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THE COURSE OF THE EVOLUTION OF THE DISLOCATION STRUCTURE AND GEOMETRY OF THE PLASTIC STRAIN AREA AS THE MAIN CRITERI ON FOR VERIFYING NUMERICAL SIMULATIONS OF PROCESSES BASED ON MATERIAL SHEARING

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ABSTRACT

Metal forming processes can be divided into two main groups: processes requiring fracture elimination or delay and processes based on fracture. While for the former group it is most important to determine the onset of fracture, for the latter group also the course of the fracture is important. The numerical modelling of the two aspects still poses a problem.

The causes of the problem are complex and lie in both the theory [1, 2] and methods of numerical modelling of processes based on material shearing (die shearing, machining, etc.) [3-6]. Hence there is a growing need for knowledge relating to the control and numerical modelling of processes based on material shearing. The problem is compounded by the dynamics of the processes. At high strain rates the formation of a continuous chip (or even a saw tooth chip) poses a danger. For this reason chip fracture is desirable. As a result of fracture a segmental chip forms, ensuring not only a high shearing process efficiency but also tool, machine and operator safety.

The main aim of this paper is to show the limitations of the hitherto methods of numerical modelling of fracture and to propose a solution to the problem.

Therefore the drawbacks of the widely used finite element (FE) method and the cell automatic (CA) method as well as the advantages and limitations of the combination of the methods (CAFE) [7] will be discussed. The possibilities of modelling the onset and course of fracture and the suitability of the hitherto fracture criteria will be examined.

A new way and new criteria of verifying the results of numerical simulations of processes based on the isothermal shearing of materials will be proposed. The criteria stem from the mesoscopic-macroscopic shear mechanism model developed by the present author [8, 9].

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