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Crystallographic orientation, nanoindentation, and tensile properties relationships in Q&P and HSQ&P processes

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Abstract

A novel quenching and partitioning process (Q&P) including the hot straining process (HS) has been recently introduced as an alternative to optimize mechanical properties in TRIP-assisted steel, which is of great interest to the automotive industry. This combination of processes is here called Hot Straining and Quenching and Partitioning process (HSQ&P). In this work, two Q&P conditions and four thermomechanical treatments (HSQ&P) were studied, using two straining temperatures (750 °C – HSQ&P750, and 800 °C – HSQ&P800) and two quenching temperatures (318 °C and 328 °C). The partitioning step was performed at 400 °C for 100 s in all cycles. Microstructural features were comprehensively studied using electron backscattered diffraction and nanoindentation techniques. HSQ&P samples showed a good combination of ductility and high-strength due to the presence of: retained austenite, intercritical ferrite with low stored internal strain energy, grain refinement via DIFT-effect (deformation induced ferrite transformation), martensite, and bainite. Significant internal stress relief was caused by carbon partitioning, which was induced by the DIFT-effect and the partitioning stage. This also led to a considerable stored energy, which was characterized by the Kernel average dislocation and geometrically necessary dislocation analysis. In addition, predominant {110}//normal direction (ND) crystallographic texture was identified, which promotes slip deformation and enhances the mechanical properties. Moreover, remarkable amounts of fine film-like retained austenite oriented along compact crystallographic directions (i.e., <111> and <112>) were observed. Finally, subsize tensile test verified the optimum mechanical behavior of HSQ&P specimens.

Biography:

Prof. Dr. Mohammad Masoumi has completed his PhD at the age of 32 years from Federal University of Ceará and postdoctoral studies from department of metallurgical and materials engineering - Polytechnic School of the University of São Paulo. He is a professor at Federal University of ABC since 2018. He has published more than 20 papers in reputed journals and has been serving as an editorial board member of repute.

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