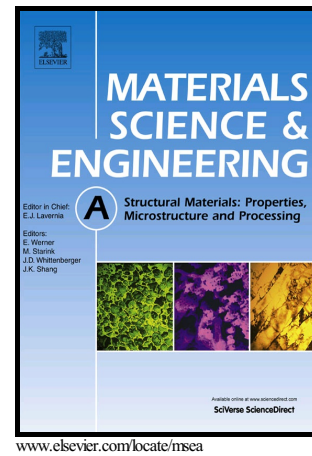


Author's Accepted Manuscript

Cyclic Deformation and Microcrack Initiation
During Stress Controlled High Cycle Fatigue of a
Titanium Alloy

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



PII: S0921-5093(17)31468-5
DOI: <https://doi.org/10.1016/j.msea.2017.11.019>
Reference: MSA35734

To appear in: *Materials Science & Engineering A*

Received date: 31 July 2017
Revised date: 4 November 2017
Accepted date: 7 November 2017

Cite this article as: Changsheng Tan, Qiaoyan Sun, Lin Xiao, Yongqing Zhao and Jun Sun, Cyclic Deformation and Microcrack Initiation During Stress Controlled High Cycle Fatigue of a Titanium Alloy, *Materials Science & Engineering A*, <https://doi.org/10.1016/j.msea.2017.11.019>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

Cyclic Deformation and Microcrack Initiation During Stress Controlled High Cycle Fatigue of a Titanium Alloy

Changsheng Tan¹, Qiaoyan Sun^{1*}, Lin Xiao¹, Yongqing Zhao², Jun Sun¹

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:

Cyclic plastic deformation, slip characteristics and crack nucleation in Ti-6Al-2Sn-2Zr-3Mo-1Cr-2Nb-0.1Si (TC21) with different morphologies of equiaxed and lamellar α phase were systematically analyzed during high-cycle fatigue. The heterogeneous plastic deformation could take place within different α morphologies during high-cycle fatigue even though the cyclic stress amplitude is much less than yield strength. Slip is the dominant deformation mode in the equiaxed primary α , while the slip and $(10\bar{1}1)$ deformation twin are prevalent in the primary α lath. Interactions between slip, twin and interface result in ledges at the primary α lath interface. The relationship between cyclic slip irreversibility, accumulated irreversible strain, and fatigue life is established. A critical parameter, accumulated irreversible strain per area in the crack initiation region (region I), was calculated to be $(8.1\pm 2)\times 10^{-4}\cdot\mu\text{m}^{-2}$ for initiating fatigue crack. Fatigue cracks will nucleate when the accumulated irreversible strain exceeds the critical value. The primary α lath is the dominant site for crack initiation. The cracks initiate and propagate in interface and slip band, and easily connect each other in the primary α lath. In comparison, most cracks lie within an individual or occupy several equiaxed α phases and often cease in front of the phase boundary, which delays the connection of microcracks. It indicates that the primary α lath is more detrimental than the equiaxed primary α phase during high cycle fatigue.

Keywords: Titanium alloy; High-cycle fatigue; Slip irreversibility; Fatigue crack initiation

Download English Version:

<https://daneshyari.com/en/article/7974223>

Download Persian Version:

<https://daneshyari.com/article/7974223>

[Daneshyari.com](https://daneshyari.com)