

COMPUTATIONAL MODELING OF CREEP AND DEFORMATION IN Ti-Al ALLOYS

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The deformation and failure of multi-colony, multiphase polycrystalline aggregates of α - β Ti-6Al alloys is governed by micro-structural features that include morphological and micro-structural characteristics. Morphological and crystallographic heterogeneities leading to anisotropic properties and localized non-homogenous deformation impose severe limitations on conventional finite element models. These arise due to the inability of Taylor type models with uniform crystal deformation to model this material, as well as from the complexity due to intra/inter-granular localization and fracture.

The Voronoi Cell FE Model (VCFEM) has been developed by Ghosh et. al to overcome the limitations of conventional FE models for heterogeneous microstructures. In this paper an assumed strain Voronoi Cell Finite Element has been developed for the modeling of large polycrystalline aggregates. Grain level non-homogeneous elastic-plastic deformation by lattice rotation and crystallographic slip is incorporated into the element formulation. Here the original OIM of the microstructure is mapped into a Voronoi Element mesh, where each Voronoi element is identified as a single crystal and thereby the morphology of the aggregate is accurately represented.

The material modeling for the Ti – Alloys is carried out using an experimentally validated crystal plasticity model for hcp microstructures which accounts for plastic anisotropy and time dependent plasticity. The material parameters for the model were obtained from experimental results of single crystal α -Ti-6Al, using a multi variable optimization method. This coupled with the element formulation will be able to effectively address all the issues that arise in deformation of Ti-6Al alloys.