster has decreased slightly after annealing compared with that before annealing. Quantitative information such as surface area and volume was obtained according to the cluster analysis. The surface area and the volume both have a trend of reduction, however, with an equivalent variation percentage. As a result, the value of surface area-to-volume ratio of void clusters almost keep as the same level as the environment changed. The results reveal a smaller dimension and similar shape profile of void clusters after heat treatment.

References
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Keywords or phrases (comma separated)

Cold spray, titanium, mico-CT, DCM

Are you a student?

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No

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What is your gender?

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Session Classification : Concurrent Session 1: Advanced Materials I

Track Classification : Advanced Materials