ORIGINAL PAPER

CORRELATION BETWEEN PRIMARY RECRYSTALLIZATION TEXTURE AND GOSS TEXTURE FOR THE ELECTROTECHNICAL STEEL

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Abstract. *In the case of texture pole figure of planes (hkl) is the density of normals, per unit solid angle, described by the curve. If the material consists of several phases, as with most materials of technological implications, each phase has its own distribution function of orientations. The texture does not influence the absolute values of material properties which are determined by the chemical composition, phase distribution, grain structure, microstructure, defects and ordering network. The texture, however, influence the properties of anisotropy. This work broached experimental correlation between primary recrystallization texture and Goss's texture characteristic of the electrotechnical steel for the transformator cores and this way was made the influence of the primary recrystallization texture on the form Goss's texture {110}<100> at the transformator sheet.*

Keywords: *Goss's texture, electrotechnical steel, primary recrystallization texture.*

1. INTRODUCTION

Preferential orientation of the crystalline network of grains one a metallic aggregate policristalin ie texture is a result of plastic deformation and recrystallization. To determine the orientation of a grain, should clarify two elements: crystal plane parallel to the front sheet and crystallography direction parallel to the direction of lamination. Symbolic texture of the sheet as follows: (hkl) $[h_1k_1l_1]$ where round brackets indicate the crystallography parallel with the front sheet and in brackets indicate crystallography direction parallel with the direction of lamination. Electrotechnical sheet texture indicates such: (110) <100>.

This type of texture is required to obtain from the sheet, the corresponding magnetic properties. The material used is an alloy Fe-3% Si who crystallizes in the volume-centered cubic (CVC). For this crystal, the cube edges <100> are the directions of easy magnetisation, the directions <110> (diagonals) are average magnetisation directions and diagonals cube <111> define hard magnetisation directions. Therefore electrotechnical sheets for transformer must type Goss texture (110) <100>. This paper studies the influence of primary recrystallization texture by form Goss texture in electro band.

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2. PRIMARY RECRYSTALLIZATION TEXTURE

The texture representation was done by means of poles figures. For a better understanding of those presented, will representation near the poles figures corresponding recrystallization samples, those figures corresponding of samples that after the final rolling. A pole figure (110) typical for the state finals after rolling is shown in Figs. 1 and 2 is represented a pole figure (110) after primary recrystallization.

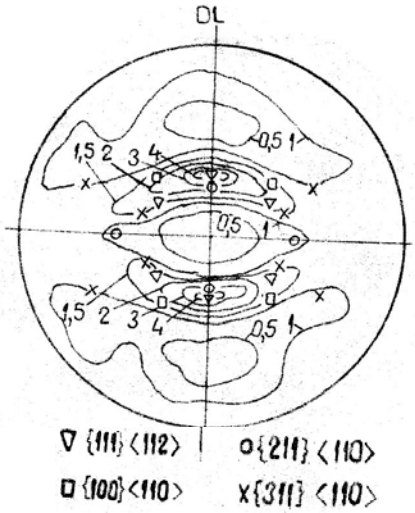


Fig. 1. A pole figure (110) made after the last rolling.

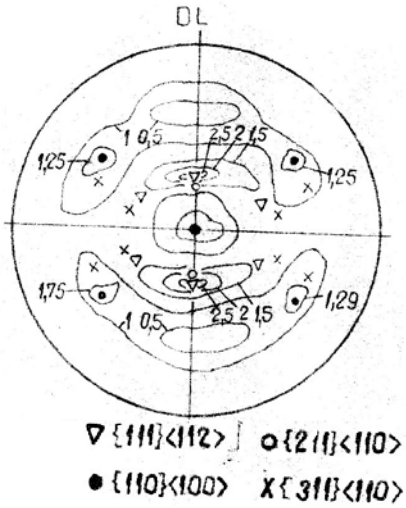


Fig. 2. A pole figure (110) made by primary recrystallization.

Study of these figures could be inferred that the texture corresponding to the two-technology phase is complex. Components of these textures are shown in Table 1.

Table 1. Texture components in electro band after the second rolling (left) and after primary recrystallization (right).

Nr. crt.	Sample rolled	Sample after primary recrystallization
1	{111}<112>	{111}<112>
2	{100}<110>	{110}<001>
3	{211}<110>	{211}<110>
4	{311}<110>	{311}<110>

As seen from Table 1 dominant component {111} <112> is the same in both samples. Then, so the texture after final rolling and texture after recrystallization it contains components {211}<110> and {311} <110> but very low intensity. It is noteworth that after primary recrystallization appeared Goss orientation {110} <100> and the orientation {100} <110> after the final rolling no longer appears. So there is some relationship orientation in a primary recrystallization texture and the cold rolling. The orientations by recrystallization sample are correlated with the phase eventually rolled through a rotation around an axis perpendicular to the plane sheet [1, 2].

3. SECONDARY RECRYSTALLIZATION

Generally, after a recrystalization. process, a metal which has undergone a previous cold deformation, it will rebuild the structure of grains. The deformed grains are replaced by a new set of grains, no strains, with the limits in new positions and orientations which generally differ from those of their predecessors. Propelling force for this type of recrystallization is reduced the deformation energy stored in the material. If the material had a oriented texture, then recrystallization material will have a texture which may differ or be the same as the deformed material. When in the whole material were obtained only deprived grains of defects and tensions ended a first process of recristallization called primary recrystalization.

If the recrystallization metal is heated so forth, is a natural result of gradual increase of average grain size. It happens by slow growth of larger grains, due to the small and often reach a limit when the grain diameter is approximately equal to the thickness of the sample (in the case of sheets). Propelling force is reduced due to decrease the overall area of grain boundary. This is the so-called normal growth of the grain which usually is not accompanied by significant changes in texture.

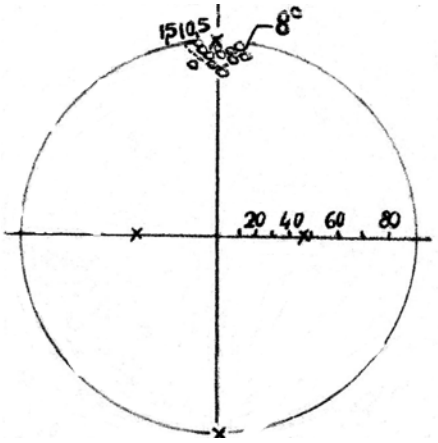
But if the normal growth of grain is prevented, extended the maintenance of annealing may result in relatively sharp increase of several grains, which will occupy the entire volume of the sample. With all that propelling force is again the reduction of grain boundary area, the results of this process are very different from the normal growth of the grain.The grain size increase very much, sometimes several orders of size. Resulting texture is more pronounced. This process is called secondary recrystalization or discontinuous increase of grain [3].

To appear secondary recrystalization should prevent normal growth of grain. To achieve this are two known mechanisms: the introduction of inclusion at the secondary stage of grain (inhibition by inclusions or particles) or creation of a strong recrystallization primary textured (inhibition texture) which uses the fact that the limits of grain were very similar oriented are small mobility. Mention that the sample thickness also exert an effect in limiting the normal growth of grain.

4. EXPERIMENTAL RESULTS

Diffraction images of samples taken for study were obtained through a network Philips X–ray diffractometer equipped with a high voltage generator PW 1130/90 and a goniometer PW1050 for texture. The thickness of samples after finals rolling and after primary recrystallization are 0.30 ± 0.01 mm. Through previous determinations of texture was found that the texture of the surface samples is the same as the thickness of the middle and so there tends to cross section along the said phases. Sample preparation for recording of diffraction images was done by polishing the sheets exposed to radiation with metallographical fine paper. Then they were polished with alumina powder of size 3000Å. After that to remove the superficial layer by corrosion. Was used a rontgen tube with anode of Co, with fine outbreak, whose radiation was filtered with an Fe foil, so that radiation was used is $CoK\alpha$. The tube worked at a voltage of 36 kV and an anodic current of 20 mA. Registration of diffraction images was done by reflection, after Schulz method [4]. Exploring the inclination angle of the sample in relation to the initially position was made up to 900 [5].

Characterization the texture of the sheet in the final state was done by drawing the pole figure (200) which, as shown in Fig. 3, is well suited to the calculation of texture perfection.



x {110}<100>

Fig. 3. The pole figure (200), which indicate the ideal positions of Goss texture.

For perfect texture characterization was used medium dispersion of poles **ρ** from the direction of lamination. Primary recrystallization texture was taken into consideration by the the most intense components {111} <112>. Experimental correlation found between the spreading of these components shown by size $\beta_{1/2}$ (see Fig.4) and a medium dispersion of poles **ρ.** Size $\beta_{1/2}$ depending on the angle of rotation around the normal to the sample and through the maximum of the {111} <112>.

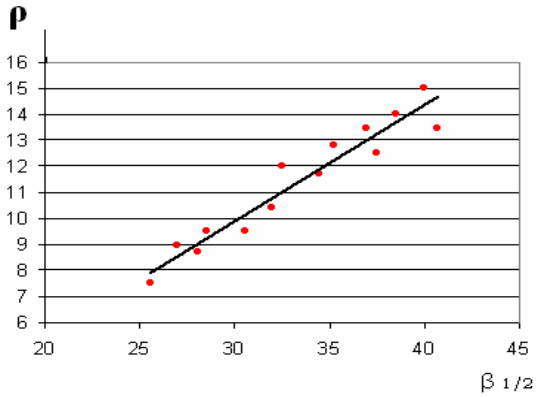


Fig. 4. Average dispersion variation of poles ρ, depending on the spreading component {111}<112> of primary recrystallization texture $\beta_{1/2}$.

5. RESULTS AND DISCUSSION

After primary recrystallization the thickness of 0.30 mm of the electrotechnical sheet is of 0.30 mm, and how the average size of grains in the primary recrystallization matrix is the order of 10 mm as follows to the grain is a three-dimensional system. According to current concepts on secondary recrystallization, especially in case of alloy Fe-3% Si, [6, 7], in a three-dimensional system with a weak texture of the matrix to develop a secondary grain, the potential secondary nucleus of grain it will develop, if he has size two times larger than average size of grain matrix.

If the texture matrix is mostly monotexturing, the potential secondary nucleus of grain should have a size greater than in the first case. In alloy Fe-3% Si there 3 sets of potential secondary grain in primary matrix [6]. One of these sets are the (110) parallel to the rolling, it is set we are interested. Technological conditions are favorable manufacturing secondary development that plane (110) parallel to the sheet. Among the factors that compete to obtain a perfect textured Goss is the stabilization of matrix from 3% Si with impurities of MnS [8]. The {110}<100> is a descendant of a component of {111}<112> obtained by primary recrystallization after the last lamination [8]. This statement is clearly confirmed by the results described in this paper. Hence the idea of a correlation between the texture of primary recrystallization and Goss texture that characterizes the final product. As seen in Figure 4, as the spreading of the component {111}<112> is much greater the medium dispersion of Goss texture is greater. This correlation creates the possibility to control the flow of manufacturing quality sheet, by checking the texture at a certain stage of manufacture and can therefore give improved quality the final product.

6. CONCLUSIONS

The paper put in evidence a correlation between the experimentally determined of primary recrystallization texture and electrotechnical final texture with grain-oriented, dedicated manufacturing the cores of transformers.

Besides shine another possible correlation between the share component {110}<100> and the grain size of final sheet, size is the participants factors contribute to the properties of the final sheet.

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