Cutting edge preparation of micro-milling tools at the limit

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Abstract

Micro-milling is an appropriate process for the industrial production of high precision parts in the die and mould industry. A main reason for premature tool failure in micro-milling is the random wear behaviour of the cutting tools. Grain outbreaks as well as an increased chipping of the cutting edge after the grinding process are reasons for an increased tool wear and a unconstant surface roughness of the machined workpiece. An approach to improve the tool wear behaviour is a defined cutting edge preparation using the immersed tumbling technology. Especially, before coating the preparation of tools with a diameter of $D \leq 0.5$ mm is of increasing interest. However, high loads within the preparation process can lead to outbreaks of the cutting edges and tool breakage. Further knowledge about the opportunity of reliable preparation of defined cutting edge micro-geometries is needed.

This contribution describes results of the cutting edge preparation of micro-milling tools with a diameter in the range of $0.1 \text{ mm} \leq D \leq 0.2$ mm. Therefore, the immersed tumbling process is used and the influence of the parameter processing time, depth of immersion and lapping medium were evaluated. After the preparation process the tools were analysed with the optical measurement device InfiteFocus from the company ALICONA IMAGING GMBH, Graz, Austria, and images with a scanning electron microscope (SEM) were taken.

The results show the possibility to manufacture homogeneous cutting edges with cutting edge radii in the range of $1.8 \text{ µm} \leq r_\beta \leq 6.4$ µm and decreased chipping of the cutting edges up to 53 %. Thereby, the lapping media showed the main influence on the cutting edge radius and the chipping of the cutting edge, see Figure 1.

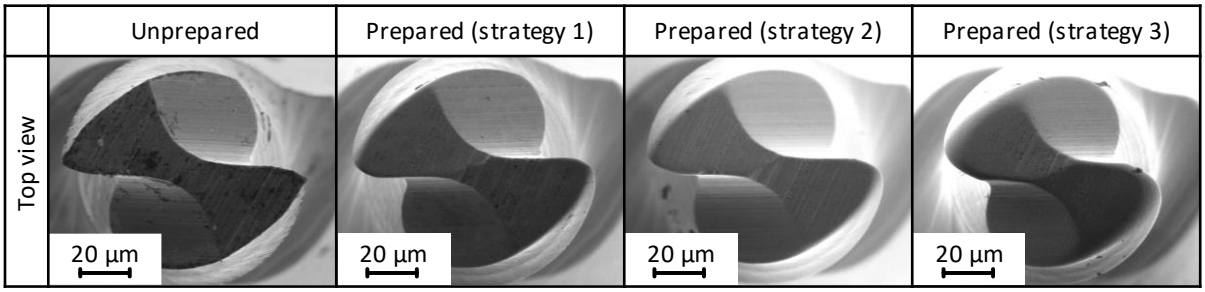

Figure 1: SEM-images of unprepared and prepared micro-milling tools with a diameter D = 0.1 mm