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Evaluating mechanical properties of complex material structures from a new combination of calotte grinding and indentation tests

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Depending on the material structure and the indentation device capabilities, it's often not possible to measure the true coating parameters without any underlying material effect. SIO developed a model and a dedicated software package called Oliver & Pharr for Coatings which allows the determination of true generic material parameters for a coating by knowing the parameters of the substrate and all underlying layers. To apply this approach to a complex multilayer stack of different materials, one needs to stop the production process after every added layer. Then the indentation measurements are performed to determine the material parameters for the top coating. This analysis is repeated for every layer in a possibly very complex coating structure. This approach has severe drawbacks: Firstly, it's not always possible to coat the complete structure layer by layer and perform the measurements after a layer is added. Secondly, it's possible that during the coating process the parameters of the underlying layer are changed, because of some interface effects. Because the calotte grinding tests are widely used to determine the layer thicknesses, SIO thought about using the possibility to directly access the deeper parts of a complex layer stack by applying a combination of calotte grinding and subsequent indentation testing. We created a new module which analyzes a series of indentation measurements which were performed from the inside to the outside of the calotte test crater. So, it's possible to perform tests on the substrate and all layers. It was built into the software package FilmDoctor® which subsequently analyzes such a measurement series starting with the substrate measurements. All evaluated values are used for the next iteration step of the new analysis method. At the end the material parameters for all layers are determined without the need of stopping or changing the production process.

Biography

Nick Bierwisch studied Computer Science from 1998-2003 in Leipzig. In 2006, he started working in the field of Contact Mechanics and he was a self-employee from 2008. Most of his work in the field of Contact Mechanics was done at Saxonian Institute of Surface Mechanics.

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