SUMMARY

ANALYSIS OF MATERIAL MOVEMENT IN MICRO– AND NANOCUTTING ZONE A DIAMOND ABRASIVE GRAIN

The doctoral thesis presents issues related to the micro– and nanoprocessing of glass, which belongs to the group of brittle materials. Nowadays, glass is widely used in industry and in everyday life. In recent years, ultraprecise glass processing has been dynamically developed, and the demand for elements made with its use is constantly growing.

In view of the above, research was undertaken to analyze the movement of glass material in the process of micro– and nanocutting with single diamond grains and the grinding process with the use of grinding wheels built on the basis of this type of grain. The aim of the research was to develop the basis for identifying the conditions under which the undesirable mechanism of brittle fracture of glass materials occurs. The result of the work is the development of experimental foundations for the technological process of processing glass materials in such a way as to control and minimize the mechanism of brittle fracture, with the possibility of the domination of the plastic deformation mechanism in the processing zone.

In addition, tests were carried out to check whether the analyzed micro– and nanosingle edge machining processes would translate and could be used in machining with multi–edge tools. From the application point of view, it is important in technological practice that the cutting processes of glass materials are carried out under the conditions of plastic flow of the material in the processing zone and ensure reproducible machining results.

In the next stages, the grinding process was to be carried out in brittle fracture conditions, using the infeed exceeding the limits of plastic processing of the glass material, and this was dictated by the next research stage checking the possibility of withdrawing defects resulting from the brittle fracture phase, using a magneto–rheological fluid with specific working characteristics in an electromagnetic field.

The perceived possibility of using magneto–rheological fluid allowed to smooth the surface structure and the cut layer formed in the micro– and nanomachining process. Such a treatment method can minimize defects on the surface and in the top layer of the processed material. At the same time, it enables the geometry to be shaped in a dimensionally determinate manner, unambiguously and with a complex shape.

The conducted research and analyzes allowed for the formulation of final conclusions confirming the hypothesis put forward in the doctoral dissertation.

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