MATERIALS MEASUREMENT

MUELLER POLARIMETER

PRODUCT BULLETIN

Employing four Photoelastic Modulators (PEMs) in the same instrument, the 150XT Mueller Polarimeter provides simultaneous measurements of all sixteen Mueller matrix elements and the complete polarization properties of a sample in a fraction of a second. This new addition to Hinds Instruments' product portfolio has applications in academic and industrial research, optical component characterization, manufacturing, and quality control. The turnkey system maps linear retardation, circular retardation (or optical rotation), linear diattenuation and circular diattenuation in a wide variety of optical, chemical, and biochemical samples.

LEADING EDGE SENSITIVITY AND REPEATABILITY

Using Hinds Instruments' patented PEM technology, the system provides the highest levels of sensitivity available today for a full Mueller polarimeter. In addition, the PEMs provide high-speed operation, modulating at a rate of tens of kHz. Leading edge sensitivity and repeatability easily provide subnanometer levels of linear and circular birefringence measurements and subpercentage determination of linear and circular diattenuation, now critical to many applications.

CAREFULLY DESIGNED FOR SIMPLE, STRAIGHT FORWARD OPERATION

A sample as large as 6" x 6" (150mm x 150mm; larger sizes optional) can be characterized manually or automatically mapped and graphically displayed. Once a sample is placed on the translation stage, intuitive software guides the operator through the step measurement process. User interface software calculates the values of linear retardation, circular retardation, linear diattenuation and circular diattenuation and displays them in a variety of formats. The software also provides file management and calibration features. In an optional mode, instead of moving the sample on XY stages, the sample can be tilted relative to the measuring light beam using automated precision rotator or rotators to produce angular maps of all sixteen Mueller matrix elements and all polarization properties of a sample.

The Mueller Polarimeter measures polarization properties integrated along an optical path through the optical sample under investigation. A HeNe laser beam is polarized and then modulated by the first two PEMs. The modulated beam is transmitted through the sample and then passes through a combination of two more PEMs, an analyzer, and a photodetector. The electronic signals are processed through Fourier analysis of captured waveform (lock-in options available for even lower level signal detection).

A software algorithm, developed through a collaboration of New York University and Hinds Instruments, converts the signal levels from the electronics module into sixteen Mueller matrix elements and the complete polarization properties of a sample. When operated in the automated mapping mode, the x-y translation stage will move the sample to the next predetermined measurement location. Results are displayed instantaneously in user-specified formats.

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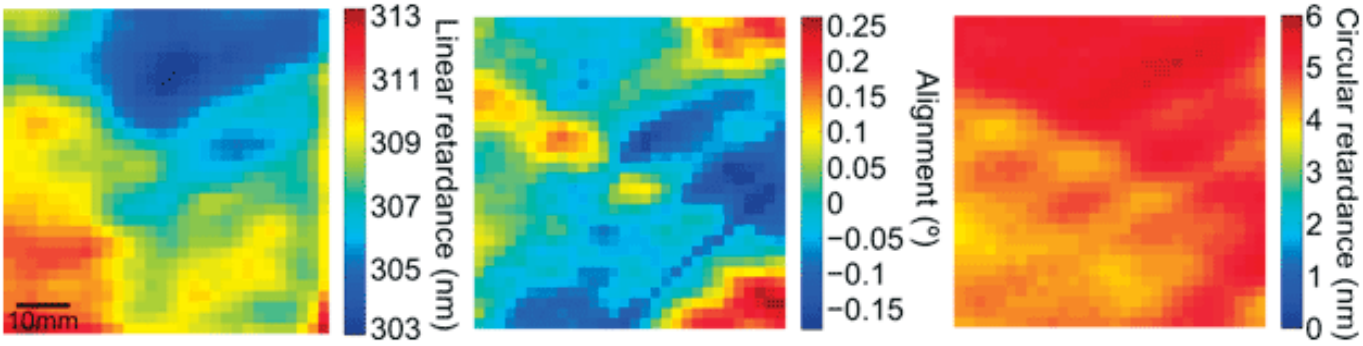


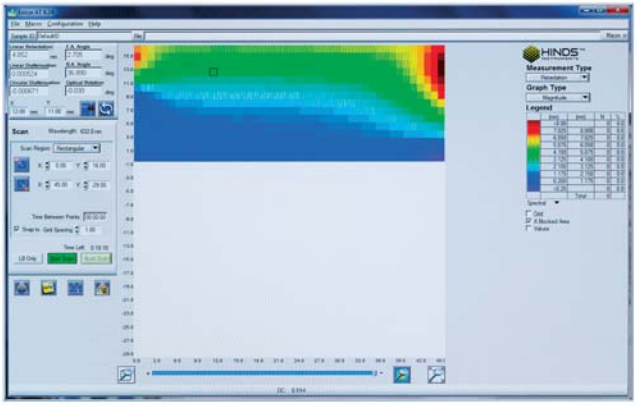
The linear retardance, linear retardance alignment, and circular retardance maps of an achromatic retardation film

SIGNIFICANT FEATURES

- Unprecedented sensitivity in a full Mueller polarimeter
- Simultaneous measurement of all sixteen Mueller matrix elements
- Simultaneous measurement of complete polarization properties
- Precision repeatability
- High-speed measurement
- No moving parts in the optical system
- Automatic mapping of variable-sized optical elements
- Photoelastic modulator technology
- Simple, user-friendly operation

APPLICATIONS

- Academic and industrial research
- Quality control metrology
- Accurate measurements of complete polarization properties for
  - Scientific optical components with complex internal structure
  - Laser crystals
  - LCDs with complex layers
  - Isomorphous crystals
  - Anisotropic crystals
  - Chemical and biological anisotropic optical materials
  - Anisotropy induced by electric or magnetic fields



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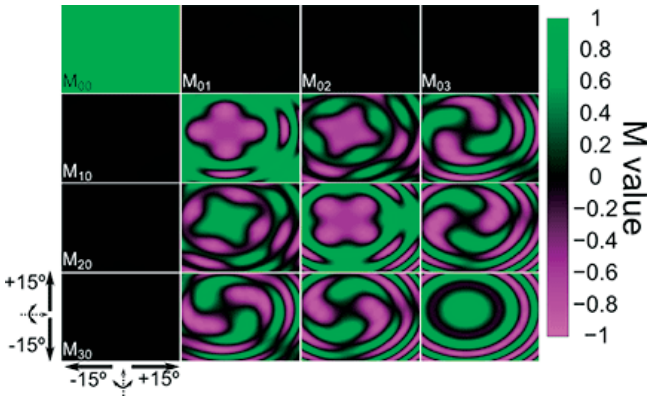
SPECIFICATIONS

for Mueller matrix elements (sensitivity is different for different Mueller matrix elements)

0.0001	0.0002	0.0001	0.0001
0.0002	0.0001	0.001	0.0001
0.0001	0.0005	0.001	0.0001
0.001	0.0001	0.0002	0.001



The raw Mueller matrix data of a 3.53 mm thick slab of approximately c-cut quartz rotated along X and Y axis through 15° in 0.5° steps.

SPECIFICATIONS FOR POLARIZATION PARAMETERS

Linear retardation range	0 to 316.4 nm
Linear retardation resolution/repeatability	0.01 nm / ±0.03 nm
Linear retardation angular resolution/repeatability[1]	0.01° / ±0.05°
Optical rotation (half of Circular retardation) range	-90° to +90°
Optical rotation (half of Circular retardation) resolution/repeatability	0.01° / ±0.05°
Linear diattenuation range	-1 to +1
Linear diattenuation resolution/repeatability	0.0001 / ±0.001
Linear diattenuation angular resolution/repeatability[2]	0.01° / ±0.1°
Circular diattenuation range	-1 to +1
Circular diattenuation resolution/repeatability[3]	0.0001 / ±0.001
Wavelength	632.8 nm (any wavelength between 180nm-2500nm viable)
PEM Frequencies	42, 47, 50, and 60 kHz
Spot size	~1 mm (0.5 mm)
Demodulation analysis[4]	Waveform capture and Fourier analysis
Scan area[5]	150 mm x 150 mm

1. Typical performance at 5 nm
2. Typical performance at Linear diattenuation = 0.1
3. Typical performance at Circular diattenuation = 0.1
4. Lock-in amplifier option available for higher sensitivity
5. Larger sizes available

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