

## PS26

***Hetero-3D* の ISS-ELF 実験で溶融凝固させた  
TiC 添加 Ti-6Al-4V 試料の表面解析****Surface Analysis for Ti-6Al-4V with TiC Melted and  
Solidified in the ISS-ELF Experiment of *Hetero-3D***

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**1. Introduction**

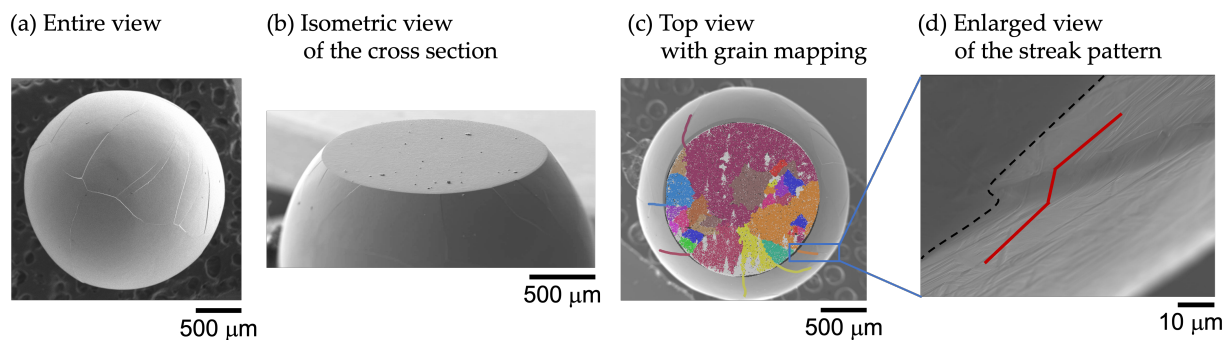
To clarify the solidification behavior of Ti-6Al-4V with TiC heterogeneous nucleation site particles, *Hetero-3D* mission was carried out. The samples were melted and solidified using the electrostatic levitation furnace in the International Space Station (ISS-ELF) and the electrostatic levitation furnace on the ground (ESL). After the experiments, streak patterns were observed on the surfaces of the ISS-ELF samples, which were not on those of the ESL samples<sup>1</sup>). Therefore, the objective of this study was to clarify the surface condition of the ISS-ELF sample by comparing the streak patterns observed only on it and the grain map on the cross section.

**2. Experimental Procedures**

The mixed powder Ti-6Al-4V with 5 mass% TiC was sintered and cut into cubes of about 25 mg. Subsequently, the sample was formed into a spherical shape in an arc furnace for stable levitation. The sample was levitated among electrodes and heated using four laser beams in the ISS-ELF. After melting, the sample was solidified by natural cooling under the Ar atmosphere<sup>2</sup>). The recovered sample was embedded in resin, cut using a diamond wire saw at about 300  $\mu\text{m}$  from the top of the sample, and polished using a polishing machine. Subsequently, electron backscatter diffraction (EBSD) analysis was conducted to obtain the prior- $\beta$  grain map on the cross section<sup>3</sup>). In addition, scanning electron microscopy (SEM) was used to observe the streak patterns on the surface of the sample.

**3. Results and discussion**

The SEM image of the entire view of the ISS-ELF sample shown in **Fig. 1(a)** confirmed streak patterns on the entire surface of the sample. In addition, the SEM image of the isometric view shown in **Fig. 1(b)** confirmed some streak patterns in the edge of the cross section. The SEM image of the cross section and the prior- $\beta$  grain map overlapped with the direction fixed so that the dimensions matched were shown in **Fig. 1(c)**. The observation of multiple crystal grains in the cross section indicates that the crystal grains were refined. Focusing on the edge of the cross section, it was confirmed that the positions of the prior- $\beta$  grain boundaries and the streak patterns approximately matched. Furthermore, an image of the streak pattern observed by high magnification is shown in **Fig. 1(d)**. This confirmed that the streak patterns observed on the surface of the sample were steps. These results indicate high possibility that the steps observed in the ISS-ELF samples were generated at the prior- $\beta$  grain boundaries.



**Figure 1.** Images of the ISS-ELF sample obtained by SEM. The entire image before polishing was shown in (a). The cross-sectional images after polishing shown in (b) and (c). They have different parts of view. To clarify the positional relationships, the streak patterns were traced in the image shown in (c). In the image shown in (d), dark gray areas are cross sections and gray areas are surfaces, with the boundary traced for clarity. In addition, the sample surface was drawn with an auxiliary line to clarify that it was a step.

#### 4. Conclusions

The streak patterns on the surface of the ISS-ELF sample were steps. In addition, the steps approximately matched with the positions of the prior- $\beta$  grain boundaries. This result clarified the high possibility on the sample were generated at the prior- $\beta$  grain boundaries.

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