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ABOUT THE FORMATION OF TWO TYPES OF MARTENSITE PHASES IN THE COURSE OF PLASTIC DEFORMATION OF AUSTENITIC CHROMIUM-NICKEL STEEL

Austenitic steels are used as materials that operate at high pressures. Steels of different chemical composition have different degrees of stability of the austenite to martensite transformation in the course of deformation. Using a sensitive magnetometer method accounting for magnetization of paramagnetic austenite, very low content of martensite deformation in volume percent were identified.

Studies on detection of the first portions of the martensite during plastic deformation of austenite allowed classification of the state of austenite in sample steels as follows: stabilized austenite (X10CrNi23-18), moderately unstable austenite (X10CrNi16-13) and highly unstable austenite (X10CrNi18-9). The schemes of pressure dependences of the specific free energy of austenite and intermediate martensite phases (ε-and α′-martensite) were offered. It was shown experimentally that austenite can be converted both to α′-martensite, and to intermediate ε-martensite which precedes the appearance of the ε-martensite shown experimentally.

The experimental data confirmed that in steels with a high stacking fault energy, deformation martensite is formed according to the scheme of $\gamma \to \alpha'$, and in alloys with low stacking fault energy, the scheme $\gamma \to \varepsilon \to \alpha'$ is realized. The increase of the paramagnetic susceptibility of austenite is observed under uniaxial compression of totally austenized samples. This phenomenon is associated with changing of the electronic structure of atoms under pressure.

Keywords: stainless steel, austenite, ε-martensite, α′-martensite, magnetic susceptibility

Fig. 1. Schemes of changes of the specific free energy of austenite G_γ and intermediate martensitic phases G_ε and $G_{\alpha'}$ depending on the pressure p and the composition: *а* – stabilized austenite (steel X10CrNi23-18); *б* – highly unstable austenite (steel X10CrNi18-9); *в* – moderately unstable austenite (steel X10CrNi16-13)

Fig. 2. Dependence of $\chi(1/H)$ for different deformation of X10CrNi23-18 steel (*a*) and X10CrNi16-13 steel (*б*), %: *a*: *1* – 0, *2* – 1.17, *3* – 1.98, *4* – 2.34, *5* – 3.69, *6* – 4.59, *7* – 7.29, *8* – 8.10, *9* – 10.44, *10* – 13.59, *11* – 14.94, *12* – 15.48, *13* – 16.20, *14* – 17.64, *15* – 26.19, *16* – 30.24, *17* – 55.90; *б*: *1* – 0, *2* – 4.16, *3* – 8.85, *4* – 14.90, *5* – 22.69, *6* – 23.98, *7* – 24.74, *8* – 25.49, *9* – 27.76, *10* – 29.27, *11* – 30.86, *12* – 31.92, *13* – 33.06, *14* – 35.70, *15* – 40.24, *16* – 44.23, *17* – 47.66, *18* – 50.45, *19* – 54.69, *20* – 59.38, *21* – 67.7

Fig. 3. The specific magnetic susceptibility χ ($H = 2.55 \cdot 10^5$ A/m) vs the relative deformation of compression K of X10CrNi23-18 steel

Fig. 4. The resultant specific magnetic susceptibility χ_∞ (austenite and paraprocess) of X10CrNi16-13 steel vs the amount of martensite of deformation $P_{\alpha'}$

Fig. 5. The amount of martensite of deformation $P_{\alpha'}$ vs the relative deformation of compression K of X10CrNi16-13 1 steel

Fig. 6. The magnetic susceptibility χ ($H = 2.55 \cdot 10^5$ A/m) vs the relative deformation of compression K of X10CrNi16-13 steel