

Author's Accepted Manuscript

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PII: S0921-5093(15)30770-X
DOI: <http://dx.doi.org/10.1016/j.msea.2015.12.080>
Reference: MSA33163

To appear in: *Materials Science & Engineering A*

Received date: 25 September 2015
Revised date: 24 December 2015
Accepted date: 24 December 2015

Cite this article as: H.C. Wu, B. Yang, S.L. Wang, M.X. Zhang, Y.Z. Shi, Y.F. Chen and Y.H. Sun, Effect of thermal aging on corrosion fatigue of Z3CN20.09M duplex stainless steel in high temperature water, *Materials Science & Engineering A*, <http://dx.doi.org/10.1016/j.msea.2015.12.080>

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Effect of thermal aging on corrosion fatigue of Z3CN20.09M duplex
stainless steel in high temperature water

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Abstract: The effects of 475 °C embrittlement on the corrosion fatigue (CF) in 290 °C water, mechanical and corrosion properties of Z3CN20.09M duplex stainless steel (DSS) were investigated. The results indicated that the hardness and modulus of the ferrite in this steel increased while the impact energy and corrosion resistance decreased with increasing aging time. It is interesting that these results were reversed when the aging time is up to 2000 h, suggesting that a self-healing behavior was occurred probably. The CF life of the specimens decreased with increasing aging time, which attributed to a combined effect of the deteriorated mechanical and corrosion properties subjected by the thermal aging.

Keywords: Duplex stainless steel; Corrosion fatigue; Age hardening; Spinodal decomposition

1. Introduction

Duplex stainless steels (DSSs) consisting of austenite and ferrite phases are extensively used in chemical industries, marine engineering and nuclear power plants due to their outstanding corrosion resistance and mechanical properties [1-8]. However, thermal aging is often occurred in the DSSs when they are being served at temperatures between 200 °C and 550 °C especially at near 475 °C for a long time [2, 9, 10]. The phenomenon is often attributed to a precipitation of the Cr-rich α' phase and Fe-rich α phase during the spinodal decomposition of the ferrite phase. Also, the Ni- and Si-rich G phase could be precipitated during the process [9-11].

Undoubtedly, the thermal aging process can deteriorate the mechanical and corrosion properties of the DSSs. On the one hand, the impact toughness and fatigue life of the DSSs as well as the hardness and modulus of the ferrite will be decreased

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