

Electro-chemical monitoring of static recrystallization

F. FILUS, I. SCHINDLER, J. FIALA, S. LASEK, T. KUBINA

VSb – Technical University of Ostrava, Faculty of Metallurgy and Materials Engineering,
17. listopadu 15, 708 33 Ostrava, Czech Republic.

G. NIEWIELSKI, D. KUC, E. HADASIK

Silesian University of Technology, Faculty of Materials Engineering and Metallurgy,
ul. Krasińskiego 8, 40-019 Katowice, Poland.

The electro-chemical potentiokinetic method has proved to be a sensitive technique for monitoring of static recrystallization in austenitic steel AISI 304 after its cold forming and annealing. Results obtained in this manner are in very good conformity with the results of metallographic and X-ray analysis, as well as with the measured values of hardness. Corrosion current density appeared to be a suitable criterion for evaluation of development of relaxation processes.

Keywords: *static recrystallization; corrosion; stainless steels; x-ray diffraction; hardness*

1. Introduction

Recrystallization is a relaxation process, the result of which is generally non-equilibrium, non-ergodic state of material. As the individual structural characteristics develop in the course of recrystallization in different manner, the description of the state achieved at certain time often differs depending on the laboratory technique used for investigation of this phenomenon and subsequent evaluation of the course of recrystallization made on this basis [6] and [9]. Investigation of properties of austenitic stainless steel AISI 304 after its cold forming and high temperature annealing revealed very close correlation between the development of static recrystallization and results of electro-chemical measurements, which gives possibility of monitoring of relaxation processes by unconventional procedure.

2. Experimental

The steel AISI 304 with chemical composition as follows was investigated: 0.06 C – 1.71 Mn – 0.35 Si – 0.032 P – 0.025 S – 9.1 Ni – 18.3 Cr (in wt. %). Rolled flat bar with dimensions of cross-section thickness 4.23 x width 40 mm was characterised by fully recrystallized austenitic structure with minority occurrence of ferrite elongated in direction of rolling – Figure 1.

Total height reduction of 30.5% to the final thickness 2.94 mm was achieved by multi-pass laboratory rolling at room temperature. Then individual samples for subse-

quent investigation were prepared by annealing in electric resistance furnace – Table 1 gives their list.

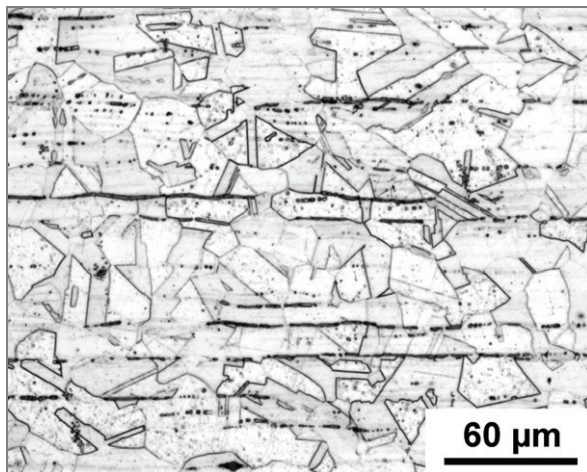


Fig. 1. Microstructure of investigated material in initial state

Table 1. Parameters of preparation of individual samples

Sample	Processing history
CR	cold rolled with total height reduction of 30.5 %
A1	subjected to recrystallization annealing after rolling – furnace 1000 °C/30 min./air
A2	subjected to recrystallization annealing after rolling – furnace 1000 °C/60 min./air
A3	subjected to recrystallization annealing after rolling – furnace 1050 °C/60 min./air

Basic description of the samples microstructure of was made using of optical microscopy (metallography) and it was completed by measurement of hardness HV5. X-ray evaluation of structure relates to magnitude of mosaic blocks (coherent diffraction regions) of austenite crystals [2–5]. Each mosaic block with due orientation gives rise to a diffraction spot – reflexion – on registration film. The basic form of Bragg's condition is

$$\lambda = 2d \sin \vartheta, \quad (1)$$

where:

λ – wavelength of the radiation used,

d – interplanar distance of diffracting lattice family,

ϑ – angle of incidence of the primary X-ray beam on the diffracting lattice family.

If mosaic blocks are larger than 10 μm , only few of them are present in diffracting volume and their reflexions are well discernable; on the basis of the number and size of discerned reflexions it is then possible to determine dimensions of large mosaic

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