MONASH
ENGINEERING

MONASH University

Faculty of Engineering - Summer Research Program 2023-2024

Project Title: Grain boundaries with a twist in titanium alloys

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Objective

Titanium alloys are widely used by the aerospace, chemical and medical sector due to their high strength in combination with relatively low weight, excellent corrosion resistant and biocompatibility. One of the very recent discoveries in this field has been that most fatigue cracks that form in typical Ti-alloys initiate from a certain type of grain boundary, a so-called twisted grain boundary. The objective of this summer project is to explore the formation of twisted grain boundaries by processing and heat treating a commercial titanium alloy and quantify the number of twisted grain boundaries by using a well-established electron microscopy technique.

Project Details

Ti-alloys are typically thermomechanically processed to achieve a refined microstructure with a good balance of mechanical properties. Part of such processing is the breakup of a coarse lamellar microstructure resulting in a refined equiaxed or duplex microstructure, Fig. 1. However, as discovered very recently, this process creates a certain type of grain arrangement/grain boundary type that promotes fatigue crack initiates. To understand the route cause for the so-called twisted grain boundary formation, the summer student will work with small Ti-6Al-4V samples extracted from a forging, create a lamellar microstructure as the starting point before hot compressing to different levels of plastic strain followed by recrystallisation heat treatment. The next step will require samples preparation from such systematic test matrix to undertake scanning electron microscopy-based analysis to characterize the density of twisted grain boundaries for each condition. The summer student will be strongly supported by a post-doctoral research fellow who recently completed her PhD within the department. The student will also become a member of a dynamic Metallurgy and Corrosion cluster that brings together a number of academics from the Department of Materials Science and Engineering.

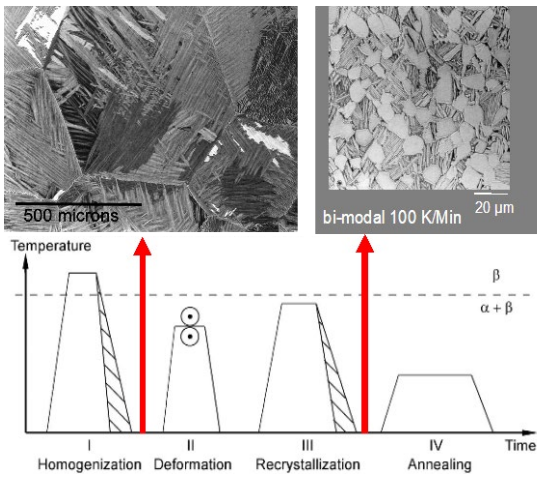

Fig. 1: thermomechanical process and resulting microstructures.

Prerequisites

Students should have an interest in metallurgy and microstructure characterization. MTE2101, MTE2102, MTE2103 and MTE3102 are recommended prerequisites.

Additional Information

It is strongly recommended for any person interested in this project to get in touch with Michael Preuss for further discussion. As the findings are also likely to be of great interest to industry, there is a distinct possibility that the student will be able to present their findings to Timet (titanium alloy manufacturer) and Rolls-Royce (aeroengine manufacturer), UK, Defense Science and Technology and CSIRO in Australia.