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INFLUENCE OF THE TEMPERATURE OF THE PRELIMINARY HEATING AND FURLOUGH ON CHANGE OF DENSITY DISLOKACII MALOLEGIROVANNYH AND HEAT-RESISTANT STEELS

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Abstract

The Explored particularities shaping the structure under high warm-up heating little chemical element and heat-resistant steel. Got new proof of the possibility of the achievement good combination shaping the structure and achievement determined density a дислокации. They Are Determined rational modes not traditional thermal processing

Keywords and Expression: Structure, Structured and Phase Conversions, re crystallization, Density not Perfection, Defects of the Construction, Parameter of the Structure, Fart Crystallization, Dispersion, Thermal History

When choosing the technology of thermal prehistory, high-temperature hardening will be the most appropriate. Compared with normalization, this process looks the most productive, it sows less decarburization, because the exposure time in the air at high temperatures is reduced.

As already described, heating at high temperatures was carried out in salt baths. Most of the results of experiments conducted earlier were obtained on carbon and low-alloy structural steels, as well as low-alloy tool steels [1].

However, a systematic study is possible when obtaining comparative data obtained under the same experimental conditions. Therefore, the data below are not only for heat-resistant steels, but also for iron of various purity, steel 40X and WX15.

The study of the microstructure of steel hardened at various heating temperatures shows the well-known fact of the growth of austenitic grains, an increase in martensite plates. All steels, including technical iron, have a sharp increase in austenitic grain, above 1100 °C.

The only difference is that in alloy steels the absolute value of the austenitic grain size is significantly lower (Fig.1).

This indicates that the main barriers to the growth of austenitic grains are refractory, insoluble phases such as aluminum nitrides and carbonitrides and oxygen-containing phases [2].

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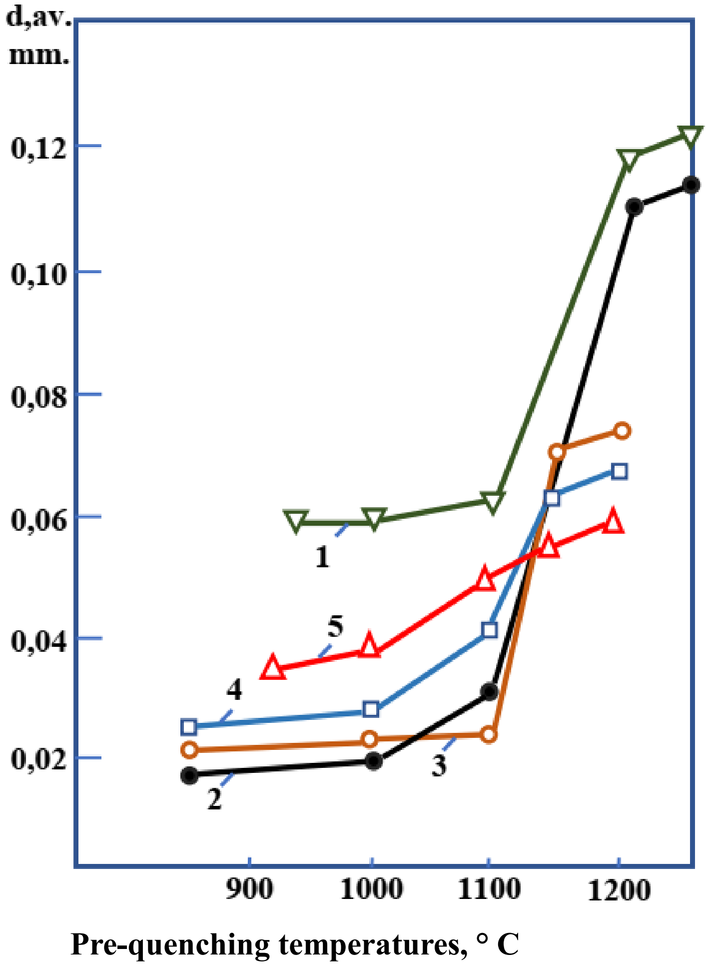

Fig 1: Change in the size of the austenitic steel grain depending on the heating temperature during quenching. 1- armco-iron, 2- 40X steel, 3- 5KHNM, 4- D5, 5- 4KHNFS.

Carbides of alloying elements such as Cr, Mo, V also dissolve in austenite at elevated heating temperatures and inhibit the growth of austenitic grains. However, in all cases, heating above 1100 ° C leads to a sharp increase in grain.

The microstructure of the studied steels was martensite of various morphologies, depending on the composition of the steel and the quenching temperature.

The structure of all medium carbon steels 40X, 5KHNM, D5, 4KHMFS is massive (dislocation) martensite.

With an increase in the temperature of heating for quenching, an increase in the length of the rails and plates of martensite is observed, as well as an increase in residual austenite (Fig. 2.)

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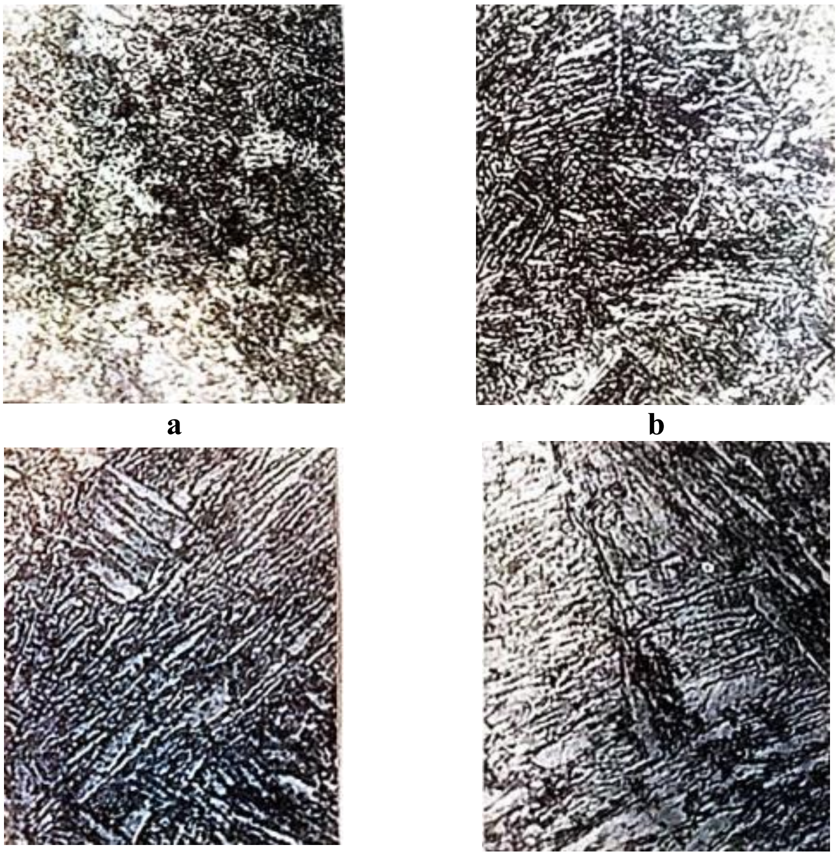

Rice 2: Microstructure of 4HMFS steel after pre-heat treatment: quenching a) 930 °C, b) 1100 °C, c) 1150 °C, d) 1200 °C, x 600.

In the microstructure of high-carbon steel SHX15, after quenching from 840 ° C, very finely needle-like rack-and-pinion martensite and excess carbides are observed. With an increase in the quenching temperature and an increase in the solubility of carbides, the structure of double martensite and residual austenite is observed (Fig. 3).

All studied steels have an extreme heating temperature, when a structure with a maximum dislocation density is formed during cooling. For most carbon and low-alloy steels, the extreme temperature of the first phase recrystallization is 1100 °C.

After accelerated cooling of this temperature, an increased level of defect in the crystalline structure of the α – phase is observed [3]. The reason for this could be the phase hardening and recrystallization of austenite during the α–γ transformation and the subsequent study of defects in the crystal structure during the reverse γ – α transformation.

However, experiments on high-temperature radiography, when analyzing the line width (311) austenite has been shown that the recrystallization of austenite under furnace heating conditions is completed at temperatures well below 1100 °from [4].

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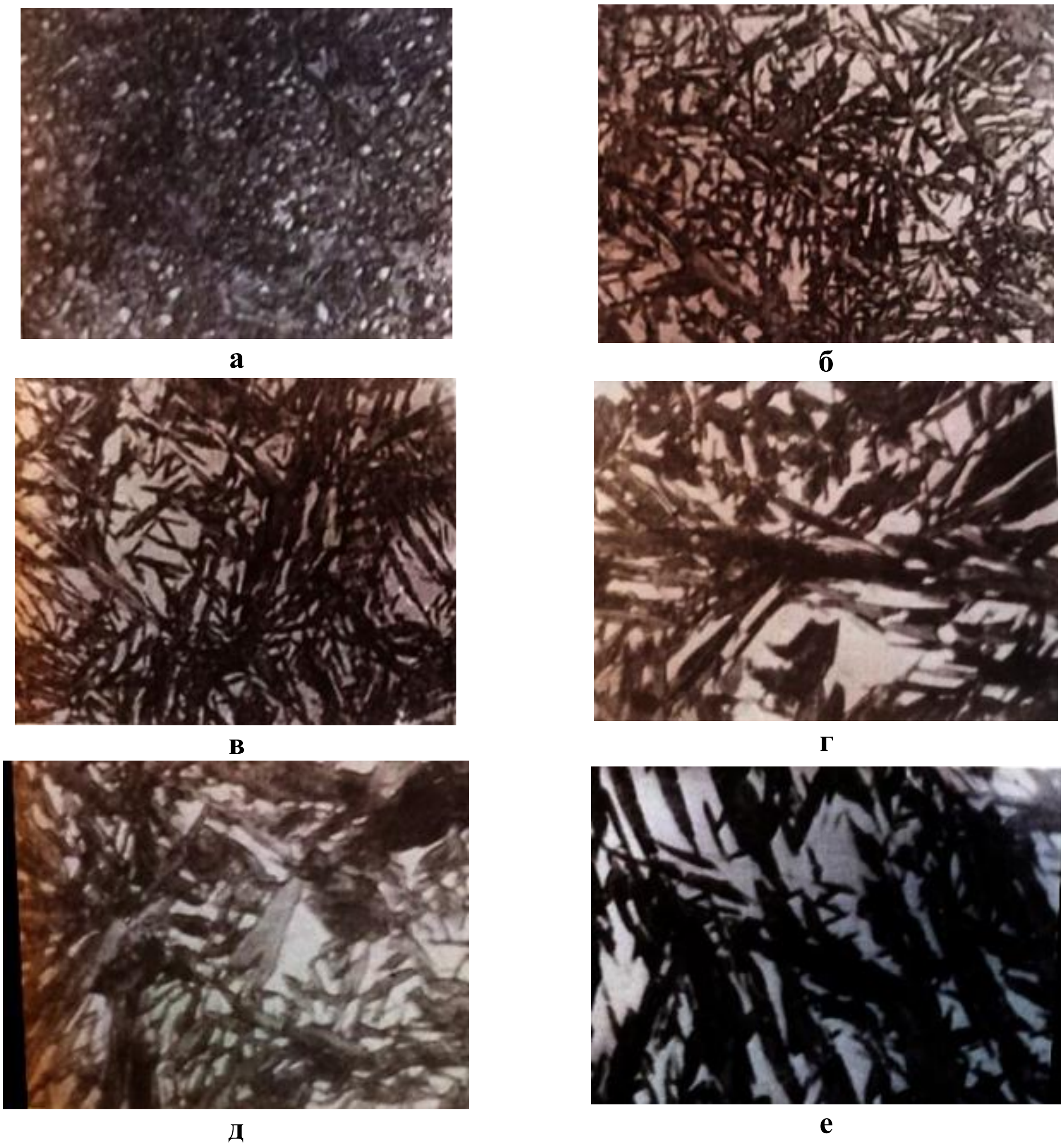

Fig 3: Microstructure of steel SHX15 after preliminary heat treatment: quenching a) 840 °C, b) 900 °C, c) 1000 °C, d) 1100 °C, e) 1150 °C, e) 1200 °C, x 1000

Experiments on heating samples of technical iron in high vacuum revealed several peaks of vacuum drop: 280-310, 510-600, 1100-1120 °C. The first two peaks were attributed to the degassing of the surface and surface layers, and the third peak, at 1100-1120 ° C, was associated with the dissociation of refractory impurity phases, mainly carbon nitride and oxygen-containing.

Since the beginning of the dissolution of these phases is characterized by the chemical micro uniformity of the solid solution (austenite), with accelerated cooling, an increased level of defects in the crystalline structure of the alpha phase is formed. This is due to the formation of

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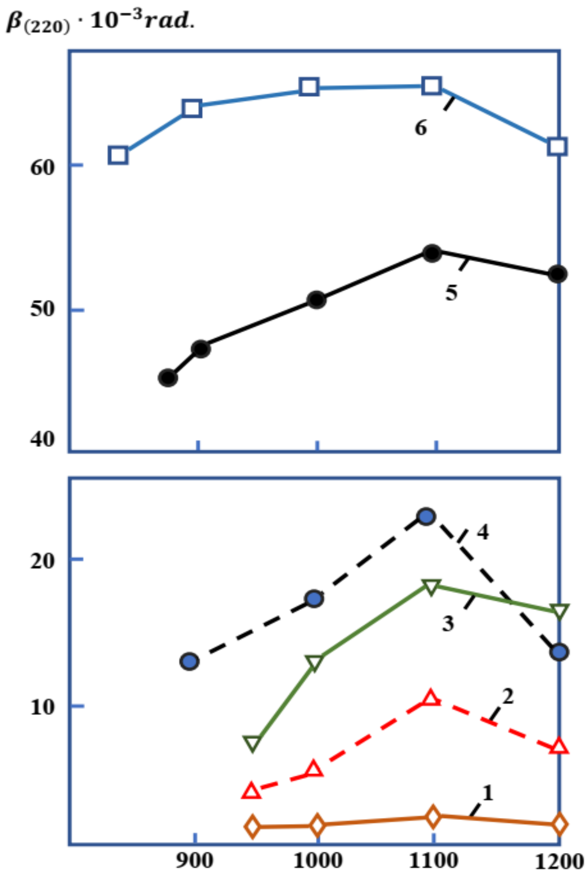
zones with different periods of the crystal lattice and, in connection with this, the formation of a block structure with the development of semi-coherent boundaries with mismatch dislocations [5].

If the heating temperature is significantly lower than the extreme one, then the homogenization of austenite occurs and, upon cooling, the defect of the α–phase lattice turns out to be lower.



Pre-quenching temperatures, °C

Fig 4: Change in the physical width of the X-ray interference line (220) depending on the quenching temperature: 1-high purity iron, 2.3 – technical iron (armco-iron), 4.5 – steel 40 X, 6- WX15, 1, 3, 5, 6 – quenching, tempering 200 ° C, 2, 4 – normalization.

Our experiments also showed that for iron and low-alloy steels, the experimental temperature corresponds to 1100 °C (Fig.4.), but for heat-resistant steels it is 1150 ° C (Fig.5.).

As can be seen from Fig.4, the extreme heating temperature for iron and steels 40X and WX15 is clearly observed, when a structure with a maximum dislocation density is formed during cooling. The graphs show a change in the physical broadening of the X-ray interference line (220) as a measure of the imperfection of the crystal structure. The peak of the maximum crystal structure of the α – phase is observed both during quenching and normalization.

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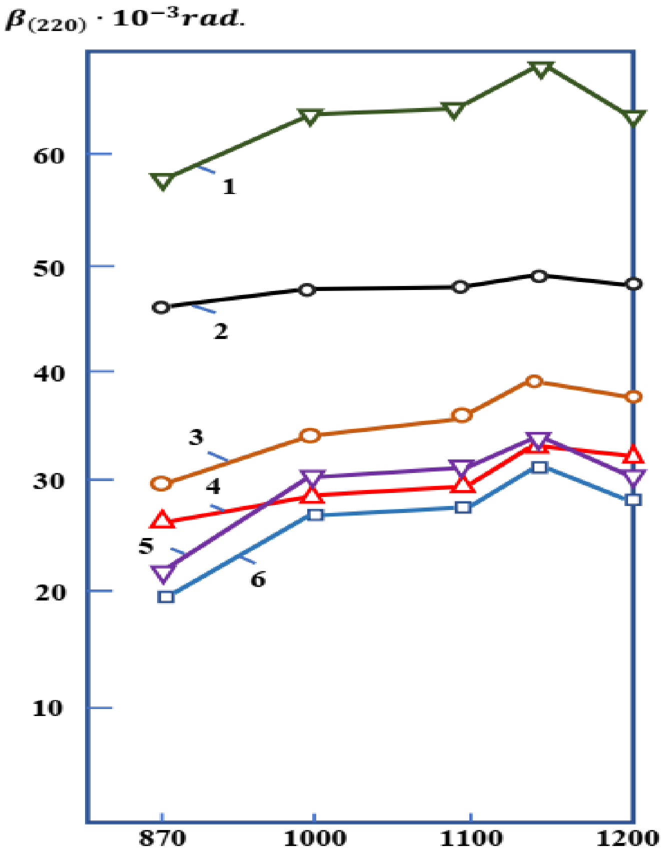

Fig 5: Change in the physical width of the X-ray interference line (220) depending on the quenching temperature: 1-high purity iron, 2.3 – technical iron (armco-iron), 4.5 – 5KHNM steel, 1- tempering 240 ° C, 2-350 °C, 4 – 500 °C, 5- 550 °C, 6- 600 °C.

Very low values of the physical width of the X-ray line (220) in high-purity iron indicate in favor of the concept of the influence of impurity insoluble phases on the formation of a maximum defect in the crystal structure.

Of all the low-alloy steels and iron considered, the peak is least pronounced in steel SHX15. (See Fig.4.). This is due to the fact that the level of defect in the crystalline structure of the α–phase is affected by the dissolution in austenite not only of refractory phases, but also by the dissolution of secondary carbides. Therefore, after cooling, the peak of the defect level of the crystal structure of the α – phase turns out to be less pronounced.

In all studies of heat-resistant steels hardened at different temperatures, there is also a pronounced peak of the maximum defect in the crystal structure (Fig.5.). However, this peak falls at 1150 °C. An increase in the tempering temperature of 5KHNM, D5, 4KHMFS steels tempered from different temperatures does not lead to a shift in the peak over the temperature range of heating for quenching.

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CONCULATION

From this it can be concluded that in these steels, the dissolution of all carbides at a temperature of 950 – 1000 ° C is completely completed, and the formation of an extremum should also be associated with the dissolution of refractory impurity phases. Technologically, the most appropriate way to prepare the thermal background of low-alloy and heat-resistant steels is quenching with intermediate tempering. At the same time, there are extreme temperatures of heating for quenching, for low-carbon steels 40X, SHX15-1100 ° C, for heat–resistant steels 5KHNM, D5, 4KHMFS - 1150 ° C, when after cooling a structure with a maximum density of α-phase dislocations is formed.

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