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An improved unified viscoplastic model for modelling low cycle fatigue and creep fatigue interaction loadings of 9–12%Cr steel. (English) Zbl 1476.74014

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Summary: An accurate constitutive model is one of the basic aspects to ensure a precise simulation. This study presents an improved unified viscoplastic model to simulate the various behavior of P92 steel under low cycle fatigue (LCF) and creep fatigue interaction (CFI) loadings. In the proposed model, an accumulated inelastic strain dependent parameter is introduced into the nonlinear kinematic hardening rule to represent the evolutionary behavior of strain-stress hysteresis loops and the varied relaxation behavior during CFI loadings. The traditional isotropic hardening rule is modified as well to capture the accelerated cyclic softening phenomena observed in the prolonged hold time of CFI tests. To validate the accuracy and the predictive capability of the proposed model, LCF tests at various strain amplitudes and CFI tests at different hold time are conducted at elevated temperature of 650°C. Good agreement between the experimental and simulated results verifies the robustness of the proposed model. In addition, the proposed model is distinguished from published models by few determined material parameters.

MSC:

74C10 Small-strain, rate-dependent theories of plasticity (including theories of viscoplasticity)
74R20 Anelastic fracture and damage

Keywords:

low cycle fatigue; creep fatigue interaction; viscoplasticity; stress relaxation; nonlinear kinematic hardening rule; strain-stress hysteresis loop

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