# Bi-lamellar microstructure in L-PBF processed Ti-6Al-4V: Heat treatment and quasi-static micro-mechanical deformation behavior

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Due to the immense application potential of complex-shaped Ti-6Al-4V components in the biomedical and aerospace industries, laser-based powder bed fusion (L-PBF) of Ti-6Al-4V has received significant interest from both industry and academia in the past decade. However, the successful implementation of L-PBF processed Ti-6Al-4V in engineering components requires a post-heat treatment on the as-built martensitic microstructure, so that a better combination of tensile strength and ductility can be achieved. Scientifically, this requires a more profound understanding of the microstructural features that govern the deformation behavior of L-PBF processed and heat-treated Ti-6Al-4V under quasi-static loading conditions.

Accordingly, the present study has a two-fold focus. Firstly, a novel post heat treatment is designed to achieve a bi-lamellar microstructure in L-PBF processed Ti-6Al-4V. This is realized by heat-treating the L-PBF processed Ti-6Al-4V above its beta transus temperature (> 1000˚C), followed by an annealing treatment at 880°C, corresponding to the α+β region. Secondly, the micro-mechanical deformation behavior of the bi-lamellar microstructure is investigated by in-situ uniaxial tensile loading, during which the deformation behavior was monitored by means of Scanning Electron Microscope (SEM) based Digital Image Correlation (DIC). SEM-DIC provided direct insights in the deformation mechanisms: (i) Strain partitioning between primary alpha and transformed beta phase. (ii) Strain accumulation at the interface between those two phases. (iii) Onset of macroscopic strain localization bands that ultimately lead to failure.

**Keywords:** Laser-based powder bed fusion (L-PBF), Bi-lamellar microstructure Ti-6Al-4V, Digital Image Correlation

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