OCD Metrology Based on Machine Learning and Raw Spectra Analysis

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State-of-the-art optical critical dimension (OCD) metrology with spectroscopic ellipsometry has been based on spectral fitting with physical modeling of sample structures. The performance of model-based OCD metrology, as a result, depends not only on spectral signal quality and data channel richness, but also model fidelity and spectral simulation engine accuracy. With the advancement of technology nodes and increasing demands for on-device and in-die metrology, sample structures get exponentially more complex, while the metrology error budget continues to shrink. Skyrocketing computing cost in modeling complex structures coupled with more dynamic process changes in development and production make it harder to deliver OCD solutions in a timely manner that meet customer requirements.

With the advent of artificial intelligence (AI) and deep learning, an alternative technology is emerging in OCD metrology. Without physical modeling and computationally expensive data fitting process, this new technology tries to mathematically map spectra directly to dimensions through machine learning of reference metrology data or information and raw spectra analysis.

In this presentation, the fundamental working principle and theoretical basis of model-less OCD metrology are laid out together with its strengths, challenges and application space. High quality, data-rich spectral signal (e.g. full Mueller Matrix ellipsometry) is shown to be nonetheless critical for high accuracy metrology. Some recent advancements in model-less solutions from Nanometrics are presented in measuring high aspect ratio (HAR) tilt, etch hole ellipticity, after-etch overlay, as well direct correlation to processing parameters.