 ICCES, vol.18, no.1, pp.5-5

Computer simulation on dislocation intermittent motion in the presence of solute atoms

Yansheng He , Qingchuan Zhang, Shihua Fu, Qi Hu

Summary

Abstract: The interaction of dislocation and solute atoms has great influence on the macroscopic mechanical behavior in alloys as well as the deformation of alloys. A dynamic Monte Carlo method is developed to simulate the interaction between dislocation and solute atom. The results show that dislocation motion is retarded by solute atoms in certain conditions. In the condition of constant external stress, the retarding effect of solute atoms becomes more inefficient with the increment of external stress. In the condition of constant stress rate, a step-like curve of the displacement-time indicates the intermittent motion of dislocation exhibiting dynamic strain aging (DSA). When dislocation is captured by solutes, the pinning force on dislocation is become larger because that more and more solutes will gather to the dislocation, and for the increasing of the external stress, the dislocation can de-pin and move fast again, and then during macro work hardening, the driving force on the dislocation will decrease, which induces the dislocation motion discontinuous and the dislocation will be pinned by solutes secondly. The repetition of pinning and de-pinning leads to dynamic strain aging. In addition, the simulation results reflect that DSA occurs only in a certain range of stress rate magnitudes. In the condition of constant strain rate, a serration curve of stress-strain which is similar to Portevin-Le Chatelier (PLC) effect has been drawn. The average stress drop magnitudes decrease with the increment of strain rate or the depreciation of solute concentration and the tendencies are similar to the experimental results.

Key words: dislocation; dynamic strain aging; PLC effect; stress rate; strain rate