Modeling of the behavior in high-cycle fatigue based on the coupling plasticity-damage in a mesoscopic scale

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ABSTRACT

The methods of prediction of lifespan in high cycle fatigue are under development since decades and are used by engineers to dimension the structures. The purpose of the work presented in this paper is to establish a numerical tool of prediction for a polycrystalline metal subjected to complex multiaxial loadings in fatigue. In order to overcome a purely phenomenological description, a model based on the coupling plasticity-damage in a mesoscopic scale is formulated in the framework of thermodynamics of irreversible processes and by the introducing of the critical approach plan. This model constitutes an improvement of the initial versions proposed in the literature. Advanced numerical methods were exploited for the development of this tool, namely the Maximum Variance Method (MVM), the implicit and explicit diagrams of integration and the jump-in-cycles method. The confrontation of the results showed the relevance of the model most accurately to capture as closely as possible degradation mechanisms and to predict lifespans in concord with the experimental one.

Keywords: Modeling, High-cycle fatigue, mesoscopic scale, Damage, critical approach plan, Life prediction.