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Hierarchy of the macrozone features in Ti-6Al-4V alloy investigated using fast Fourier transform-based crystal elasto-viscoplastic simulations

Xiaolei Chen[a,b], Lionel Germain[a,b], Stéphane Berbenni[a,b]

[a] *University of Lorraine, Arts et Métiers, CNRS, LEM3, F-57000 Metz, France*
[b] *Laboratory of Excellence on Design of Alloy Metals for low-mAss Structures (LabEx DAMAS), University of Lorraine, Metz, France*
lionel.germain@univ-lorraine.fr

Titanium alloys exhibit complex microstructures containing heterogeneities at different length scales. The microtextured regions with the same or nearly the same crystallographic orientation, also called “macrozones”, are suspected to have a detrimental influence on the alloy performance under cyclic loadings. Recent studies [1] evidenced an effect of the degree of microtexture on the yield strength of polycrystalline aggregates. In the present study, several features of the macrozones have been hierarchized as a function of their influence on mechanical properties. Large 3D aggregates containing macrozones with different shapes, volume fractions, orientations have been tensile tested using the fast Fourier transforms-based crystal elasto-viscoplastic (EVPFFT) numerical simulations [2] in a homemade parallel version (MPI). Both macroscale responses, microscale stress and strain fields (Von Mises stress, triaxiality distributions) are found to be affected by the presence of macrozones and their features as illustrated in Fig. 1. Location of stress hotspots in the different representative volume elements (RVEs) are also discussed.

Keywords: Ti-alloys; Macrozone; Morphology; EVPFFT; Yield stress; Stress triaxiality

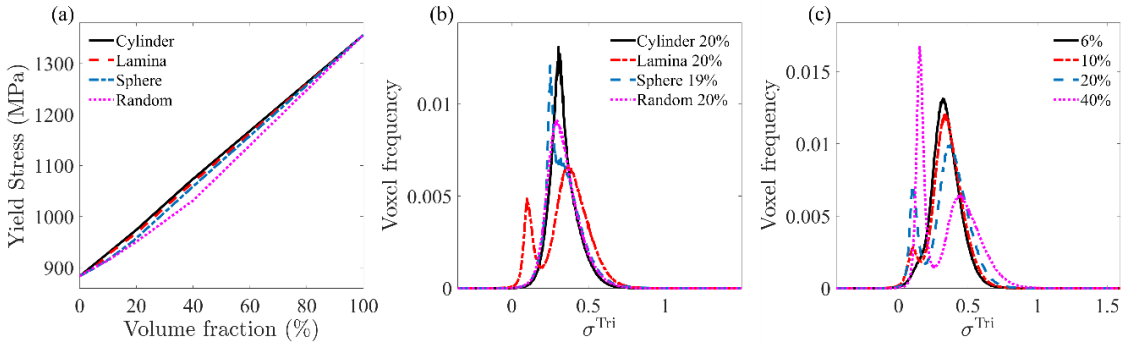

Fig.1: (a) Yield stress of Ti-alloy aggregates as a function of morphology the macrozone. Distribution frequencies of the stress triaxiality (b) with different morphologies of the macrozone at approximately constant volume fraction of 20% and (c) with different volume fractions of the macrozone of the “Lamina” morphology.

References:

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