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DEVELOPMENT OF A SENSOR MODEL FOR A DYNAMIC INDENTATION DEVICE

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Introduction. Quality control of materials at various stages of the product life cycle is an urgent and demanded task in production. Nowadays, sampleless methods for controlling physical and mechanical properties are widely used to solve the problem of non-destructive testing (NDT) of products or components at the stages of production, testing and operation. The use of these methods reduces the final cost of products, increases efficiency and makes it possible to carry out control at the stage of operation of the product, sometimes without stopping its operation. One of the promising methods for sampleless testing of the mechanical properties of product materials is the method of dynamic indentation (DI). This method makes it possible to carry out sampleless control of the hardness and other mechanical properties of the material. This method has the ability to perform NDT of both metals and low-modulus polymers and composite materials. Currently, most research in the field of the DI method is focused on solving the transition from the values of the contact impact interaction (CII)characteristics of the indenter with the material during the test to the values of specific mechanical characteristics.

The purpose of this work is to develop a computer model of the sensor for the dynamic indentation device. To achieve the goal, the following tasks were set: development of the finite-element model of the primary transducer, development of the finite element model of the CII process and development of a 3D model of the dynamic indentation sensor layout.

Main part. The essence of the DI method and its instrumental implementation is to record the parameters of the indenter motion in the course of the CII with the material under test. Registration of indenter motion parameters is carried out using a primary transducer, which is currently based on the magnetic induction principle. A fixed inductance coil is used as a means of recording the parameters of indenter motion. The movement of the magnet causes a change in the magnetic flux passing through the inductor during the CII. At the same time, an EMF signal, proportional to the speed of the indenter movement over the entire time interval of its EMF, is induced in the coil.

The dynamic indentation sensor is one of the main elements of the device with the help of which primary information is obtained during the CII. At present, portable Leeb hardness testers are used for dynamic indentation devices, which imply recording the velocity of the impactor at the beginning and the end of the interaction. The dynamic indentation method is based on the continuous recording of the impactor motion parameters over the entire time interval of the CII, thus the use of hardness testers designed to measure hardness using the Leeb method is not advisable.

Conclusion. As a result of the performed work, two finite element models of the process of registering the movement of the impactor and the CII process, as well as a 3D model of the dynamic indentation sensor itself, were developed. These models will form the basis of the future dynamic indentation sensor, and will also be used to further study the indentation processes and their relationship with the mechanical characteristics of the materials under study. Currently, a prototype of an experimental sensor is being developed, and a library of results is being collected to implement machine learning methods in this prototype.

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