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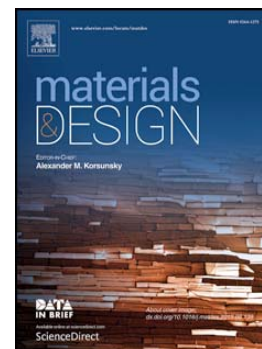
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**Grain refinement in surface layers through
deformation-induced ferrite transformation in microalloyed steel plate**

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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 °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.

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