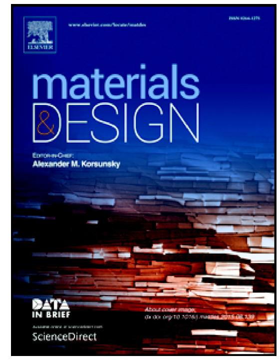

Vickers microhardness and microstructure relationship of Ti-6Al-4V alloy under cyclic forward-reverse torsion and monotonic torsion loading

Xinkai Ma, Fuguo Li, Jun Cao, Jinghui Li, Han Chen, Chen Zhao

PII: S0264-1275(16)31416-2
DOI: doi: 10.1016/j.matdes.2016.11.028
Reference: JMADE 2464

To appear in: *Materials & Design*

Received date: 13 August 2016
Revised date: 4 November 2016
Accepted date: 7 November 2016

Please cite this article as: Xinkai Ma, Fuguo Li, Jun Cao, Jinghui Li, Han Chen, Chen Zhao , Vickers microhardness and microstructure relationship of Ti-6Al-4V alloy under cyclic forward-reverse torsion and monotonic torsion loading. The address for the corresponding author was captured as affiliation for all authors. Please check if appropriate. Jmade(2016), doi: 10.1016/j.matdes.2016.11.028

Vickers microhardness and microstructure relationship of Ti-6Al-4V alloy under cyclic forward-reverse torsion and monotonic torsion loading

Xinkai Ma, Fuguo Li*, Jun Cao, Jinghui Li, Han Chen, Chen Zhao

State Key Laboratory of Solidification Processing, School of Materials Science and Engineering, Northwestern Polytechnical University, Xi'an 710072, China

*Corresponding Author: Fuguo Li

Tel.: +86 29 88474117; fax: +86 29 88492642; Email: fuguolx@nwpu.edu.cn

Abstract: The effect of strain reversal on the hardening and grain refinement of Ti-6Al-4V alloy due to cyclic forward-reverse torsion (CFRT) has been investigated in this study by twisting the bars with different strain reversal amplitude. The results showed that microhardness and its distribution were very sensitive to CFRT and increased distinctly after pre-CFRT pure shear deformation. It was observed that the ultimate microhardness and homogeneity were superior for CFRT as compared to monotonic torsion (MT), while the hardenability exponent of MT is higher than CFRT. Besides microhardness in the center layer and surface layer of a bar exhibited different evolutionary process with the increasing amplitude of strain reversal. Grain refinement induced by latticed dislocation tangle and work hardening enhanced by strain gradient were also discussed to reveal the evolution of microstructure and microhardness.

Keywords: Ti-6Al-4V alloy; cyclic forward-reverse torsion; strain reversal hardening; latticed dislocation zones

1. Introduction

Titanium and its alloys, especially Ti-6Al-4V alloy, have been widely used in industrial applications such as aerospace, automotive, marine and biomedical because of low density, high strength and excellent toughness[1]. As grain refining is a very effective way to improve the mechanical properties of materials, more and more attention has been attracted on the severe plastic deformation (SPD) techniques due to their ability to refine the grains in polycrystalline materials down to sub-micrometer or the nanometer level[2-4]. Grain refinement is dependent on not only alloy compositions but also the strain paths applied during SPD processing and different SPD methods impart different strain paths [5]. Popular SPD methods include equal channel