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Development of expert system for the process of high-speed diamond grinding of superhard materials based on macro- and microscale 3D models

ABSTRACT. A feature of grinding of superhard materials is the absence of excess hardness of the tool material over the machined one. Hence there is no cutting process in the classical way, and the grinding process is a process of controlled mutual microdestruction of two equally hard materials (diamond grain and processed superhard material (SHM)) upon high-speed impact. The manufacturing and operation processes of the diamond-abrasive tool were investigated with the help of dynamic 3D modeling of the high-speed diamond grinding processes at macro and micro levels. This makes it possible to solve the following tasks: at the design stage, calculation of the tool design for certain processing modes; at the manufacturing stage, determination of rational conditions for sintering the diamond layer of the grinding wheel; at the application stage, the theoretical determination of processing productivity, especially the consumption of diamond grains. The solution of these problems by means of simulation allows processing efficiency to be significantly increased. The introduction into industry of the results of such modeling of high-speed diamond grinding processes can be effectively accomplished using expert systems that allow problematical situations to be solved based on optimizing the manufacturing conditions and operating modes of diamond wheels; the expert systems also increase the level of automation directly in production.

Keywords: algorithm, diamond wheel, finite element method, methodology, simulations, variables

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