OR0204

Experimental Studies vs. FEM Simulation Results of the Dry Cutting Behaviour of MW-CVD Diamond-Nanocomposite coatings

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For wear-related thin film applications, the development of film systems for mechanical loading is structured in three steps: 1. Deposition of the film system, 2. Characterization of the film system and 3. Operation testing in applications. Operation testing in application is a time consuming step in coating development. To improve the film system, all the three steps have to be repeated several times which is often time consuming and expensive.
To reduce the effort, numerical FEA simulation was introduced into the chain of coating development to predict the coating behaviour and to generate optimum coating properties due to the simulation results. Therefore two scenarios were simulated by FEA using ABAQUS finite-element software.
One the one hand is the crack initiation and its evolution upon loading by a standardized ball indentation test. On the other hand an orthogonal cutting model was introduced to predict the cutting forces during dry cutting of aluminum alloy.
As film system, diamond/beta-SiC nanocomposite coatings were deposited by MW-CVD onto WC_6Co cemented carbide cutting inserts. This film system combines excellent hardness and sufficient overall film ductility.
The two scenarios for the numerical FEM analysis were also carried out experimentally and compared with the FE results. Therefore simulation relevant coating and coating-compound characteristics were characterized. The results show good compliance between experiments and FEA-simulation for both scenarios.

Keywords
nanocomposite
coatings
diamond
FEM
machining