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Effects of Retained Austenite Transformation on the Tensile Deformation Response of 300M Steel

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Abstract

Transformation-induced plasticity (TRIP) of interlath retained austenite is investigated for a 300M steel with a ~2,100 MPa tensile strength. Stress-induced transformation during elastic loading at -196°C reduces but does not eliminate retained austenite from the microstructure. This transformation generates a transient reduction in plastic strain hardening rate, $d\sigma/d\varepsilon_P$, immediately after yielding, but this effect has no significant impact on subsequent tensile deformation at -196°C or room temperature. Strain hardening in combination with high strain energy density promote strain-induced transformation before the ultimate tensile strength during tensile testing at -196°C, and this manifestation of the TRIP effect is associated with an increase in the extent of uniform elongation relative to tensile deformation at room temperature. In contrast, strain-induced transformation is limited to plastic strains in the vicinity and beyond the tensile strength during room-temperature deformation.

Keywords: High-strength steel, stress-induced martensite transformation, strain-induced transformation, tensile deformation, strain hardening