Scanning electron microscopy studies of Fe-3%Si texture obtained by etch-pit method

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To understand the texture development during grain growth in polycrystalline metallic materials some information is required about growth behavior of grains having different orientations. The etch-pit method is an useful technique for this purpose and sometimes is very helpful to obtain a quantitative analysis of the texture of materials, in special for electrical steel with oriented grain like Fe-3%Si. This technique is complementary to the X-ray diffraction [1].

This work shows some micrographs obtained by scanning electron microscope (JEOL JSM 840-A / LME - IFUSP) where information about the misorientation between neighboring grains, the crystallographic orientation grain and also the texture is identified in different samples of Fe-3%Si after a hot compression processing.

To determine the grain orientation of Fe-3%Si after hot compression process, etch-pits were obtained using chemical etchant ($H_2O + H_2O_2 + H\,Cl$). The corrosion figures are obtained by the removal of low index crystal planes; In the cubic lattice these are the {100}, the {110} and {111} planes that can consequently bound etch pits. In this material some alloys elements are very important such as manganese, sulfur and carbon. The manganese sulfide precipitation during the hot compression process inhibits the grain growth that is necessary to obtain the secondary recrystallization that produces the {110}<001> texture to provides at the end of the total thermo – mechanical processes of this steel high permeability and very low core loss needed for large transformers at reasonable cost [2]. The SEM image give us more accuracy of this process related to the angular corners concerning to optical microscope. The following figures give us some observation with the corresponding texture in some Fe-3%Si samples utilizing the etch-pit method.

The figure 1 shows a scanning electron micrograph where the texture of the grains in the Fe-3%Si sample, after a hot compression process, is near to {211} <011>.

The figure 2 shows a scanning electron micrograph where is possible to verify the same {001} <011> texture but with some deviation on the orientation of the two grains in the Fe-3%Si sample, after a hot compression process.

The figure 3 shows a scanning electron micrograph of a polycrystalline Fe-3%Si sample after a hot compression process and two texture types are present, {211} <011> and {001} <011>.

References

1. Horn, E and Lotter, U, Prakt. Met. 22 (1985) 397.
2. Rodrigues, V.A., Dr.Sc thesis, Universidade São Paulo-Brasil , (1996).

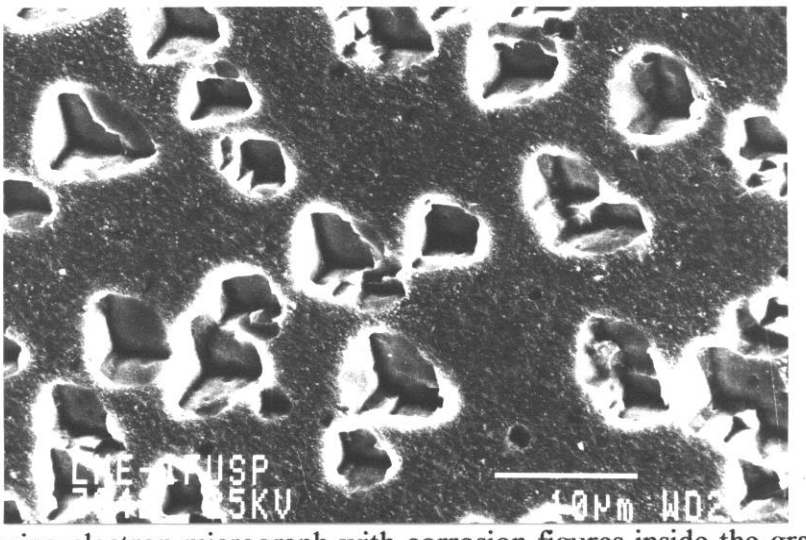

FIG. 1 - Scanning electron micrograph with corrosion figures inside the grains of the Fe-3%Si sample after hot compression processing. The grain texture is near to {211} <011>.

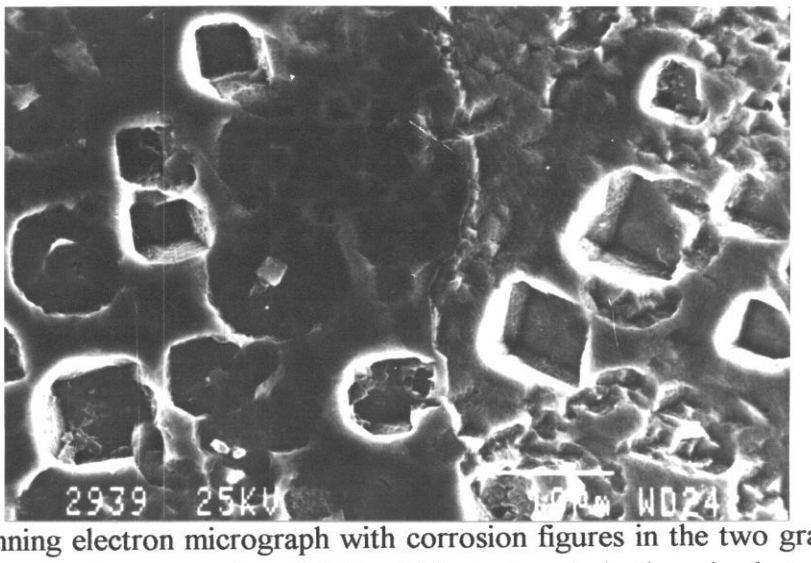

FIG. 2 - Scanning electron micrograph with corrosion figures in the two grains in the Fe-3%Si sample, after hot compression processing. {001} <011> texture in both grains but with some deviation between them.

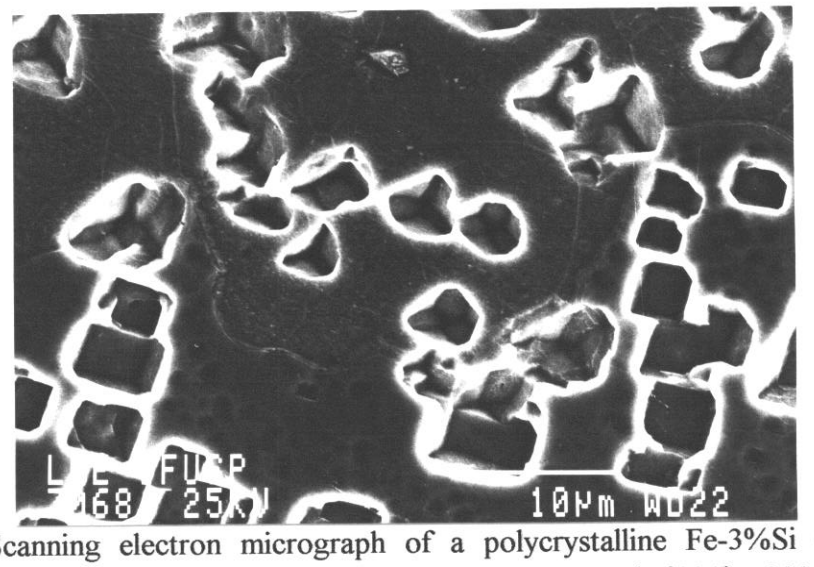

FIG. 3 - Scanning electron micrograph of a polycrystalline Fe-3%Si sample after a hot compression process including two texture types: {211} <011> and {001} <011>.