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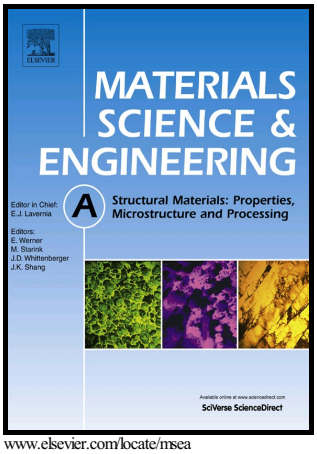

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Effects of caliber rolling on microstructure and mechanical properties in twinning-induced plasticity (TWIP) steel

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Abstract

The effect of caliber rolling on microstructure and mechanical properties of Fe-Mn-Al-C twinning-induced plasticity (TWIP) steel has been investigated to find alternative methods of wire drawing process using the numerical simulation, electron backscatter diffraction (EBSD) techniques, transmission electron microscopy (TEM), and hardness test. Behavior of twinning, texture, and effective strain was different with areas of rolled wire due to the difference in stress state and strain. The center area had maximum twin density, low angle boundary (LAB), effective strain, and hardness; whereas the surface area had minimum values. In comparison with wire drawing process, caliber rolling process imposed higher stain with slightly uniform distribution on wire, indicating that caliber rolling can manufacture high strength wires more effectively. For instance, after the area reduction of 22%, the tensile strength and hardness inhomogeneity factor of specimen processed by caliber rolling had 47% higher and 15% lower than those of wire drawing process, respectively. In other words, caliber rolling process was suitable to make high strength materials deformed and hardened by twinning mechanism such as TWIP steels due to the characteristics of imposing severe strain with multi-direction, multi-pass with different shape at each pass, and alternating the loading direction between passes. Therefore, caliber rolling process can be a strong candidate in replacement of wire drawing process, especially TWIP steels.

Keywords : Twinning-induced plasticity (TWIP) steel; Caliber rolling; Deformation twin; High strength; Stress state

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