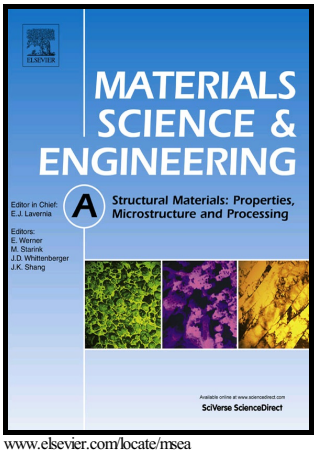
Characterization of deformation in primary α phase and crack initiation and propagation of TC21 alloy using in-situ SEM experiments

Changsheng Tan, Qiaoyan Sun, Lin Xiao, Yongqing Zhao, Jun Sun



www.elsevier.com/locate/msea

PII: S0921-5093(18)30494-5
DOI: https://doi.org/10.1016/j.msea.2018.03.123
Reference: MSA36316

To appear in: *Materials Science & Engineering A*

Received date: 11 February 2018
Revised date: 29 March 2018
Accepted date: 30 March 2018

Cite this article as: Changsheng Tan, Qiaoyan Sun, Lin Xiao, Yongqing Zhao and Jun Sun, Characterization of deformation in primary α phase and crack initiation and propagation of TC21 alloy using in-situ SEM experiments, *Materials Science & Engineering A,* https://doi.org/10.1016/j.msea.2018.03.123

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

Changsheng Tan[1], Qiaoyan Sun[1], Lin Xiao[1], Yongqing Zhao[2], Jun Sun[1]*

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

[2]*Northwest 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 α 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 α 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