MATEC Web of Conferences **12**, 04025 (2014)
DOI: 10.1051/matecconf/20141204025

Mean stress effect under Multi-Axial High Cycle Fatigue loading for cast A356-T6 alloy

M. Iben Houria[1], Y. Nadot[2], R. Fathallah[1], M.J. Roy[3] and D.M. Maijer[3]

[1]Laboratoire de Génie Mécanique, Ecole Nationale d'Ingénieurs de Monastir, Avenue Ibn El Jazzar, 5019 Monastir, Tunisia
[2]ISAE-ENSMA – UPR CNRS 3346, Institut Pprime, Département Physique et Mécanique des Matériaux, Téléport, 2, Avenue Clément Ader, BP. 40 109, 86961 Futuroscope, France
[3]Dept. of Materials Engineering, The University of British Columbia, Vancouver, BC, Canada V6T 1Z4

Abstract. Mechanical engineers are submitted to the antagonistic criteria when designing security components, such as, used in aeronautic, automotive and industrial components. They have to look for solutions leading to have as less as possible the weight, cost and in the same time as more as possible the security under complex and severe conditions of use. They consider fatigue to be the most common mechanism which causes components fail. In this context, cast A356-T6, which presents a good casting properties and mechanical strength resistance, will be studied in this paper.

This work presents an experimental investigation to characterise the effect of mean stress on the Multiaxial High Cycle Fatigue (HCF) of cast A356-T6 alloy containing natural and artificial defects with various Secondary Dendrite Arming Spacing (SDAS). Traction, torsion and combined traction-torsion fatigue tests have been carried for two loading ratio $R_\sigma = 0$ and $R_\sigma = -1$. The fractured surfaces are analyzed through fractographic Scanning Electron Microscope (SEM) in order to determine the defect causing failure. To study the effect of the mean stress, the results are reported in kitagawa diagrams and Goodman diagrams for all the studied cases. In order to characterise qualitatively the effects of the defect size and SDAS, surface response method has been used. Interesting relationships and correlations have been obtained and introduced to improve the defect stress gradient (DSG) criterion for such defective material.

The obtained results show clearly that: (i) the mean stress has detrimental, it is more significant in tension, lesser in tension-torsion case and slightly in torsion tests. (ii) The improved DSG criterion describes very well the trend of the fatigue limit as a function of defect size and SDAS.