Influence of process parameters on micro-milling process of tungsten carbide-based MMC-Material

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Abstract

Micro-injection moulding is a key technology for the cost-effective production of plastic parts for a wide range of industrial applications. The commonly used moulds are made of hardened steel, because of the local high loads during the micro-injection moulding process. These moulds are usually machined by micro-milling with coated cemented carbide tools. These tools suffer from random tool breakage and excessive wear. One solution to achieve the required service life of these tools is to produce injection moulds made of non-ferrous metals and reinforce the surface of the moulds in regions of high loads. The reinforcement can be achieved by inserting tungsten carbide particles into the surface of these soft materials through laser melt injection. The resulting metal-matrix-composites (MMC) exibit the needed wear resistence during the moulding process, while the ground material can be machined without servere tool wear of the micro-milling tools. Since the micro-milling of these MMC-Materials is not state of the the art, stable process parameters have to be developed.

Thus, this investigation addresses the micro-milling process of the resulting MMC-Material through analysing different parameter combinations. The feasibility of binderless polycrystalline diamond as an innovative cutting material is investigated and successfully demonstrated in this study. The process forces and the surface roughness were measured. Furthermore, images with a scanning electron microscope were analysed to evaluate the resulting surface integrity for all parameter sets. The passive force was found to be the highest component of the process forc and shows a stagnating behaviour, when the feed rate was increased over a certain value. Ductile cutting of tungsten carbide-particles could be achieved within the choosen set of parameter, without damaging the non-ferrous base material. This was found to be of high significance for a stable cutting process and when high surface quality is required.