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A Microscopic Mechanics Model

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In the present work, an analytical micromechanics model is proposed to describe the influence and interaction of fatigue and creep. Here, a recently proposed fatigue crack growth model by the present authors is adopted which views the fatigue crack growth process as the intermissive elastic cleavage fracture of the dislocation free zone (DFZ). The effects of cyclic loading make the plastic zone hardening (or softening), thus raise the stress level in DFZ and bring it to fracture. The calculated curves exhibit three different stages of fatigue crack growth which is in general agreement with the experimental observation. The fatigue-creep interaction model is such that the fatigue damage is represented by the climbing dislocations and the creep damage is represented by the micro void ahead of the dislocation pile-up. The dislocation distribution function is determined by the integral equation of the equilibrium condition of dislocations. For the tensile stress distribution in DFZ, we adopt the cohesive zone model. The bridging relation is taken of the form as nonlinear atomic action. When the bridging stress within DFZ increases up to the tensile strength, fracture takes place. The growth of the void enhances the stress concentration ahead of crack-tip, thus promote the growth rate of fatigue crack.

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