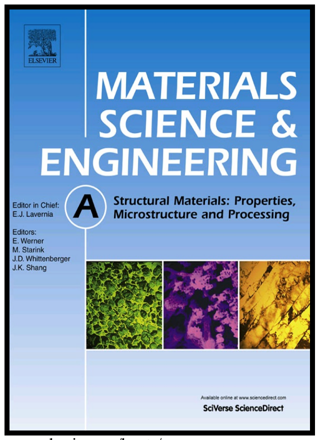
Author’s Accepted Manuscript



www.elsevier.com/locate/msea

Insights into dynamic strain aging under cyclic creep with reference to strain burst: Some new observations and mechanisms. Part-1: Mechanistic Aspects

Aritra Sarkar, A. Nagesha, P. Parameswaran, R. Sandhya, K. Laha

PII: S0921-5093(16)30160-5
DOI: http://dx.doi.org/10.1016/j.msea.2016.02.043
Reference: MSA33348

To appear in: *Materials Science & Engineering A*

Received date: 26 October 2015
Revised date: 8 February 2016
Accepted date: 14 February 2016

Cite this article as: Aritra Sarkar, A. Nagesha, P. Parameswaran, R. Sandhya anc K. Laha, Insights into dynamic strain aging under cyclic creep with reference t strain burst: Some new observations and mechanisms. Part-1: Mechanisti Aspects, *Materials Science & Engineering A* http://dx.doi.org/10.1016/j.msea.2016.02.043

Insights into dynamic strain aging under cyclic creep with reference to strain burst: Some new observations and mechanisms. Part-1: Mechanistic Aspects

Aritra Sarkar[1]*, A. Nagesha[1], P. Parameswaran[2], R. Sandhya[1] and K. Laha[1]

[1]Mechanical Metallurgy Division, Indira Gandhi Centre for Atomic Research, Kalpakkam-603102, Tamil Nadu, India

[2]Materials Synthesis and Structural Characterization Division, Indira Gandhi Centre for Atomic Research, Kalpakkam-603102, Tamil Nadu, India

[*] Corresponding Author. Ph: +91-44-27480500 ext. 21212 email: aritra@igcar.gov.in

Abstract

Investigations on the cyclic creep behavior of 316LN austenitic stainless steel (SS) are carried out at 823 K as a function of mean stress (σ_m), stress amplitude (σ_a) and stress rate. Strain burst was found to be a common observation at 823 K, which is attributed to the periodic locking and unlocking of dislocations in regular intervals under pronounced influence of dynamic strain aging (DSA). Three distinct stages are identified in the cyclic creep curve based on total accumulated strain or cyclic life. Strain accumulated or life spent in these stages is found to be a strong function of the loading condition (σ_m - σ_a - stress rate combinations). *Critical strain* and *threshold cycles* for the occurrence of a strain burst were found to have a negative mean stress dependence for fixed σ_a and stress rate and positive stress rate dependence for fixed σ_a and σ_m. Frequent appearance of strain bursts towards the end of life results in excessive geometric softening with clear implications on the failure mode which changes from fatigue failure to creep (necking) in specific cases. Dominant damage modes (cyclic hardening/mean stress dependent hardening or geometric softening/fatigue softening) observed under different loading conditions in cyclic creep in particular where strain burst is prominent is illustrated through a map. Characteristic steps in the form of "spider-web" patterns marking sudden increase in the rate of Stage-II crack propagation is noticed on the fracture surface which is a signature of strain bursts occurring during cyclic creep.

Keywords: *strain burst, DSA, cyclic creep, 316LN SS*

1.0 Introduction

Discontinuous plastic deformation during tensile or cyclic loading is a widely researched topic in the last decades [1-20]. Characteristic feature of such discontinuity can be categorized into (a) yield-drop and/or jerky flow (serrated yielding) in monotonic tensile tests or (b) serrations appearing in stress-strain hysteresis loops in total strain controlled low cycle fatigue (LCF) tests. The above phenomenon was mainly attributed to the periodic locking-unlocking of dislocations by solute atoms in a solid solution, which is known as dynamic strain aging (DSA) or Portevin-Le Chatelier (PLC) effect [1-10]. It may be noted that manifestations of DSA in the form of serrations are most prominent at some