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Improving mechanical properties of nano-bainitic steels

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The 3rd generation advanced high strength steel demands strength levels in excess of 1000 MPa with a significant ductility and cost effectiveness to be used for structural applications. Nano-bainitic steels designed with proper alloying elements and processed through suitable plastic deformation process can fulfill the requirement. The key aspect is to delay the plastic instability due to TRIP effect which will improve the strength and total elongation. In this study bainitic microstructure was produced by austempering at low temperature to achieve fine bainitic laths and sufficient retained austenite. A controlled cold-rolling and cryo-rolling was performed after the austempering treatment which introduced transformation of austenite to martensite due to TRIP effect resulted in a desired microstructure. Since the displacive nature of transformation promotes austenite stability through carbon partitioning and generation of high dislocation density, cold or cryo rolling introduced deformation twins in the retained austenite. The interaction of dislocations with twin boundaries helps to avoid excessive stress concentration due to dislocation pile-up, which delays the plastic instability and therefore plays a crucial role in retaining ductility[1]. A processing-structure-property correlation along with detailed characterization was done to establish the experimental results.

Keywords: Austempering, Cold-rolling, Cryo-rolling, Twin

References:

[1] Wei, Yujie, et al. "Evading the strength–ductility trade-off dilemma in steel through gradient hierarchical nanotwins." *Nature communications* 5.1 (2014): 1-8.