# Hierarchy of the macrozone features in Ti-6Al-4V alloy inferred from massive FFT-based polycrystal plasticity calculations

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**Abstract**

Titanium alloys exhibit complex microstructures containing heterogeneities at different length scales. Microtextured regions (MTRs), usually called "macrozones", exhibit grains having the same or nearly the same crystallographic orientation. They are known to have a detrimental influence on the alloy performance under cyclic loadings and dwell fatigue. Recent numerical studies based on crystal plasticity evidenced an effect of the degree of macrozones on the yield strength and stress distributions in polycrystalline aggregates. In the present study, a fast Fourier transform-based crystal plasticity elasto-viscoplastic (CP-EVPFFT) code using MPI (Message Passing Interface) and the FFTW library, is used to perform massive calculations for the study of the mechanical response in the microplastic stage of large 3D polycrystalline aggregates containing macrozones. These macrozones are synthetically generated with three different features: crystallographic texture with different orientation and intensity, volume fraction, and morphology. The 3D microstructure is obtained from EBSD data measured on a Ti64 hot rolled and annealed plate. Using two metrics, namely the equivalent Von Mises stress and the normal stress to basal plane, intragranular stress hotspots are found to be affected by the presence of the different macrozone features. The discussion concludes on a hierarchy of these macrozone features for mechanical performance of the Ti64 alloy.

**Keywords:** Micromechanics, Titanium alloys, Crystal Plasticity, Macrozones, Poycrystaline Simulations

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