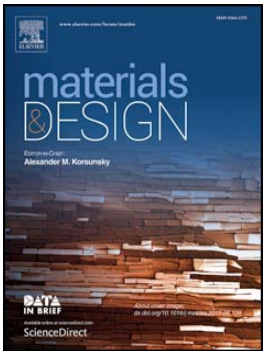

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PII: S0264-1275(16)31281-3
DOI: doi: 10.1016/j.matdes.2016.09.097
Reference: JMADE 2347

To appear in:

Received date: 27 June 2016
Revised date: 24 September 2016
Accepted date: 27 September 2016

Please cite this article as: X.J. Shen, S. Tang, J. Chen, Z.Y. Liu, R.D.K. Misra, G.D. Wang, Grain refinement in surface layers through deformation-induced ferrite transformation in microalloyed steel plate, (2016), doi: 10.1016/j.matdes.2016.09.097

Grain refinement in surface layers through deformation-induced ferrite transformation in microalloyed steel plate

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Abstract

A novel thermo-mechanical process was adopted to obtain deformation-induced ultrafine-grained ferrite in the surface layers of a microalloyed steel plate. The new process referred as rolling coupling water-cooling control process applies water-cooling in the midst of rolling. Deformation-induced ferrite transformation led to ultrafine ferrite grains (1 – 3 μm) in the surface layer of the plate, with ultrafine-grained layer accounting to ~13.5% of the total thickness of the plate. In the mid-thickness, relatively coarse ferrite grains (~7.8 μm) and pearlite microstructure was obtained. The ductile-brittle transition temperature corresponding to the ultrafine-grained structure was -118 ^{o}C and excellent toughness was obtained in the surface layer such that the average impact toughness of the complete plate was high. The mechanism of formation of ultrafine-grained structure at the surface is elucidated.

Keywords: Microalloyed steel plate; toughness; rolling coupling water-cooling control process; deformation-induced ferrite transformation; ultrafine ferrite.