Dynamic recrystallization simulation of Ti-6Al-4V alloy during hot compressive deformation by cellular automata method

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Abstract

To accurately predict and optimally control the microstructural evolution during dynamic recrystallization, cellular automata (CA) is used to simulate the microstructure evolution of Ti-6Al-4V alloy during a typical hot compressive deformation process. The material constants for the CA model are obtained from hot compressive flow curves obtained from experimental study at a temperature range from 1000℃ to 1200℃ at an interval of 100℃ and a strain rate range from $0.1S^{-1}$ to $10.0S^{-1}$. To simulate the hot compression, the CA model with dynamic recrystallization (DRX-CA) is developed to predict microstructural evolution of dynamic recrystallization during the hot compressive deformation of Ti-6Al-4V. The developed model has the capability of tracking the deformation history of each cell using dislocation density being an internal variable. The simulation results are compared with the experimental results for validation which have good agreement to each other. They also show that the DRX-CA model established could accurately reflect the relationship between the flow stress, volume fraction recrystallisation and recrystallised grain size and the thermo-mechanical behaviours.

Keywords: Flow stress, Cellular automata, Microstructural evolution, Dynamic recrystallization