Hot compressive deformation behaviour and flow stress prediction of TC4 titanium alloy

†*Fei Han[1], †Rongquan Chen[1], Chunhui Yang[2], Xianmin Li[3]

[1]College of Mechanical and Material Engineering, North China University of Technology, Beijing, 100144, P.R. China

[2]School of Computing, Engineering and Mathematics, University of Western Sydney, Sydney 1797, Australia

[3]BAOTI Group Co., Ltd, Baoji, Shaanxi, 721014, P.R. China

*Presenting author: hanfei@ncut.edu.cn

†Corresponding author: hanfei@ncut.edu.cn, chenrongquan010@163.com

Abstract

To investigate the hot compressive deformation behaviour of TC4 titanium alloy, isothermal compression tests are carried out at a temperature range from 700℃ to 900℃ with an interval of 100℃ and a strain rate range from $0.1S^{-1}$ to $10.0S^{-1}$ using Gleeble-3800 thermo-simulation machine. The experimental results show the flow stress of TC4 titanium alloy increases quickly while the strain increases and reaches a peak value, then decreases to a steady value. It clearly indicates that dynamic recovery and recrystallization occur during hot compression tests. The flow stress of TC4 titanium alloy decreases when the deformation temperature increases and the strain rate decreases. Based on experimental results, a modified material constitutive model of TC4 titanium alloy is developed to include the relations among the flow stress, strain rate and forming temperature with material constants expressed by using a polynomial fitting of strain. The flow stress values predicted by the proposed constitutive model agree well with experimental results. The maximum relative error and average absolute relative error between the predicted and experimental results are 10.56% and 2.88%, respectively. It confirms that the modified constitutive model is suitable to be employed to investigate hot compressive deformation behaviour of TC4 titanium alloy.

Keywords: TC4 titanium alloy, hot compression, flow stress, constitutive model