Induction hardening depth measurements by laser ultrasound for automotive industry

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Induction hardening is a heat treatment process for improving the hardness and surface wear resistance in the top layer without losing toughness in the core of the component. Induction hardening is typically used for components such as crank shafts in the automotive industry. The resulting hardening depth that impacts the performance, can be varied by changing temperature and/or time. Today the quality control consists of destructive Vickers hardness testing by microscopy only before and after a production-campaign, which may be days or weeks of manufacturing. In a worst-case scenario, the destructive testing after the campaign detects that the quality of the hardened surfaces is below acceptable levels which might require that the whole batch must be scrapped. This work will solve this problem by demonstrating the use of an integrated system based on a non-destructive testing (NDT) method. This work will demonstrate how a laser ultrasonic-based system can be used to image the microstructural difference in depth, and thereby quantify the resulting hardening depth. The hardened surface results in a fine martensitic structure compared to a significantly coarser microstructure of the bulk, which can be imaged by looking at the back-scattered signals. The results to be presented will show the accuracy of laser ultrasonic data compared to destructive microscopy. The major advantage with LUS, compared with other NDT- methods, is that it is a contact free method and is therefore more suitable for inline automation and implementation in complex industrial processes.