Texture sharpness of Fe-3%Si grain-oriented electrical steels with different magnetic properties

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Grain-oriented Fe-3%Si steels are characterized by a sharp {011} <100> Goss texture and a very large grain size in the range of millimetres to centimetres. They are used as cores in electrical transformers due to their specific soft-magnetic properties, i.e. high permeability and low core losses.

The texture sharpness is usually regarded as a measure for the magnetic properties of grain-oriented steels and vice versa. The analysis of the texture sharpness is not at all trivial due to the enormous grain size and narrow peak of the orientation distribution function. One of the few publications found in the literature comparing the deviation of the <100>-axis (direction of easiest magnetization) from the rolling direction (RD) for high permeability (HGO) and conventional grain-oriented steel grades (CGO) was written by Taguchi et al. in 1976 [1]. Unfortunately, there is no information given as to the measurement and analysis of the data. It is astonishing that no further attempts have been made during the last decades to investigate the texture of grain-oriented electrical steels (and to correlate it with the magnetic properties) although more powerful tools with regard to measurement speed and precision have been developed.

Recently, a measurement technique for orientation determination of large grained materials with high statistical significance was developed by the authors, based on a stacked sample setup in combination with large-area EBSD based orientation microscopy (EBSD: electron backscatter diffraction) [2]. Since standard techniques of texture analysis like series expansion with spherical harmonics (Bunge and Roe) are suitable only to a limited extend in case of sharp orientation distributions, a novel method for the evaluation of the Goss orientation spread was proposed based on discrete misorientation distributions normalized by the volume in Rodrigues orientation space [3]. This new technique was applied to HGO and CGO and peak widths of 4.3° and 6.5°, respectively, were found.

In order to test the method, a set of HGO samples is investigated. These samples differ in magnetic properties due to variations of process parameters. It is well known, that aging during cold rolling as well as ultra-rapid heating (URH) prior to decarburization both affect the magnetic properties in a positive way. By applying the texture analysis described above, we are measuring which possible effect aging and URH do have on the peak width of the Goss peak and if a direct correlation of the texture sharpness and the magnetic properties is feasible.

[1] S. Taguchi et al., JMMM **2** (1976), 121-131.

[2] M. Frommert et al., JMMM **320** (2008), e657-e660.

[3] M. Frommert et al., to be published.

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