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Influence of Cooling Lubricants on the Interaction Between Indenter and Material Surface During Scratch Tests

Felix Kästner[1] and Kristin M. de Payrebrune[2]

[1] Institute for Computational Physics in Engineering, Technische Universität Kaiserslautern, Erwin-Schrödinger-Str. 56, 67663 Kaiserslautern, Germany, felix.kaestner@mv.uni-kl.de
[2] Institute for Computational Physics in Engineering, Technische Universität Kaiserslautern, Erwin-Schrödinger-Str. 56, 67663 Kaiserslautern, Germany, kristin.payrebrune@mv.uni-kl.de

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Striving for the optimization and the increase of efficiency of various systems demand further developments of classic manufacturing methods. Especially grinding processes, which are characterized by undefined cutting-edge geometries, reveal many fields where there still is a lack of understanding in terms of individual and connected processes. In particular, the processes at and their effects on the individual abrasive grit are insufficiently researched and, therefore, do not allow sufficiently accurate behavior predictions.

In order to optimize grinding processes and, ultimately, the resulting quality of the workpiece surface, it is necessary to look at the entire process in a holistic and qualitative way. Due to the large number of influences to which the grinding process is subject, it is initially advisable to break down the process as far as possible into individual scratch tests and then gradually return to the overall process. One approach is the development and expansion of an FEM-based physical force model, which allows for the stimulation and prediction of a scratch tests and, subsequently, also the entire grinding process with all relevant influencing factors.

One of these influencing factors, which are essential but yet unconsidered, are cooling lubricants, especially their tribologically favorable influence on the interaction between workpiece and indenter, which is a model of a single abrasive grit we use in scratch tests. Therefore, it is important to identify and investigate the different aspects, such as the friction phenomena, of scratch tests that are influenced by the use of cooling lubricants. In addition to temperature and force characteristics, which have been found to differ with and without cooling lubricant, differences in the scratch geometry on the material surface have also been observed in recent tests. Based on these findings, this work examines the relationships between scratch geometry and cooling lubricant. Optical measuring methods are used to record the scratch geometry, which allows the depth and width of the scratch to be reliably recorded.