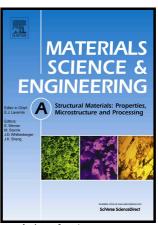
Author's Accepted Manuscript

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www.elsevier.com/locate/msea

PII: S0921-5093(16)30318-5

DOI: http://dx.doi.org/10.1016/j.msea.2016.03.103

Reference: MSA33498

To appear in: Materials Science & Engineering A

Received date: 19 December 2015 Revised date: 22 February 2016 Accepted date: 21 March 2016

Cite this article as: Walter L. Costin, Olivier Lavigne and Andrei Kotousov, A study on the relationship between microstructure and mechanical properties o acicular ferrite and upper bainite, Materials Science & Engineering A http://dx.doi.org/10.1016/j.msea.2016.03.103

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A study on the relationship between microstructure and mechanical properties of

acicular ferrite and upper bainite

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Abstract

Acicular ferrite and bainite are microstructural constituents commonly found in ferritic

weld metal and many other ferrous alloys, in highly localised volumes. These

constituents are known to have a significant impact on the mechanical properties of the

bulk material. It is well established that acicular ferrite and bainite have substantially

different morphologies and features, which determine their intrinsic mechanical

behaviour. This work utilises micro-testing techniques to evaluate and compare the

mechanical properties of these two micro-constituents with an ultimate objective to

understand their impact on bulk properties of ferrous alloys. Microscopic regions

consisting of either acicular ferrite or upper bainite were first selected and then

characterised using a high resolution Scanning Electron Microscope (SEM) and

Electron Backscattered Diffraction (EBSD). Conventional nano-indentation and an

advanced characterisation procedure were implemented to evaluate elastic modulus,

yield strength, hardness and strain hardening exponent of both micro-constituents. The

fracture resistance was estimated from micro-fracture tests that were conducted within

these selected regions. The experimental studies have indicated that, at the micro-scale,

despite their different microstructures, acicular ferrite and upper bainite have very

similar mechanical properties. Nevertheless, the fracture resistance of upper bainite was

more dominated by the contribution of plastic deformations.

Keywords: EBSD; mechanical characterization; nano-indentation; bainite; acicular

ferrite; fracture.

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