Development of a handling system for single carbon fibres as tool electrodes in micro-EDM

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Abstract

A variety of technical applications require precisely machined micro holes with diameters much less than 1 mm. One established process to manufacture micro holes is electrical discharge machining (EDM). EDM is especially applicable for electrically conductive hard materials, but it still poses a challenge to create hole diameters below 50 µm. On top of that, based on the state of the art it is very time-consuming to prepare pin tool electrodes of even smaller diameters. These are usually made in an additional electrical discharge dressing process. One promising solution to overcome this obstacle is the use of single carbon fibres as tool electrodes because these fibres are already fabricated with diameters between 5 µm and 10 µm. Nevertheless, the handling of a single carbon fibre is especially challenging due to its small diameter, its brittleness and its vulnerability to shear force.

To solve this problem a special handling system for the clamping and guiding of the carbon fibre tool electrode was designed. The requirements were systematically assessed and several partial solutions for each component were brought together. The partial solutions were combined to three concepts of the handling system. Essential criteria for the system were defined and the concept variants were evaluated according to those. As the most important criterion the clamping force was identified. Therefore, the final clamping jaws are made of polymer which allows part of the energy to transform into the deformation of the jaws instead of the fibre. One jaw is movable and establishes the electrical contact between the electrode and the generator through a conductive coating. A glass micro pipette is applied as a guide to ensure the positioning accuracy of the electrode. The developed handling system will be used in extensive experiments in the future with the objective of determining the properties of single carbon fibres as tool electrodes in micro-EDM. These findings will help to improve the reproducibility as well as the productivity of the micro-electrical discharge drilling process.