Determination of the case depth by ultrasonic backscatter of case and induction hardened steel with a soft hardness gradient.

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Heat treatment of steel is a common industrial procedure to alter the microstructure of a component locally. Often, only the surface of a component is heat-treated to a certain thickness such that it benefits from the high durability provided by a hardened microstructure, while the core microstructure remains ductile. The nondestructive determination of this thickness, the case hardened depth, can be performed by evaluation of the differences of the ultrasonic backscatter from the grains in the different layers. However, current methods require a small transition zone from the hardened to the core microstructure for accurate results. In this work, a different approach for the determination of the case hardened depth of components with a large transition zone is described. This approach utilizes ultrasonic frequencies about 20 MHz in contact technique. The ultrasound is introduced in an oblique setup with a wedge and is mode converted to the transverse mode. The statistical evaluation of the backscattering shows promising results for the determination of the case hardened depth of hardened components with a smooth decrease of the hardness over the thickness. Furthermore a theoretical model could be derived for the prediction of the backscattering dependent on the average grain size increasing over the depth.