Boron doped single crystal diamond for temperature measurement in the cutting zone

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Abstract

Ultraprecision machining is an established process for manufacturing of optical components in automotive, medical or aerospace industry. The use of single crystal diamond tools enables the manufacturing of optical and functional surfaces such as mirrors or lenses. Despite the high mechanical hardness, wear of the diamond tools occures during the process. To characterize und interpret the wear processes of diamonds, the cutting temperature needs to be analysed. Currently, the development of the cutting temperature during the process is not completely investigated.

The aim of the project is to measure the temperature in the cutting zone of the diamond. This is done by the use of the electrosensory features of the boron-doped diamond tool, which enables a direct measurement in the cutting zone of the diamond tool without delay time. To realise this, the electrosensory properties of the BDD were investigated and a proper degree of doping was determined. For the metrological connection of the BDD an evaluation of electronics with integrated software were developed to digitize analog signals. The metrological system was tested for operational readiness and investigations with typical process conditions of ultraprecision cutting were carried out. First results show the succesful application of BDD as cutting tool with integrated sensor properties. Furthermore, the BDD enables a contactless automatic touching, which increase the touching accuracy. The next steps of this ongoing work address the improvement of sensor sensitivity.