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Structural transformations in austenite 18Cr10NiTi stainless steel induced by deuterium implantation

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The samples of austenite 18Cr10NiTi stainless steel were studied. Deuterium introduction into the samples was performed by implantation of D_2^+ ions having the energy of 24 keV, current density of 2-5 μA/cm^2 with the doses ranging from 1×10^{15} to 4×10^{18} D/cm^2 at 295 K or 100 K. The ion-implanted deuterium desorption temperature variations as a function of deuterium dose.

Temperature of 295 K. As the irradiation dose increases the number of temperature regions of deuterium desorption in the spectrum is increasing from 1 to 4. The nature of ion-implanted deuterium gas- release peaks is related to the following: (1) formation of the deuterium solid-solution phase state in the steel with a limiting concentration of ~4 at.% characterized by the presence of a peak on the maximum temperature 385 K side in the thermal desorption spectra (TDS); (2) interstitial metal atom-deuterium and deuterium-vacancy complexes formed by the ion implantation, which manifest themselves in the TDS as peaks with maximum temperatures of 435 K and 485 K; (3) extensive temperature regions of deuterium desorption in the temperature range from 450 to 900 K arising due to the diffusion processes in the implantation layer, structureless region formations.

Temperature of 100 K. As the implantation dose increases, the peak intensity is increasing too, that is related to the interstitial metal atom-deuterium complexes and maximum temperature increasing. In the thermal desorption spectrum this peak becomes prevailing, and for a dose of 5×10^{16} D/cm^2 the temperature of its maximum is the highest, 500 K. During further increase of the implantation dose the intensity of this peak increases too and its maximum temperature decreases.

For doses higher than 5×10^{17} D/cm^2 the deuterium thermal desorption spectrum undergoes qualitative change that is demonstrated by a low-temperature peak on the maximum temperature (~265 K) side that evidences on the origin of a new phase state formation – a hydride.

TEM investigations of austenite 18Cr10NiTi steel samples implanted with a deuterium ion dose of 6×10^{17} D/cm^2 at 100 K have shown that simultaneously there exist **α**-martensite needles, **ε**-interlayers and residual austenite in the surface layer. The data obtained indicate on the fact that shearing polymorphic transformations take place. Measurements on the magnetization of a sample of steel, irradiated with the dose of 6×10^{17} D/cm^2, revealed the presence of a ferromagnetic phase.