Effect of second cold rolling and intercritical annealing on a new medium Mn ultra-fine duplex AHSS

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Our work is focussed on the development of novel thermo-mechanical processing schedules for the production of third generation advanced high-strength steels (G3 AHSS). This particular study explores the effect of the sequence of cold rolling (CR) and intercritical annealing (IA) on the microstructure and mechanical properties of a new G3 AHSS with an ultrafine duplex (austenite + ferrite/austenite) microstructure. It has been shown that IA on a novel fully martensitic low-carbon medium manganese steel produces ultrafine duplex microstructure with high strength and high ductility. Subsequent CR of this duplex microstructure triggered a transformation-induced plasticity (TRIP) process and transformed more than 95% of the austenite to α'-martensite. This deformed microstructure (deformed ultrafine ferrite and α'-martensite) was the base material for this study.

Various IA heat treatments were applied to explore the microstructure and mechanical properties of this steel alloy. The effect of IA on microstructure (grains size, phase fractions and chemical composition of different phases) was investigated by means of SEM-transmission Kikuchi diffraction (TKD), atom probe microscopy (APM) and X-ray diffraction (XRD). The microstructure-property relationships of these steels is discussed in terms of a pathway for enhanced strengthening.