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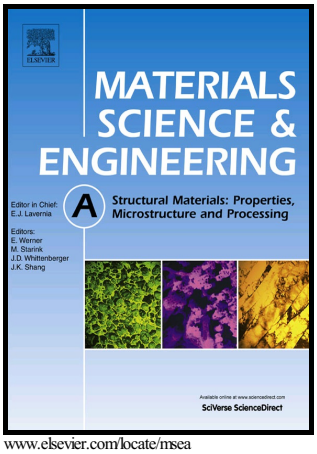

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Evolution of microstructure and crystallographic texture of microalloyed steel during warm rolling in dual phase region and their influence on mechanical properties

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Abstract

High strength and high toughness steels can be developed by warm caliber rolling in ferrite region. However, high deformation resistance limits its application. In the present study, warm rolling was applied to plate rolling which is more suitable for industrial production to develop high strength and high toughness steels. To reduce deformation resistance, warm rolling was carried out in dual phase region. We elucidate here the evolution of microstructure and crystallographic texture and their influence on mechanical properties of microalloyed steel subjected to warm rolling. The study suggests that high strength and high toughness can also be obtained by warm rolling in the dual phase region. Elongated ultrafine microstructure and intense α-fiber texture component and γ-fiber texture component can be obtained through warm rolling. The main mechanism of microstructure evolution during warm rolling was dynamic recovery. Reducing warm rolling temperature can refine grain size, enhance α-fiber texture component and weaken γ-fiber texture component. Warm rolling can greatly enhance strength by ~64-158 MPa compared to the conventional controlled rolling (CR) process, and the warm-rolled plates had high elongation in spite of high strength. The toughness was improved because of grain refinement and delamination. Delamination can induce ductile fracture at low temperature, and delay the occurrence of brittle fracture such that high toughness is obtained in steel plates. The effect of warm rolling temperature and impact test temperature on delamination and impact property was elucidated.

Keywords: warm rolling; ultrafine-grained microstructure; crystallographic texture; strength, toughness; microalloyed steel.