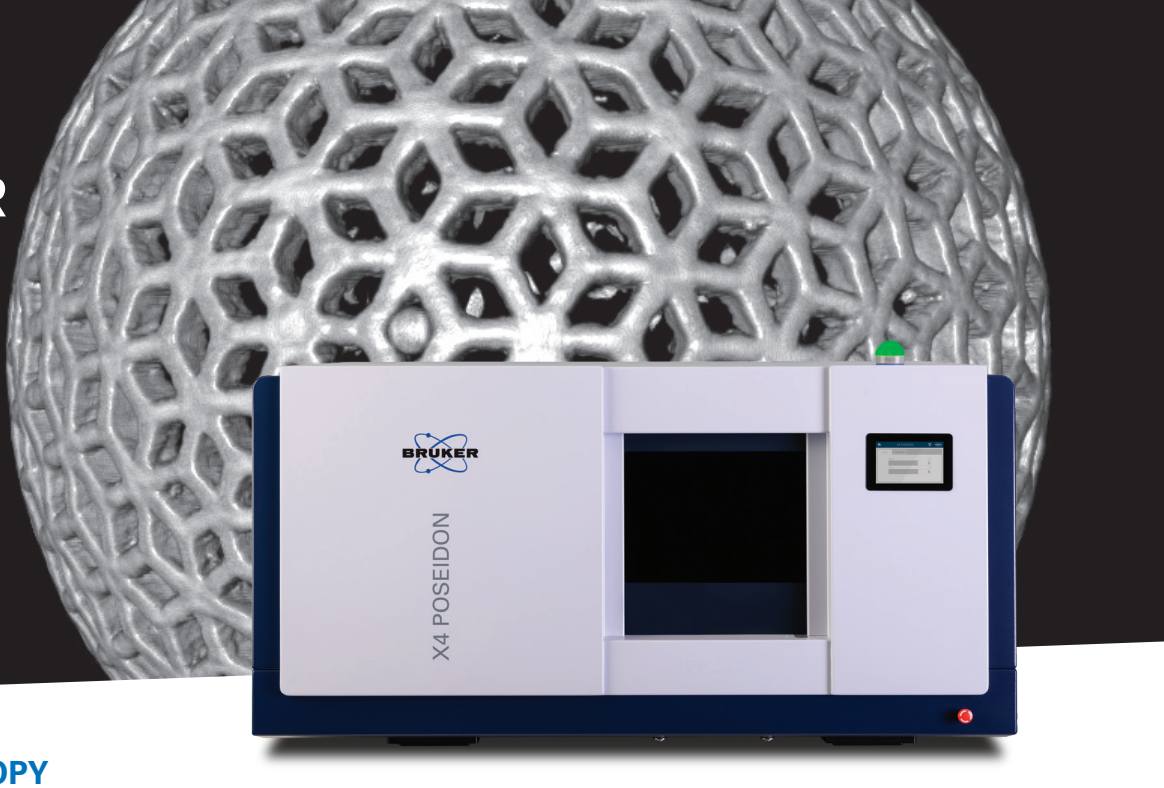

X-RAY MICROSCOPY

X4 POSEIDON – Ultralight weight titanium 3D print for space applications

Application Report 3

Space exploration pose many challenges, especially missions where spacecraft are planned to land on planets. Due to the exorbitant costs and high risk, the focus on reliability and quality is extreme. Another challenge is the low weight requirement. The extreme forces acting on the spacecraft when landing on Mars or the Moon are partly actively corrected by small rocket systems, while passive cushioning systems are also used to dampen landings.

This report shows a 3D analysis of a 3D printed titanium ball. These structures are used in spacecraft to dampen landings. The structure is extremely open and by design very lightweight. The ball design, material choice and printing technology used ensure the high toughness required for the application. XRM quality inspection enables confirmation of the structural structural integrity and low number of defects and pores.

The X4 POSEIDON microCT imaging workstation is a benchtop 3D imaging core facility in your lab. The following settings were used for this study:

- 7 Mpixel Flat-panel X-ray camera
- 90 kV, 150 µA
- Scan duration: 28 min
- Voxel resolution: 8 µm
- Object diameter: 12 mm

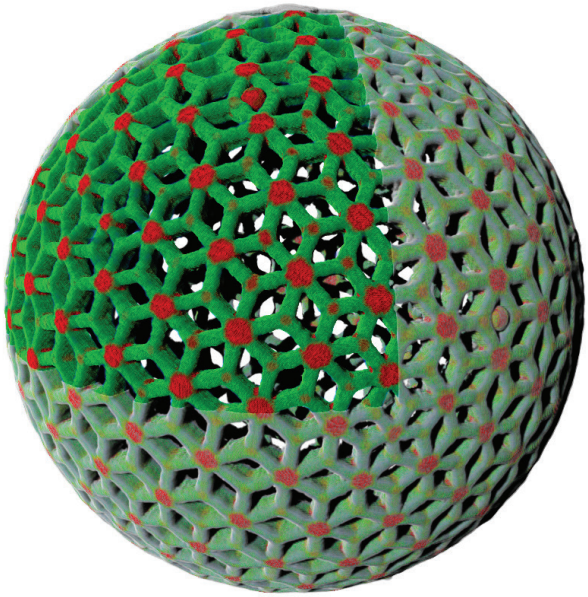

Figure 1
Thickness analysis of the ball mesh structure.

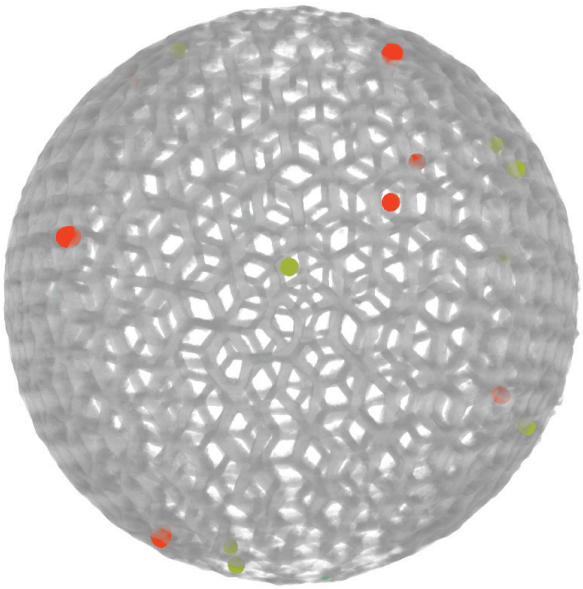

Figure 2
Individual object analysis of the high-density inclusions.

A thickness analysis is performed on the mesh that makes up the global structure of the titanium ball (Figure 1). This provides an overview of the homogeneity of the printed struts and highlights any deviations in the thickness. The red color coding indicates the thickest region of the mesh. The thickest regions are at the connection points of the mesh structure as expected. The scan confirmed the high structural integrity and low number of defects and pores, these could be impurities in the raw material or imperfections of the printing process and have an impact on the mechanical properties of the structure.

High-density inclusions are present inside the mesh structure of the ball. To determine the sizes and location of these inclusions an individual object analysis is performed. This provides the volume equivalent sphere diameter of each object, and can be clearly visualized in 3D indicating the location of each inclusion.

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