

STUDY OF PLASTIC DEFORMATION OF AUSTENITIC STAINLESS STEEL

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The majority of papers are devoted to investigation of plastic deformation of stainless steel

performed by methods of electron microscopy and X-ray diffraction. Mossbauer studies were not systematical.

In the present paper the phase transformations in 12Cr18Ni10Ti austenitic stainless steel under plastic deformation have been studied by methods of Mossbauer spectroscopy on ^{57}Fe nuclei and XRD.

The elemental composition of investigated samples was (in weight %) C – 0,1; Cr – 17,3; Ni – 9,7; Mn – 0,62; Si – 0,54; Ti – 0,51; Fe – basis. The thickness of steel plates in initial state was $135 \pm 1 \mu\text{m}$. The samples were rolled to thickness $\approx 30 \mu\text{m}$. The deformation degree is determined by formula: $\varepsilon = (d_0 - d) \times 100 \% / d_0$, where d_0 – thickness of sample before deformation, d – thickness of sample after rolling. The maximal degree of deformation was 78 %. Small deformation degrees were obtained by the working of samples on scheme: first rolling – intermediate homogenizing thermal annealing – second rolling. The thermal annealings of samples were carried out in vacuum (5×10^{-6} mm Hg). The alumel–chromel thermocouple was used for determination of temperature ($\pm 5^\circ\text{C}$).

Mossbauer spectra were taken by registration of γ -quanta in absorption geometry (MS) and by registration of conversion electrons (CEMS). In first case Mossbauer spectroscopy provides information on average phase state on the whole sample. In second case the analysis of state of surface layers ($\sim 0.1 \mu\text{m}$) is performed. $^{57}\text{Co}(\text{Cr})$ with activity of $\sim 30\text{mCi}$ was used as source of γ -quanta. MS- and CEMS-spectra were obtained at room temperature. Spectrometer calibration was performed using a precise standard α -Fe enriched with ^{57}Fe up to 89%. Processing and analysis of experimental Mossbauer spectra were performed using software package MSTools. The code DISTRI was used for processing of the spectra.

As a result of spent examinations:

1. It is shown that the rolling of investigated stainless steel causes $\gamma \rightarrow \alpha$ -transformation.
2. The dependence of relative amount of α -phase on surface and bulk of sample vs deformation degree was obtained.
3. It is established that the process of $\gamma \rightarrow \alpha$ -transformation at plastic deformation have threshold level (with threshold deformation degree $\varepsilon \approx 5 \pm 1\%$).