Non-propagating fatigue cracks in austenitic steels with a micro-notch: Effects of dynamic strain aging, martensitic transformation, and microstructural hardness heterogeneity

Yuri Nishikura, Motomichi Koyama, Yusuke Yamamura, Takuro Ogawa, Kaneaki Tsuzaki, Hiroshi Noguchi

PII: S0142-1123(18)30165-8
DOI: https://doi.org/10.1016/j.ijfatigue.2018.04.027
Reference: JIJF 4666

To appear in: *International Journal of Fatigue*

Received Date: 22 February 2018
Revised Date: 12 April 2018
Accepted Date: 25 April 2018

Please cite this article as: Nishikura, Y., Koyama, M., Yamamura, Y., Ogawa, T., Tsuzaki, K., Noguchi, H., Non-propagating fatigue cracks in austenitic steels with a micro-notch: Effects of dynamic strain aging, martensitic transformation, and microstructural hardness heterogeneity, *International Journal of Fatigue* (2018), doi: https://doi.org/10.1016/j.ijfatigue.2018.04.027

Non-propagating fatigue cracks in austenitic steels with a micro-notch: Effects of dynamic strain aging, martensitic transformation, and microstructural hardness heterogeneity

Yuri Nishikura[a], Motomichi Koyama[a*], Yusuke Yamamura[a], Takuro Ogawa[a], Kaneaki Tsuzaki[a], and Hiroshi Noguchi[a]

Kyushu University, Motooka 744, Nishi-ku, Fukuoka, Fukuoka, 819-0395 Japan

Corresponding author: Motomichi Koyama, e-mail: koyama@mech.kyushu-u.ac.jp

Abstract

The non-propagation limit of a microstructurally small fatigue crack was investigated with respect to dynamic strain aging (DSA), martensitic transformation, and microstructural hardness heterogeneity. In this study, we selected four model alloys: Fe-19Cr-8Ni-0.05C, Fe-19Cr-8Ni-0.14C, Fe-23Mn-0.5C, and as-hot-rolled Fe-30Mn-3Si-3Al steels. Transformation-induced cyclic hardening results in the most significant improvement of the non-propagation limit, i.e., in the case of the Fe-19Cr-8Ni-0.05C steel. Within different contexts, DSA, transformation-induced crack closure, and hardness-heterogeneity-enhanced plasticity-induced crack closure could also realize superior non-propagation limits. The effects of DSA and hardness heterogeneity can be combined with the effects of transformation, which is expected to create a new venue of material design and selection in terms of the crack non-propagation limit.

Keywords: Non-propagating fatigue crack; austenitic steel; high cycle fatigue; martensitic transformation; dynamic strain aging