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Abstract

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Fitting 3D model to polycrystalline alloys based on 2D micrographs

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Many components are made of polycrystalline alloys featuring a cellular microstructure of particular interest in various applications, e. g. the study of mechanical properties, propagation of microscopical cracks, and non-destructive testing of components by ultrasound techniques. In all these applications, the studied phenomena depend on the spatial distribution and on the shape distribution of the cells. [1] studied an α-titanium alloy and stated the grain size of this polycrystalline alloy to be log-normally distributed. [2] suggested a Laguerre-tessellation based on dense non-overlapping sphere packings as an adequate model. In any case, if the 3D model is to be fit on exclusively 2D information, one runs into an ill-posed problem. We approach this problem by iterative adaptation of the cell number and comparing the achieved results based on extracted 2D sections.

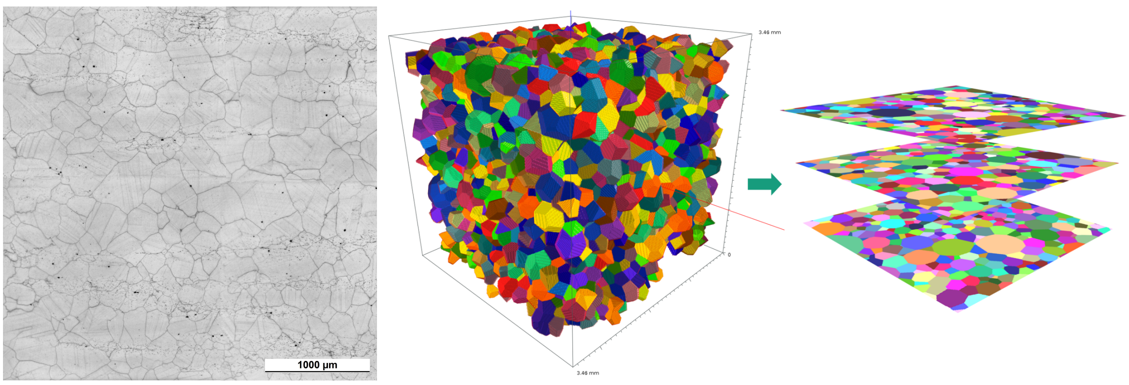

Figure 1: Left: Micrograph of an Inconel-617 alloy featuring the 2D parameters of the granular microstructure. Center: Visualization of a realization of the Laguerre-tessellation resulting from 4 000 densely packed spheres with a log-normally distributed volume size. Right: Extracted sectional planes for comparison with the 2D micrographs.

References

[1] Okazaki, K. and Conrad, H. (1972). Grain size distribution in recrystallized alpha-titanium. Transactions of the Japan Institute of Metals, 13(3):198-204.

[2] Fan, Z., Wu, Y., Zhao, X., and Lu, Y. (2004). Simulation of polycrystalline structure with voronoi diagram in laguerre geometry based on random closed packing of spheres. Computational Materials Science, 29(3):301-308.