1.1.1. PHYSICAL BASICS AND INDUSTRIAL APPLICATIONS OF 3MA – MICROMAGNETIC MULTIPARAMETER MICROSTRUCTURE AND STRESS ANALYSIS

Dobmann G., Fraunhofer IZFP, Saarbrücken, Germany

Micromagnetic NDT techniques like the measurement of the magnetic Barkhausen noise, the incremental permeability and the harmonic analysis of the tangential magnetic field allow deriving inspection procedures to online monitoring and control machinery parts and components in production processes in order to characterize mechanical properties like hardness, hardening depth, yield and tensile strength. These types of inspection procedures continuously were further developed in the last two decades so that today the forth generation of system hard and software is in industrial use. The application is in steel industry where steel sheets in hot-dip-galvanizing lines were annealed after cold rolling but also in heavy plate rolling mills where after thermo-mechanical rolling special textures and texture gradients can occur. An increasing number of applications are also to find in the machinery building industry and here especially in case of machinery parts of the car supplying industry. The contribution introduces in the methodology of the micromagnetic, multiparameter, microstructure and stress analysis (3MA), which, however, only can be applied at ferromagnetic materials and describes the physical basics of the techniques. The applied technology is especially sensitive for mechanical property determination as the relevant microstructure is governing the material behavior under mechanical loads (strength and toughness) in a similar way as the magnetic behavior under magnetic loads, i.e. during the magnetization in a hysteresis loop. In different case studies the advantage to implement 3MA into the industrial processes is discussed.

3MA-probe with robot to measure on-line hardness at strips

3MA-application at gear-wheels

Fig. 1

References:

1. **Altpeter I., Becker R., Dobmann G., Kern R., Theiner W., Yashan A.** Robust Solutions of Inverse Problems in Electromagnetic Non-Destructive Evaluation, Inverse Problems 18 (2002), 1907–1921.