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PRACA DOKTORSKA

Wpływ temperatury na indukowaną odkształceniem przemianę martenzytyczną w wysokowytrzymałych stalach wielofazowych

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ABSTRACT

Effect of deformation temperature on strain-induced martensitic transformation in high-strength multiphase steels

The aim of this study was to determine the effect of deformation temperature on the transformation induced plasticity effect and relationships between microstructure and mechanical properties in high-strength multiphase steels with metastable retained austenite. Investigated steels were characterized by different manganese contents: 1.5, 3 and 5%. A literature part contains the characterization of steels with retained austenite characterized by a various matrix and manganese content. The influence of factors affecting the stability of retained austenite which conditioning its gradual deformation-induced martensitic transformation leading to a favorable balance between strength and plasticity of steel, with particular emphasis on the temperature factor was determined. In order to prove the dissertation thesis, examinations of mechanical properties and microstructural features were performed. Scanning and transmission electron microscopy, X-ray diffraction and EBSD techniques, which allowed to quantifying the microstructural features of retained austenite and strain-induced martensite, were of fundamental importance for achieving the purpose of the work.

The transformation of metastable austenite into martensite was studied as a function of plastic deformation temperature at reduced temperatures: -60 and -20°C, room temperature (20°C) and elevated temperatures: 60, 100, 140 and 200°C. Detailed microscopic examinations were performed and the amount of γ phase was determined. The identification of the retained austenite and deformation martensite as well as a characterization of the influence of the Mn content on the evolution of the microstructure and mechanical properties of examined steels was essential for the realization of the purpose of the work. At general, it was found that as the deformation temperature increases, the retained austenite stability increases, which results in its reduced susceptibility to martensitic transformation. However, at 200°C in medium manganese steels, thermal activated processes determining the kinetics of the transformation of austenite into martensite have been identified. It was found, that the stabilization of the γ phase is a result of the synergistic interaction of the chemical composition as well as the degree of fragmentation and morphology of the γ phase.