The effect of the beta phase on the micromechanical response of dual-phase titanium alloys

Patrick J. Ashton, Tea-Sung Jun, Zhen Zhang, T. Benjamin Britton, Annette M. Harte, Sean B. Leen, Fionn P.E. Dunne

PII: S0142-1123(17)30138-X
DOI: http://dx.doi.org/10.1016/j.ijfatigue.2017.03.020
Reference: JIJF 4283

To appear in: *International Journal of Fatigue*

Received Date: 24 October 2016
Revised Date: 20 March 2017
Accepted Date: 22 March 2017

Please cite this article as: Ashton, P.J., Jun, T-S., Zhang, Z., Benjamin Britton, T., Harte, A.M., Leen, S.B., Dunne, F.P.E., The effect of the beta phase on the micromechanical response of dual-phase titanium alloys, *International Journal of Fatigue* (2017), doi: http://dx.doi.org/10.1016/j.ijfatigue.2017.03.020

The effect of the beta phase on the micromechanical response of dual-phase titanium alloys

Patrick J. Ashton [a], Tea-Sung Jun [b], Zhen Zhang [c], T. Benjamin Britton [c], Annette .M. Harte [d], Sean B. Leen [a], Fionn P.E. Dunne [c]

[a] Mechanical Engineering, National University of Ireland, Galway, Ireland

[b] Department of Mechanical Engineering, Incheon National University, Incheon, Republic of Korea

[c] Department of Materials, Imperial College, London, UK

[d] Civil Engineering, National University of Ireland, Galway, Ireland

Abstract

This paper investigates the role of beta phase on the micro-mechanical behaviour of dual-phase titanium alloys, with particular emphasis on the phenomenon of cold dwell fatigue, which occurs in such alloys under room temperature conditions. A strain gradient crystal plasticity model is developed and calibrated against micro-pillar compression test data for a dual-phase alpha-beta specimen. The effects of key microstructural variables, such as relative beta lath orientation, on the micromechanical response of idealised alpha-beta colony microstructures are shown to be consistent with previously-published test data. A polycrystal study on the effects of the calibrated alpha-beta crystal plasticity model on the local micromechanical variables controlling cold dwell fatigue is presented. The presence of the alpha-beta phase is predicted to increase dwell fatigue resistance compared to a pure alpha-phase microstructure.