The use of binderless carbide as a milling tool to increase process reliability and economic efficiency

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Abstract

In order to fulfill the continuously growing requirements for high-quality optics and special components in the aerospace industry as well as in mold and tool making, mainly hard and wear-resistant materials are used. A common process for machining these materials and realizing these requirements is milling. In industry, milling tools made of carbide are predominantly used for milling. These enable long tool life and high process reliability. According to the state of the art, carbides are used as cutting material with the addition of an elastic binder, which considerably increases the elasticity modulus of the cutting material. However, this results equally in a loss of hardness of the cutting material, a shorter cutting path l_c and lower process reliability.

To counteract this, various methods are being investigated at the FRAUNHOFER INSTITUTE FOR PRODUCTION SYSTEMS AND DESIGN TECHNOLOGY IPK, Berlin, and at the company SOMMERTOOLS CNC-NC SCHLEIFTECHNIK, Genthin. One approach is to reduce the binder, which allows harder tools to be produced.

Within the scope of these investigations, milling tools were manufactured from carbide with a content of tungsten carbide WC > 99 % and cobalt Co < 1 %. For this purpose, the manufacturing process of the milling tools as well as the milling strategy were developed. The optimization method Design of Experiments (DoE) was used to identify the ideal milling parameters.

The manufactured milling tools have a diameter D = 9.8 mm and were validated with an aluminum alloy used in the aerospace industry. The aluminum alloy exhibits high tool wear in conventional milling tools. The novel milling tool was able to achieve a cutting path l_c > 100 m at a metal removal rate Q = 81 cm³/min. These results show that the developed milling tool can be used as a roughing tool. The low wear behavior of the milling tool enables precise and reproducible preparation of the workpiece, which means that the final machining steps can be minimized while maintaining the same surface quality.