

Magnetic Field Sensor with an Amorphous Core for Non-Destructive Testing

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Non-destructive testing is an important part of production processes and the inspection of machinery and structures, as well as steel components used in construction, energy and transport, particularly in the aviation and maritime industries. Despite the intensive development of these methods over the last 120 years, the demand for their improvement, simplification and acceleration remains high [1]. The subject of this paper is a magnetic field sensor that can significantly improve and expand the application of magnetic methods in non-destructive testing. The sensor is supposed to detect the magnetic field leakage caused by discontinuities in ferromagnetic material during magnetisation [2].

A magnetic field sensor with a core made of multiple layers of amorphous tape was designed, manufactured and tested. Amorphous strips are thin metallic strips usually obtained by ultra-fast cooling of liquid alloy on the surface of a rotating drum. Unlike classic electrical steel sheets, they do not have a long-range crystalline structure. This structure promotes very good magnetically soft properties – low core losses, low coercivity and high permeability [3].

The cores made had a horseshoe shape. The individual layers were glued together with epoxy resin. The winding was wound on the core. Due to the low signal value in the measuring system, it was decided to use an amplifier. Subsequently, the correct operation of the sensor was verified. The test objects were two steel samples. The samples were placed in a magnetic yoke generating a varying magnetic field. Then, the results were analyzed, confirming that the proposed sensor was capable of detecting discontinuities beneath thin coatings.

The objective of the study was to verify the performance of a sensor with an amorphous core used as a magnetic field leakage detector in the magnetic non-destructive testing method. A core design meeting the specified requirements was developed. An amplifier design was developed and constructed to process signals from the cor. The operation of the complete system was verified, confirming its effectiveness in detecting defects in materials.

References:

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