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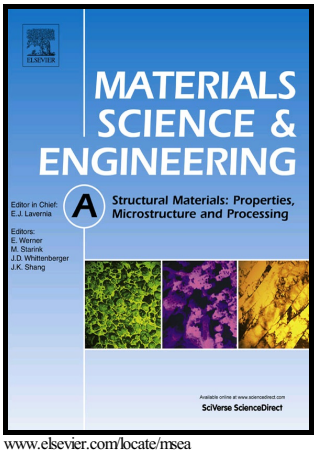

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Influence of rolling asymmetry on the microstructure, texture and mechanical behavior of high-manganese twinning-induced plasticity steel

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Abstract

In this work, a Fe-23Mn-1.5Al-0.3C twinning-induced plasticity steel was subjected to both symmetric (SR) and asymmetric rolling (ASR) to investigate the influence of an additional shear strain component introduced during asymmetric rolling on the microstructure and texture evolution as well as on the mechanical properties. ASR was performed using a roll diameter ratio of 2:1. Electron backscatter diffraction, transmission electron microscopy, and X-ray diffraction were utilized for careful characterization of the microstructures and textures in the top, middle, and bottom layers of the sheets. The overall refinement of the microstructure was found to be more developed in the asymmetrically rolled specimens as compared to the symmetrically rolled ones. Furthermore, the top layer (at the smaller roll) revealed a stronger deformation with higher density of deformation twins compared to middle and bottom layer. Additionally, secondary twinning was activated during ASR, whereas only primary twinning was observed during SR. With increasing rolling degree (up to 40% thickness reduction) a weak Brass-type texture dominated by α-fiber (<110>//ND) texture components and the {123}<634> S texture component developed during rolling using both processing techniques. As a result of the additional shear strain introduced during ASR, the complete texture rotated around the transverse direction by ~6°. It was shown that additional simple shear introduced by ASR can affect the mechanical properties, microstructure and texture development.

Key words: Twinning-induced plasticity steel, cold rolling, asymmetric rolling, texture, microstructure.