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Effect of tempering on the microstructure and mechanical properties of a medium carbon bainitic steel

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Abstract: The effect of tempering on the microstructure and mechanical properties of a medium carbon bainitic steel has been investigated through optical microscopy, electron back-scattered diffraction, transmission electron microscopy and X-ray diffraction analyses. A nano-level microstructure containing plate-like bainitic ferrite and film-like retained austenite is obtained by isothermal transformation at M_s+10 °C followed by tempering within 240 °C–450 °C. Results show that the sample tempered at 340 °C occupies the optimal balance of strength and toughness by maintaining a certain level of plasticity; samples tempered at 320 °C and 360 °C with low and high yield ratio come second. The microstructure of the steel is not sensitive to tempering temperatures before 360 °C. When the temperature is increased to 450 °C, the significantly coarsened bainitic ferrite plate and the occurrence of a small quantity of carbide precipitation account for its low toughness. The amount of retained austenite increases with the tempering temperature before 400 °C, followed by decreasing with further increase in the temperature. This behavior is related to the competition between retained austenite further transforming into bainite and decomposing into carbide during tempering.

Keywords: Carbide-free bainite; Tempering; Microstructure; Mechanical properties

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