Infrared Müller Matrix Ellipsometry of Thin Films and Structured Surfaces

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Non-isotropic thin films can be characterized by their infrared Müller matrix (MM), which, besides anisotropy and structure, can provide information on film chemistry, composition, and molecular interactions. However, laboratory thin-film infrared MM measurements are inherently difficult, mainly because of low optical throughput, source prepolarization, and non-ideal polarizers.

We developed a novel IR Müller ellipsometer with high optical throughput that enables sensitive MM measurements of thin films below 100 nm. The measurement scheme can be restricted to a subset of defined polarizer settings, allowing one to extract quadruples of Müller matrix elements within a few 10 seconds to minutes. Tandem polarizers guarantee a sufficiently high degree of polarization necessary to accurately measure block-offdiagonal MM elements.

We demonstrate MM measurements of thin polymer films and structured surfaces (trapezoidal SiO\textsubscript{2} gratings), the offdiagonal MM elements of which are highly sensitive towards structure and orientation, as verified by RCWA calculations.

![Fig. 1. Azimuth-dependent Müller matrix (measured vs. simulated) of a trapezoidal SiO\textsubscript{2} grating on Si.](Fig1)

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