11th World Congress on Computational Mechanics (WCCM XI)
5th European Conference on Computational Mechanics (ECCM V)
6th European Conference on Computational Fluid Dynamics (ECFD VI)
July 20–25, 2014, Barcelona, Spain

A FEM MODEL FOR PREDICTION OF FATIGUE CRACK INITIATION IN FORGED M3:2 TOOL STEEL IN HIGH CYCLE FATIGUE

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Key words: *fatigue crack incubation, fatigue crack initiation, finite element method, high cycle fatigue, high speed tool steel.*

In general, failure of a component due to cyclic loading can be divided into 3 stages namely the fatigue crack incubation (i.e. formation of crack plus early crack growth), short crack, and long crack growth. The two consecutive stages, incubation and short crack growth, are also referred as fatigue crack initiation. It has been generally accepted that crack initiation occupies most of the fatigue life in HCF regime. In high strength steel, the crack initiation with the crack length in the order of 100μm-1mm consumes $90-98\%$ of total fatigue life [1, 2, 3, 4, 5]. Therefore, it is of a great importance to predict the lifetime in terms of initiation. For predicting the initiation life, a model combined two step simulation approaches including incubation life estimated by the Fatemi-Socie damage model [6] and short crack life calculated by continuum damage mechanic (CDM) [7, 8] are used. The model particularly addresses the critical role of microstructural characteristics of primary carbides as well as local plastic strain of a metal matrix on the fatigue driving mechanism. In this study, forged M3:2 high speed tool steel (DIN HS6-5-3 with 1.28%C, 4.2%Cr, 3%V, 6%W, 5%Mo) is applied to the validation of this proposed model. The simulation result of initiation life from the proposed model is compared to the experimental initiation life based on Berns' data in [9] and it can be recognized that the proposed model is reasonable. By estimating the cycles to the crack initiation the numerical model generates a useful tool for lifetime calculations.

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