

# 琉球大学学術リポジトリ

## Evaluation of Fatigue Life based on Crack Growth Behavior

メタデータ	言語: 出版者: 琉球大学 公開日: 2014-09-25 キーワード (Ja): キーワード (En): 作成者: フェルドス, エムディ ショフィール メールアドレス: 所属:
URL	<a href="http://hdl.handle.net/20.500.12000/29677">http://hdl.handle.net/20.500.12000/29677</a>

論 文 要 旨

Abstract

論文題目

Title: Evaluation of Fatigue Life based on Crack Growth Behavior

(き裂成長挙動に基づく疲労寿命の評価)

This dissertation is concern with the improvement technique of crack growth behavior and fatigue life of engineering metals and light alloys having notch and slit. A series of tests were conducted in aluminum alloy 2024-T3 to investigate the effect of additional holes and notches on the fatigue behavior of double hole specimens. Also, circular pins were inserted into the additional holes, but not removed before testing in some cases. Basic specimen has dual holes and their cracks interacted with the specimen edge. This part describes how the improvement of fatigue life in the shorter life case of a basic specimen was examined by applying additional holes or notches. A method of enhancement of fatigue life of notched material is discussed in the present study. Also, the improvement of acceleration behavior of crack growth was investigated with constant stress amplitude under negative stress ratio  $R=-1$ . Then a technical method to detect the fatigue crack growth was discussed. Stop-holes were drilled at crack tips or in the vicinity of the crack tips to remove the plastic zone and the effect of that on crack growth behavior were investigated. Steel pins were inserted into the stop-holes and its effect was discussed. Finite element method (FEM) was used to analyze the stress concentration at the edge of stop-holes. Specially, it was discussed whether the crack growth behavior was improved or not in the case of relatively smaller width by both the experimental and analytical results. In another case, a method of improving the fatigue life and crack growth behavior of a center holed specimen was investigated. Local plastic deformation was applied around the hole by indentation on both sides of the specimen to achieve the purpose. From the experimental results, it was found that the fatigue life and crack growth behavior of a holed or notched specimen can be improved by a simple technical method that is related to the local plastic working. Also, the role of small cracks on fatigue life and loss of ductility were discussed to understand the reality of fatigue damage in low cycle fatigue. The series of low cycle fatigue tests were carried out focusing on elucidating the reality of fatigue damage. These tests showed that the fatigue lives were pronouncedly extended by removing crack surface layer. Also, it was quantified that the loss of fracture ductility is correlated with crack length but not with the number of fatigue cycles. This study will discuss about the importance of the behavior of small cracks to explain the concept of fatigue phenomenon.

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