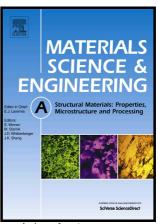
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Characterization of deformation in primary α phase and crack initiation and propagation of TC21 alloy using in-situ SEM experiments

Changsheng Tan¹, Qiaoyan Sun¹*, Lin Xiao¹, Yongqing Zhao², Jun Sun¹

¹State Key Laboratory for Mechanical Behavior of Materials, Xi'an Jiaotong University, Xi'an, Shaanxi, 710049, P.R. China

²Northwest Research Institute of Nonferrous Metals, Xi'an, Shaanxi, 710016, P.R. China

*Corresponding author. Tel.: +86 29 82668614; fax: +86 29 82663453. E-mail address: qysun@mail.xjtu.edu.cn (Qiaoyan Sun).

Abstract:

In present work, the localized deformation, crack initiation and propagation behavior of Ti-6Al-2Sn-2Zr-3Mo-1Cr-2Nb-0.1Si (TC21) titanium alloy was investigated through the in-situ scanning electron microscope (SEM) test and electron backscatter diffraction (EBSD). The results indicate that deformation in α phase is mostly accommodated by the prismatic slip. The localized deformation is concentrated at the interface of primary a lath. Some parallel slip bands with prismatic and pyramidal slip are prevalent in primary α lath, while the multiple slip bands with prismatic slip are dominant in equiaxed primary α phase. Higher ability to coordinate local plastic strain (nearly to 79.5%) is induced in equiaxed α than the primary α lath (7.9%). Most of the cracks easily initiate at the shear bands in primary α lath, which is a fatal site for the tensile deformation. The main crack propagates quickly along the shear bands or interfaces of α lath and then penetrates into the β_{trans} matrix and also transfers across the equiaxed a phase along the slip bands. The results indicate that the high compatibility of deformation in equiaxed primary α phase delays the initial crack nucleation. Whereas, it does not show satisfied resistance against crack propagation in front of the main crack tip due to the abundant slip bands.

Keywords: TC21 titanium alloy; Localized deformation; In-situ SEM test; Crack initiation; Crack propagation

1. Introduction

Due to the low density, high strength and high corrosion resistance, titanium alloys have been applied widely to aircraft structures and engines [1,2,3]. It has been

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