

Author's Accepted Manuscript

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PII: S0921-5093(18)30687-7
DOI: <https://doi.org/10.1016/j.msea.2018.05.037>
Reference: MSA36475

To appear in: *Materials Science & Engineering A*

Received date: 5 April 2018
Accepted date: 10 May 2018

Cite this article as: Sunil Goyal, K. Mariappan, Vani Shankar, R. Sandhya, K. Laha and A.K. Bhaduri, Studies on creep-fatigue interaction behaviour of Alloy 617M, *Materials Science & Engineering A*, <https://doi.org/10.1016/j.msea.2018.05.037>

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Studies on creep-fatigue interaction behaviour of Alloy 617M

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Abstract

In this investigation, response of Alloy 617M to creep-fatigue interaction loading has been studied. The creep-fatigue interaction tests were conducted in air environment at a constant strain rate of $3 \times 10^{-3} \text{ s}^{-1}$ and strain amplitude of $\pm 0.4\%$ with hold periods of 1 min, 10 min and 30 min at peak tension or compression at 973 K. The material showed initial hardening to a saturation followed by reduction in stress initiated by crack nucleation, propagation and final failure. The fatigue life decreased in presence of hold period. The decrease in fatigue life was more in tensile hold than in compressive hold. The fatigue life showed saturating trend for higher hold periods. Fractographic studies revealed significant intergranular creep cavitation under tensile hold whereas compressive hold exhibited transgranular fatigue striations in association with intergranular creep cavitation. Significant stress relaxation was found to take place during hold and was more in compressive hold than under tensile hold. The creep and fatigue damage have been assessed based on linear damage summation rule. Creep damage fraction was assessed from the stress relaxation considering the average stress, minimum stress and integrated stress over the relaxation curve. The creep-fatigue damage assessment considering integration of creep damage during stress relaxation showed most conservative compared to the other two approaches.

Keywords: Creep-fatigue interaction; Alloy 617M; Stress relaxation; Mean stress; Creep-fatigue damage assessment

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