Application of the endochronic theory of plasticity for life prediction with asymmetric axial cyclic straining of AISI 304 stainless steel

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Abstract

In this paper, experiments of asymmetrical axial cyclic straining were conducted to explore the mean strain effects on the stable hysteresis loop and the fatigue life of AISI 304 stainless steel. The experimental results show that the imposed mean strain level has almost no influence on the shape of a stable hysteresis loop under the same strain amplitude condition. In terms of the mean strain effect on the fatigue life, at a strain amplitude greater than 0.6%, the imposed mean strain level was found to have no significant effect on the fatigue life, whereas a prominent effect on the fatigue life was found at low strain amplitude. Moreover, the endochronic theory of plasticity has been utilized to develop the stress–strain relationships to simulate the stable hysteresis curve in tension. A good agreement exists between the simulation curve and the experimental data. In this study, the fatigue damage parameter ðDWPÞT is applied to the predictions of fatigue life. The prediction life is obtained by the ðDWPÞT damage parameter calculated on the basis of the simulated hysteresis loop which has a good correlation with the experimental life.

Keyword：AISI 304 stainless steel; Stable hysteresis loop; Fatigue life; Endochronic theory of plasticity