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Polarization Metrology of Anisotropic Materials

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Full Mueller matrix measurements allow for elimination of ambiguity and a fuller understanding of polarization metrology. The Exicor® 150XT system offers complete Mueller matrix measurement from 350nm to 800nm with automated sample translation and optional tip-tilt measurements. Integration times as low as 0.01 seconds for measurements of the Mueller matrix to 0.001. Partial Mueller matrix systems can attain measurements of 8 Mueller parameters with precision of 0.0001.

Polarization metrology covers a broad range of techniques from ellipsometry, circular dichroism, and transmission polarimetry. Each technique focuses on the measurement and modeling of a subset of possible polarimetric interactions of a sample. Mueller matrix polarimetry in both transmission and reflection can address the needs of a broad range of applications with a single system, and unite a range of different metrology techniques under a single banner.

The polarization state of light can be expressed as a four element Stokes vector, $[S_0, S_1, S_2, S_3]$. To express the interaction of a Stokes vector with a sample, the 4x4 Mueller matrix contains all of the polarimetric optical properties of a sample. Linear retardance, linear dichroism, circular retardance and circular dichroism as well as information about depolarization present in the sample.

The anisotropy of aligned molecules leads to linear optical properties such as linear retardance and linear dichroism. The measurement of linear retardance has been applied to the measurement of internal strain of a material. By measuring the linear retardance of a sample, and relating that measured retardance through the photoelastic constant of a material, the internal stresses from injection molding, annealing and curing can be measured. In addition, linear dichroism and retardance can be modeled and fit to find the refractive index of layered materials and how

compose the broad field of ellipsometry.

As an example of a material that exhibits both linear dichroism, and linear retardance, Figure 1 shows the measured Mueller matrix for a petrographic

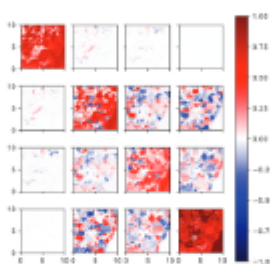


Figure 1. Mueller matrix of petrographic thin section of EtOH using a Hinds Exicor 150XT transmission Mueller polarimeter.

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