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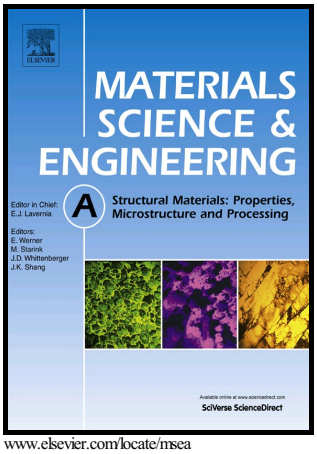

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The toughening mechanisms of microstructural variation and Ni addition in direct-cooled microalloyed ferrite-pearlite steels

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Abstract:

The toughening mechanisms of microstructural variation and Ni addition were investigated in two direct-cooled microalloyed ferrite-pearlite steels by using the U-notched Charpy tests. Results show that the impact toughness of the low Ni steel decreases dramatically from 110 J to 20 J when the prior austenite grain size increases from 10 μm to 37 μm, and then stays unchanged as the prior austenite grain size continues increasing from 37 μm to 90 μm. When the prior austenite grains are finer than 37μm, the cleavage fracture is much postponed and the area of ductile fracture is much enlarged by the significantly improved ability to perform plastic deformation. When the prior austenite grains are coarse, the energy absorbed by cleavage, which is the main mode of fracture, conforms to the Griffith type equation and is much less compared to that consumed by ductile fracture, leading to the low impact toughness. The cumulative effect of ferrite content and pearlite interlamellar spacing on impact toughness is not obvious, because their influences are contradictory as the cooling rate is