

## Author's Accepted Manuscript

The role of intergranular fracture on hydrogen-assisted fatigue crack propagation in pure iron at a low stress intensity range

Yuhei Ogawa, Domas Birenis, Hisao Matsunaga, Osamu Takakuwa, Junichiro Yamabe, Øystein Prytz, Annett Thøgersen



PII: S0921-5093(18)30939-0  
DOI: <https://doi.org/10.1016/j.msea.2018.07.014>  
Reference: MSA36678

To appear in: *Materials Science & Engineering A*

Received date: 22 May 2018

Accepted date: 5 July 2018

Cite this article as: Yuhei Ogawa, Domas Birenis, Hisao Matsunaga, Osamu Takakuwa, Junichiro Yamabe, Øystein Prytz and Annett Thøgersen, The role of intergranular fracture on hydrogen-assisted fatigue crack propagation in pure iron at a low stress intensity range, *Materials Science & Engineering A*, <https://doi.org/10.1016/j.msea.2018.07.014>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting galley proof before it is published in its final citable form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## The role of intergranular fracture on hydrogen-assisted fatigue crack propagation in pure iron at a low stress intensity range

Yuhei Ogawa<sup>a,b</sup>, Domas Birenis<sup>c</sup>, Hisao Matsunaga<sup>d,e,f,g</sup>, Osamu Takakuwa<sup>d,e,g</sup>, Junichiro Yamabe<sup>g,h</sup>,  
Øystein Prytz<sup>c</sup>, Annett Thøgersen<sup>i</sup>

<sup>a</sup> Graduate School of Engineering, Kyushu University, 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

<sup>b</sup> Research Fellow of the Japan Society for the Promotion of Science, 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

<sup>c</sup> Department of Physics, Centre for Materials Science and Nanotechnology, University of Oslo, PO Box 1048 - Blindern, NO-0316 Oslo, Norway

<sup>d</sup> Department of Mechanical Engineering, Kyushu University, 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

<sup>e</sup> Research Center for Hydrogen Industrial Use and Storage (HYDROGENIUS), Kyushu University, 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

<sup>f</sup> International Institute for Carbon-Neutral Energy Research (I2CNER), Kyushu University, 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

<sup>g</sup> AIST-Kyushu University Hydrogen Materials Laboratory (HydroMate), 744 Motoooka, Nishi-ku, Fukuoka 819-0395, Japan

<sup>h</sup> Department of Mechanical Engineering, Fukuoka University, 8-19-1 Nanakuma, Jonan-ku, Fukuoka 814-0180, Japan

<sup>i</sup> SINTEF Materials and Chemistry, PO Box 124 - Blindern, NO-0314 Oslo, Norway

\*Corresponding Author. [yuhei.ogawa.bz@gmail.com](mailto:yuhei.ogawa.bz@gmail.com)

### Abstract

Hydrogen-assisted fatigue crack growth (HAFCG) in pure iron at a relatively low stress intensity range exhibits brittle-like intergranular (IG) fracture, while the macroscopic crack acceleration is not significant. The present study focuses on the mechanism of IG fracture in terms of the microscopic deformation structures near the crack propagation paths. We found that the IG fracture is attributed to hydrogen-enhanced dislocation structure evolution and subsequent microvoid formation along the grain boundaries. The impact of such IG cracking on the macroscopic fatigue crack growth (FCG) acceleration is evaluated according to the dependency of IG fracture tendency on the hydrogen gas pressure during testing. It is demonstrated for the first time that increased hydrogen pressure results in a larger fraction of IG fracture and correspondingly faster FCG. On the other hand, the gaseous hydrogen environment also has a positive role in decelerating the FCG rate relative to air due to the absence of oxygen and water vapor. The macroscopic crack propagation rate in hydrogen gas is eventually determined by the competition between the said positive and negative influences.

Download English Version:

<https://daneshyari.com/en/article/7971654>

Download Persian Version:

<https://daneshyari.com/article/7971654>

[Daneshyari.com](https://daneshyari.com)