Workshop »Digital Data creates value – recognising and exploiting opportunities«

Toward a Virtual Coater™ by fast computer modeling algorithm

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Thin film materials are key components in a large variety of fields. The performance and reliability of these products depend to a high degree on the precision, reproducibility and intrinsic performance of the coatings involved, but also on the understanding of the process and the implication of the implication of incorrectly setting its parameters. Therefore, with increasing size, throughput, functional integration of coated products as well as market specific regulatory requirements, a simulation-driven development of deposition processes and advanced thin film materials becomes a necessary tool.

The Virtual Coater™ simulation suite aims to realize an easy-to-operate and computer-low-resources computational material-modelling platform that serves as a translation environment to accelerate the development of thin film materials and the related deposition processes. Making use of existing and validated simulation tools, it provides a multi-physics approach for the prediction of deposition process features as well as intrinsic film properties.

Process features from a 3D description of industrial coater includes the prediction of film uniformity and deposition rate, whereas intrinsic film properties are linked to the composition, microstructure and morphology (e.g. density, surface roughness and defects), optical, mechanical and electrical properties. Besides detailed models of process dynamics and film material models, this simulation framework is capable of real-time capable process simulation.

In this lecture, we will present the latest developments in the field, and we will demonstrate how a modeling platform built on optimized fast multi-scale algorithms can depict a "digital twin" of an industrial magnetron sputtering system, and how it can be used to tune the deposition process to achieve desirable coating properties. Extension toward coating properties optimization with Genetic Algorithms will also be presented.