

ICMCTF 2025 - PP1 Session - Invited - Abstract

Complementary Cutting-Edge Plasma Monitoring Techniques for Process Development, Production Control and Machine Learning (ML)

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As specifications in the thin film industry become more and more demanding, high production yields and cost effective production becomes a major factor in this competitive market. Increasing demands for better specifications and lower scrap rates drive the demand for efficient process control systems.

In addition, data analysis using artificial intelligence (AI) and machine learning (ML) technologies has made tremendous progress in recent years, sparking interest in using these methods for the diagnostics and control of plasma applications. To utilize this capability, a large number of data sets from complementary process diagnostics methods are required.

This presentation will highlight the opportunities and advantages of utilizing the latest developments in real-time in-situ data acquisition of different diagnostic techniques in a single system: Spectroscopic plasma process monitoring acquires data from the actual process plasma whereas in-situ broadband photometric measurements gather properties of the growing coating such as film thickness or color values. In addition, time-resolved electrical measurements of generator power, voltage and current provide valuable electrical process information especially in pulsed plasma applications.

Selected plasma applications are used to illustrate how process variations influence the results of the different measurement techniques. Consequently, by combining different methods and analyzing the complementary data in real-time, interdependencies between process and product properties become visible and can be used to achieve more accurate and reliable process control. At the same time the collected data can be fed into the analysis using AI and ML techniques to improve product quality and long-term production stability.

Real-time process control examples combining different diagnostic methods will be presented and first approaches to the application of ML methods will be illustrated using various coating applications from industry and R&D, such as metallic and reactive sputtering, HIPIMS and PECVD processes for tribological, optical and glass coating processes.

Speaker: Thomas Schütte