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ROZPRAWA DOKTORSKA

Kształtowanie struktury i tekstury metastabilnego austenitu stali X5CrNi18-10 w procesie odkształcenia plastycznego na zimno

PROMOTOR

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ABSTRACT

The aim of this dissertation was determination of the influence of the structure forming and the deformation texture on the mechanical properties of cold-rolled sheets from two melts of industrial stainless steel with austenitic structure, grade X5CrNi18-10. The transformation of the metastable austenite to strain-induced martensite (γ→α') was investigated as a function of temperature and strain rate. The mechanism and morphology of the transformation products as well as their texturing and crystallographic relationships occurring between γ and α' phases have been determined.

Experimental investigations included the cold-rolling of steel sheets with an initial thickness of 2.0 mm within the degree of deformation (10÷70%) and the static tensile tests at room and lowered temperature from -100°C to -196°C at a strain rate of about $10^{-5}s^{-1}$ and $10^{-3}s^{-1}$, as well as hardness measurements. The metallographic analysis was performed using a light and also electron microscopy type SEM and TEM (HREM). The phase composition of sheets was determined on the basis of the X-ray qualitative and quantitative analysis. Investigations of the deformation texture were carried out by X-ray diffraction method taking into account the orientation distribution function (ODF) and backscattered electrons (EBSD).

It was found that the plastic deformation of the investigated steel induces the direct transformation (γ→α') of the (bcc) lattice during both the cold-rolling process, as well as the tensile test at lowered temperature. This transformation exhibits a typical crystallographic relationship between austenite and α' martensite given by Kurdjumov-Sachs. The quantitative estimation of the formed deformation martensite α', depending on the degree of plastic deformation was also obtained in the dissertation. It was found that increasing the degree of plastic deformation during the cold-rolling process of investigated sheets resulted in the increase of the mechanical properties and decrease of ductility. The lowering of the deformation temperature of the investigated steels to the cryogenic temperature influences the simultaneous increase of R_m and A_{22}. The improvement of the ductile properties may be related to the TRIP effect.

In this dissertation the microstructure of the steel and deformation texture (FRO) as a function of the deformation degree during the cold-rolling process were investigated and determined. For comparison purposes, the analysis of the texture by electron backscatter diffraction (EBSD) was additionally performed. Satisfactory qualitative comparison results of the deformation texture determined by EBSD with those determined by X-ray diffraction method were obtained.