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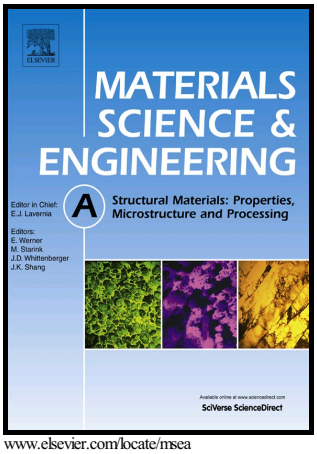

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Micro and macro mechanical behavior of a transformation-induced plasticity steel developed by thermomechanical processing followed by quenching and partitioning

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Abstract

A low-alloyed transformation induced plasticity steel was subjected to thermomechanical processing (TMP) followed by quenching and partitioning treatment to achieve a desired combination of the strength and ductility. The developed microstructures were precisely analyzed, and the mechanical responses of individual micro-constituents were studied by nanoindentation using a reliable scanning probe microscopy. The results indicate that the characteristics of the constituent phases (i.e., the lath martensite, blocky fresh martensite and the retained austenite) were dictated by the prior TMP. The occurrence of dynamic recrystallization and the formation of equiaxed-shape fine austenite grains during TMP would provide fast diffusion track for carbon to diffuse through the untransformed austenite. The carbon partitioning from martensite to the surrounding austenite ensures the austenite stabilization and was identified as the major factor for martensite softening at micro-scale level. The room temperature mechanical properties were studied via shear punch and tensile testing methods. The obtained superior mechanical properties, the ultimate tensile stress of ~1400MPa and shear elongation to fracture of ~19% were justified considering the proper work hardening behavior of the material.

Keywords: Quenching and partitioning; Nanoindentation; Thermomechanical processing; Mechanical properties; X-ray diffraction

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