An approach for reliable classification of process specific influences using the Barkhausen noise multiparameter analysis

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Components for drive train applications are mainly case-hardened. Following the heat treatment hard finishing by grinding is applied to remove hardening distortion, to generate high-quality surfaces and to meet demanded form tolerances. Resulting from the grinding process, the thermo-mechanical load affects the subsurface area and therefore influences the functional behaviour of the workpieces. Using wrong adjusted process parameters or an imperfect coolant supply can result in thermo-mechanical damages, called grinding burn. Depending on the degree of damage, different effects occur. Low tensile residual stresses can already be observed for light damages. A decrease of the hardness due to tempering zones indicates a stronger degree of damage, whereas rehardening zones respectively grinding cracks combined with high tensile residual stresses characterize the strongest degree of damage.

Temper etching is a common method to detect grinding burn in industrial environments. Applying different chemicals, thermal damaged surface areas can be identified by a discoloration. Disadvantages are the environmental compatibility and the disposal of the chemicals. Light damages (low tensile residual stresses without any tempering zones) can not be detected by temper etching due to the fact that only structural changes are indicated by this method. Furthermore, the disposure time, the chemicals concentration and the cleanliness of the chemicals as well as the workpiece highly influence the result. Certain insecurities of this method are the consequence. Besides temper etching, nondestructive micromagnetic methods can be used for evaluation of ground surfaces. Recently, the analysis of the Barkhausen noise gained in importance in industrial production for quality control. However, the influence of the grinding process on the Barkhausen signal ist still not finally scientifically validated.

In this study, the Barkhausen noise was used for a nondestructive characterization of process specific influences on the subsurface area. Case-hardened workpieces of 18CrNiMo7-6 steel were finished by external cylindrical grinding with varying process parameters. The subsurface area was investigated by microsections and depth paths of the residual stress state. Based on the results, different influencing grades were defined and a Barkhausen multiparameter analysis was carried out. Specific parameters as the RMS-value and the Coercivity were identified for a reliable detection of thermo-mechanical influences. With these results an apporach for clear seperation between good and rejected parts was developed. Furthermore, the filter settings were varied to get information out of different areas of the subsurface region. Depending on the degree of influence, different signals could be observed with varying filter settings. With the use of these results a distinct classification of different process specific influences due to grinding is possible and more reliable as with temper etching.