RESIDUAL STRESSES AND SURFACE WORKHARDENING INDUCED BY MICRO CUTTING PROCESSES

Hermann Autenrieth, Brando Okolo, Volker Schulze, Alexander Wanner, Detlef Löhe

Institute for Materials Science and Engineering I, University of Karlsruhe (TH),
Kaiserstrasse 12, 76131 Karlsruhe, Germany

Machining processes such as cutting constitute a critical finishing stage in production. Numerous studies reported in the literature show that the thermoplastic deformation induced by the cutting process can ultimately determine the operational behavior of a component. A number of factors have been identified as capable of markedly influencing this thermoplastic deformation. These factors include the cutting edge geometry, the depth of cut, and the hardness of the workpiece. A primary consequence of the cutting process is the development of residual stresses in the worked surface. Compressive residual stresses are beneficial for the fatigue life of mechanically loaded components while tensile residual stresses may lead to unanticipated failure. Therefore it is important to gain further knowledge of how these factors influence the state of the materials.

The present study focuses on how the depth of cut and cutting edge radius influence the residual stress state and work hardened state in normalized AISI 1045 steel which was machined by an orthogonal micro cutting process. X-ray diffraction has been used to determine the residual stress state in the micro cut surfaces applying the $\sin^2\psi$ method. Hardness profiles elucidating the depth distribution of work hardening in the subsurface regime were obtained using micro indentation. Special attention has been given to the ploughing effect determined by the ratio of the cutting edge radius to the depth of cut. The results provide a basis on which an optimization of the cutting process can be managed.

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Corresponding author:
Dipl.-Ing. Hermann Autenrieth
Institut für Werkstoffkunde I
Universität Karlsruhe (TH)
Kaiserstrasse 12
D-76131 Karlsruhe, Germany
Tel.: ++49/721/608-2676
Fax: ++49/721/608-8044
Email: hermann.autenrieth@iwk1.uni-karlsruhe.de

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