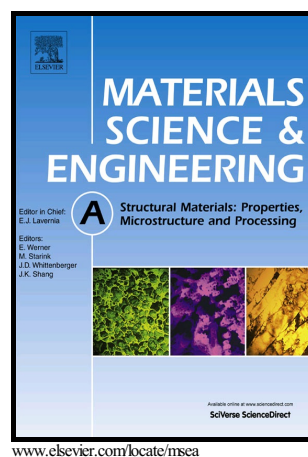


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Innovative processing of obtaining nanostructured bainite with high strength -
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process-structure-property relationship

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Abstract: The study focused on the processing how to obtain nanoscale bainite for improving mechanical properties of a low-carbon-medium-manganese steel with nominal chemical composition of Fe–0.07C–7.9Mn–0.14Si–0.05Al–0.002S–0.003P (wt. %), using warm rolling, intercritical annealing and bainite transformation. The results indicated that, after bainitic hold at 330°C for 2 h, the steel had a yield stress (σ_y) of 770 MPa and tensile stress (σ_{TS}) of 1130 MPa, with a high elongation-to-failure (ε_f) of 0.62 at strain rate of $1 \times 10^{-3} \text{ s}^{-1}$. The product of σ_{TS} and ε_f was high at 70 GPa %, which is twice that the value (30 GPa %) required for third generation advanced high-strength steels. Furthermore, it is remarkably higher than the reported value of 46 GPa% for steel with identical chemical composition. Microstructural observations indicated that the steel consisted of nanoscale lamellae with characteristics of radial arrangement of bainitic ferrite and retained austenite (RA) of average thickness of ~120 nm. The volume fraction of RA was as high as 32% with carbon concentration of 1.75 wt. %. The bainitic isothermal temperature and time not only affected the bainite morphology but also the volume fraction, distribution, microstructure and carbon concentration of RA, which are responsible for superior combination of high strength and good ductility of the steel.

Key words: Low-carbon-medium-manganese steel; Nanoscale bainite; Retained austenite; Bainitic treatment

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