Detection of grinding burns on carburized steel by Magnetic Barkhausen noise technique

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Keywords: grinding burns, magnetic Barkhausen noise,

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Gears and geared system are used for the transmission of power at different speeds and torques from an engine to driven module. The gears and shafts are one of the critical rotating components of modern aircrafts. Manufacturing of gears consists of several processing operations which may be gathered into seven blocks reflected by the following consecutive steps: rough machining, teeth cutting, thermochemical treatment, teeth grinding, finish machining, coating/plating, non-destructive testing and dimensional inspection. Nowadays two steel grades, AISI 9310 according to AMS 6265 standard and Pyrowear Alloy 53 according to AMS 6308 standard, are predominantly used for manufacture of aerospace gears and shafts. Gears are often subjected to carburizing process to improve their wear and fatigue resistance. Subsequently the grinding process is carried out to achieve the required dimensional and geometrical tolerance. Grinding needs a special attention in choosing the correct parameters as well accurate and continuous control. Inaccurately performed grinding may cause "grinding burns" that strongly impact he expected characteristics and performance of gears or shafts. Therefore different NDT techniques are applied to reveal the presence of grinding burns. Magnetic Barkhausen Noise (MBN) technique is presently widely and successfully used.

In this work the artificial defects for simulation of the grinding burns were manufactured on the carburized AISI 9310 steel substrate by laser processing. Single passes of laser beam along the straight lines at various process parameters caused surface heating and melting. Laser beam radius was 2 mm at the power between 80 and 320 W. Travel speed of the laser beam was in the range of 250 to 1250 mm/min.

Microstructure observations of laser irradiated areas were performed by Light Microscopy (LM) along with the hardness measurements on their cross section parallelly and perpendicularly to the surface. MBN measurements were performed perpendicularly to the tracks created on the surface by laser beam. Results showed a correlation between the Barkhausen Noise signal and hardness of the material.

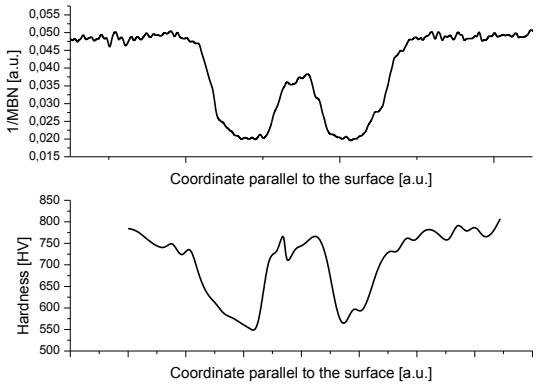

Figure 1. Inverse of the MBN and surface hardness as a function of coordinate parallel to the surface

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