In situ metrology for Atomic Layer Deposition processes

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Atomic Layer Deposition is a versatile deposition process offering excellent control over film properties and outstanding reproducibility. Nevertheless, the development of novel processes needs a detailed characterization of the interaction between process parameters and film growth. Further, many ALD processes aren't as simple as the idealized ALD principle promises. Therefore adapted ex situ and in situ metrology methods are essential to develop, monitor and control ALD processes.

This talk will demonstrate how in situ metrology can be used to handle and improve typical metrology tasks necessary for ALD process development, advanced tool control and process monitoring. There will be examples for a faster and more detailed process development using in situ Quartz Crystal Microbalances. With these highly sensitive measurement technique sub-processes with only a few or even single cycles are sufficient to characterize the process parameter dependent film growth. This approach helps to study tool properties and newly developed processes in much more detail saving time and money as well as enabling improved process control and reproducibility. Further the film growth monitoring helps to analyze and prevent tool errors and mis-processing. This will be illustrated with an example showing the bubbler fill level dependent precursor dose and the resulting changing of the film growth within an 300 mm ALD chamber. In situ ellipsometry measurements will demonstrate how process parameters can affect the initial ALD film growth on given substrates and how processes can be made more efficient by adapting process parameters like pulse times to specific substrates or application.