

Non invasive testing for electrical steels with Goss orientation

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Goss texture analysis is one of the most important tests for the quality assessment of Grain Oriented Electrical Steels (GOES). In general this test is very expensive and time consuming since the very complex instrumentations have to be involved [1]. In this work we take into account the magnetic properties of the crystalline structure of the material under test, in order to check its orientation. Starting from the theory developed in previous papers [2-3] the accuracy and the reliability of the proposed method are improved. The Goss orientation of a GOES lamina can be assessed using a disk sample smaller than the material grain as described in figure 1. The disk is cut by a suitable laser technique inside the grain boundary: in this way the sample has uniform crystalline structure and the measurement procedure proposed in [3] get accurate results. The 3-D Goss orientation of the grain under test is estimated by means of the measurement of the lag angle between magnetic field and magnetic induction. In particular, starting from the positions of the zero lag angle, we get information about the orientation of the three axis angles of the crystalline structure respect to the reference frame. In the figure 2 the typical relationship between crystalline orientation and the zero lag angles values is reported.

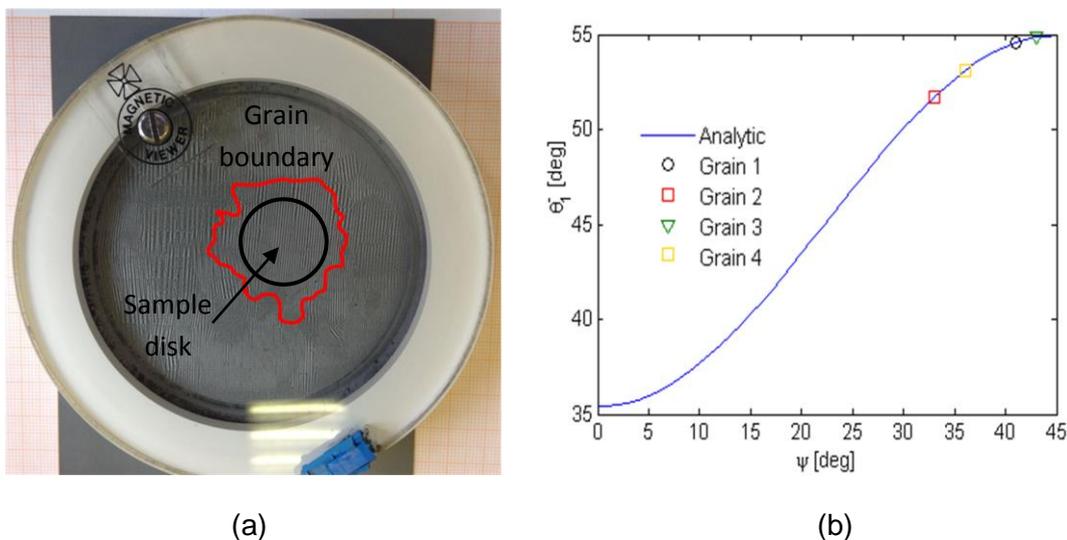


Figure 1. a) Grain boundary and the sample disk; b) typical relationship between Goss orientation ψ and the zero lag angles θ_1 for different grains.

[1] H. J. Bunge, Texture Analysis in Material Science, Butterworth & Co. 1982.

[2] Cardelli, E., Faba, A., Laudani, A., Pompei, M., Quondam Antonio, S., Fulginei, F.R., Salvini, A., "A challenging hysteresis operator for the simulation of Goss-textured magnetic materials", (2017) Journal of Magnetism and Magnetic Materials, 432, pp. 14-23.

[3] Cardelli, E., Faba, A., Laudani, A., Antonio, S.Q., Fulginei, F.R., Salvini, A., "Surface Testing the Crystal Grain Orientation by Lag Angle Plots", (2017) IEEE Transactions on Magnetics, 53 (6), art. no. 7882682.