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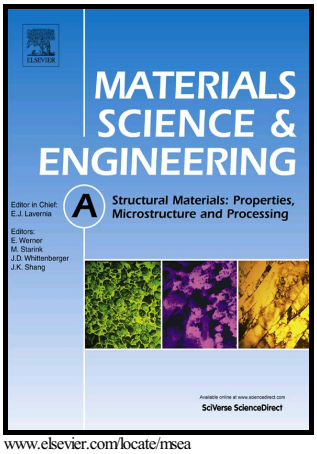

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Improvement of tensile properties in (austenite+ferrite+κ-carbide) triplex hot-rolled lightweight steels

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Abstract

In this study, (austenite+ferrite+κ-carbide) triplex microstructures were obtained from the hot-rolling and subsequent 800 °C-annealing of Fe-0.8C-(12,15,20)Mn-7Al (wt.%) lightweight steels, and their effects on ultra-high strength along with good ductility were investigated in relation with microstructural evolutions occurring during the tensile deformation. In the 12-wt.%-Mn hot-rolled specimen, lamellar κ-carbides were populated along austenite grain boundaries, which seriously deteriorated the ductility. When the Mn content increased to 15 or 20 wt.%, the volume fraction of κ-carbide decreased, and slip bands were sufficiently formed inside austenite grains during the deformation, which resulted in excellent ductility as well as ultra-high strengths. Very high yield strength was also achieved by forming triplex microstructures, in which the austenite deformed during the hot rolling greatly contributed to the strength enhancement. In the 800 °C-annealed specimens, the decreased volume fraction and morphological change from lamellar to polygonal-particle type of κ-carbides enhanced the ductility in spite of the slightly reduced strengths. This was because slip bands were sufficiently formed in austenite grains during the deformation, while voids were formed inside well-developed slip bands. The existence of a large amount of austenite was highly valuable for increasing the ductility by developing fine dislocation substructures such as Taylor lattices as a key feature of deformation mechanisms.