Crack closure modification in dwell-fatigue

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Abstract

The phenomenon of dwell-fatigue at ambient temperature has been a concern to the aircraft industry for over three decades. However, most laboratory fatigue tests are time-independent, where any load hold effect on fatigue growth has not been considered. Thus, there is a clear need to investigate fatigue under dwell conditions. The aim of the experimental procedure described in the paper will be to examine the effect of dwell on crack closure behaviour using a compact tension (CT) specimen. The experiment will be set up using a Deben loading stage and images are obtained using an Alicona microscope. Rather than applying a constant amplitude and constant frequency loading throughout the procedure as in a typical fatigue test, the load will be held at the maximum and/or minimum value after a specified number of cycles for a chosen dwell-time. Several tests with different dwell times will be carried out and the results will be analysed by utilising digital image correlation (DIC). A typical graph of crack propagation length against the number of cycles under constant amplitude load shows a gradually increasing trend. Whereas previous investigations that suggest that when dwell-fatigue is adopted, the rate will increase, with a consequent effect on overall life.

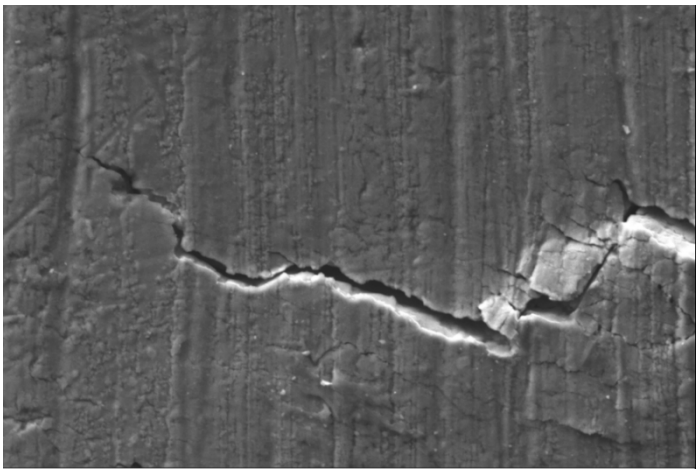

Fig1: The image of a crack tip from the Alicona at the load hold of 1250N

The paper will particularly look at the behaviour of crack closure under dwell fatigue for Ti-6/4 alloy. Since the crack propagation rate changes with the dwell time, there is a modification of the initial part of the relationship between load and crack opening displacement. The paper will compare the results with those for constant amplitude loading, and suggest reasons for the modification.

References

[1] *R.P. Wei and Z. Huang, Influence of dwell time on fatigue crack growth in nickel-base superalloys, Materials Science and Engineering: A Volume 336, Issues 1–2, 25 October 2002, Pages 209-214*