Effect of the sheet-straightening process on magnetic properties and texture evolution of high-strength Fe-Si alloys.

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Fe-Si alloy sheets, called also non-oriented (NO) electrical steels, have excellent magnetic properties such as magnetic permeability, high frequency, low iron loss, and almost zero magnetostriction. This type of steel has good application prospects in high-speed high-frequency motors, transformers, and other equipment [1]. Their good soft magnetic characteristics strongly rely on the ability to control the grain size, texture, and chemistry of the final steel sheets products. The most appropriate texture for NO steels is the "rotating cube" texture, which provides isotropic magnetic properties in all plane directions of non-oriented steels [2]. In the present work, we have used a fairly innovative technological approach applicable to fully-finished high–strength NO electrical steel before punching the laminations. It is based on a specific mechanical treatment by means of the sheet-straightening process in combination with subsequent annealing under dynamic heating conditions. It has been revealed that the proposed unconventional treatment clearly led to effective improvement of the steel magnetic properties thanks to its beneficial effects involving additional grain growth with appropriate crystallographic orientation and residual stress relief. The main idea behind the improvement of soft magnetic properties relies on the formation of huge grains with the desired orientation. The coarse-grained microstructure with the pronounced intensity of cube and Goss texture components was achieved by using deformation-induced growth of ferrite grains during annealing at dynamic conditions. The magnetic measurements of fully finished samples in AC magnetic field conditions have clearly indicated that the evolved microstructures and textures of the strips, obtained by the application of a straightening mechanism and heat treatment using two different procedures, are directly responsible for their final magnetic characteristics. The power loss data have clearly shown that the investigated steel treated according to our innovative approach exhibited a more than 16% decrease in power losses at 400Hz in comparison with the material treated by conventional stress relief heat treatment without activation of grain growth.

References:

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