

SOME ASPECTS CONCERNING THE TRANSFORMATION OF RESIDUAL AUSTENITE IN MARTENSITE AT THE CRYOGENIC TREATED BEAR STEELS

GHEORGHIAN MIRELA, CIUCESCU DORU

University of Bacau

Abstract: The treatment under 0°C it is imposed to the pieces in which the residual austenite is not wished by the negative effect on the physico – mechanical properties and on the dimensional stability. The classic treatment can not assure the rotation precision on the bear steels, giving a quantity of 10 – 18 % residual austenite. In this paper the influence of cryogenic quenching temperature on the kinetics of austenite – martensite transformation.

Keywords: residual austenite, cryogenic quenching, austenite – martensite transformation, bearing steels.

1. INTRODUCTION

In the steels the martensitic reaction starts at the temperature M_s and may vary in a large intervals from 500°C till much under the surrounding temperature. At the end of the transformation, at the temperature M_f , the whole austenite is transformed, normally, in martensite, but, practically, a certain quantity remains as residual austenite. The speed of cooling must be very great in order to obtain a minimum quantity of residual austenite.

Up to the present does not exist unanimity of opinions concerning the mechanism, the kinetics and the morphology of martensitic transformation.

In this paper is analyzed by X – ray method the forming of residual austenite in the bear steels after cryogenic quenching at different temperature.

2. SOME CRYSTALLOGRAPHIC ASPECTS IN MARTENSITIC TRANSFORMATION

The martensitic transformation is a phase transformation in which is changing the crystalline structure, the martensite being considered a sursaturated ferrite (the martensite has till 1,4% carbon when the ferrite at equilibrium has 0,02% carbon). This effect is due to the interstitial carbon atoms (fig. 1).

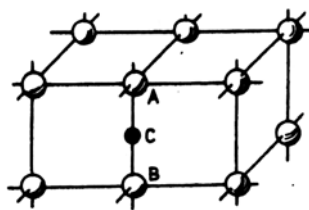


Fig. 1. The distorsioning of the ferrite due to the interstitial atom of carbon (C).

Concerning the geometry restructuration during the forming of martensite, there are some theories:

- the Bain hypothes (fig. 2);
- the Kurdjunov – Sachs hypothes (fig. 3);
- the Arharov – Wanyorek hypothes (fig. 4).

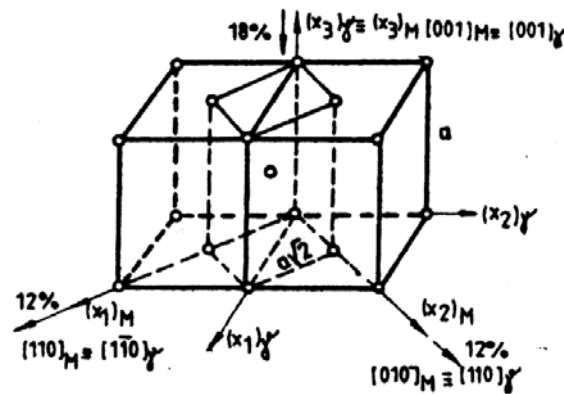


Fig.2. The Bain distorsion

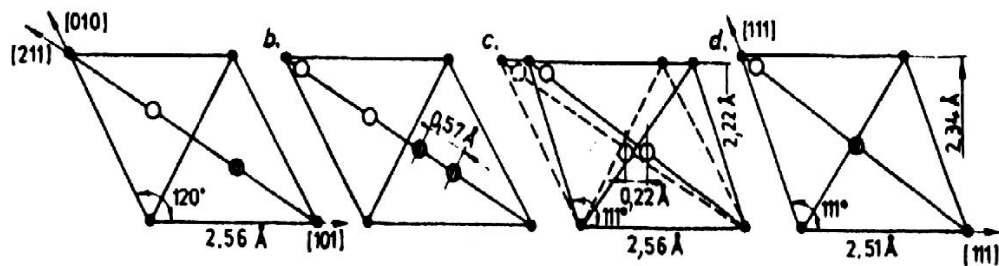


Fig. 3. the Kurdjunov – Sachs distorsion

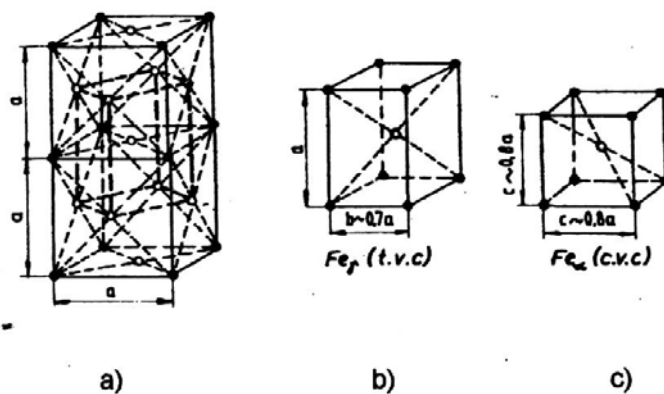


Fig. 4. The Arharov - Wanyorek distorsion

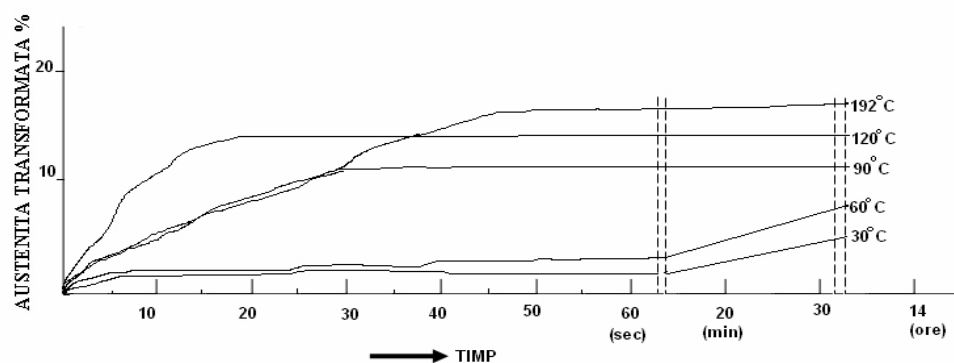
A very important property of martensitic transformation is that it is producing only during continuous coolings. The speed of transformation becomes nearly zero when the coolig is interrupted due to the phenomenon of stabilisation.

The actual theories sustain that during the isothermal maintaining it is producing the segregation of interstitial foreign atoms at the limits of dislocations, forming a Cottrell type atmosphere.

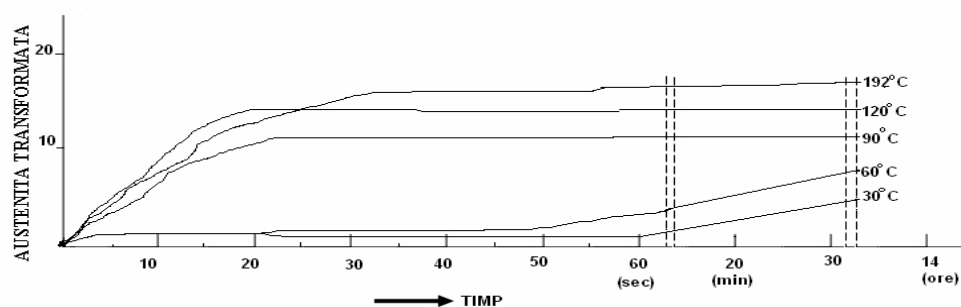
3. THE EXPERIMENTAL RESULTS

The experimental researches were made on 6204 UG radial bearings from 100Cr6 and 100CrMnSi6-4 steel according to SR EN ISO 683-17-2002.

It were established the curves of kinetic transformation for the steels 100Cr6 (fig. 5a) and 100CrMnSi6-4 (fig.5b).



a.



b.

Fig 5. The kinetic curves of martensite transformation at the steels: a. 100Cr6; b. 100CrMnSi6-4

It is to be noted that the initial speed of transformation is greater then later. Also, when raising the cooling temperature the speed of transformation decreases. increases importantly when the temperature is decreasing. At the both steels the martensite transformation is insignificant after 30 minutes.

The results concerning the evolution of the residual martensite are given in the table 1.

Table 1. The evolution of the residual martensite at different temperatures

Steel	Rate of martensite transformation (%)					Rate of martensite transformation during maintaining at -196°C (%)				
	Temperature [(C)									
	25 quenching	-30 B ₁	-60 B ₂	-90 B ₃	-120 B ₄	25 călire	-30 B ₁	-60 B ₂	-90 B ₃	-120 B ₄
100Cr6	18	9,55	12,18	14,70	16,08	6,2	3,738	2,94	1,50	0,7
100CrMnSi6-4	17	7.17	11.5	11.71	13.4	7.7	6.7	4.5	2.57	1.44

4. CONCLUSIONS

From the analyzing of the results concerning the evolution of quantity of residual austenite with the time and the temperature, may be pulled the following conclusions:

1. from the point of view of reducing the quantity of residual austenite, the optimum treatment is the quenching at -60°C;
2. for drastic conditions imposed to the dimensional stability, the optimum treatment is the quenching at -60°C;
3. it is necessary that speed of re-arrival at the surrounding temperature must be as slow as possible;
4. the stabilization during the maintaining in oil after the quenching is producing at any temperature, this fact imposing an immediate cryogenic treatment.

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