Capabilities

The RC2® design builds on 20 years of experience. It combines the best features of previous models with innovative new technology: dual rotating compensators, achromatic compensator design, advanced light source and next-generation spectrometer design. The RC2 is a near-universal solution for the diverse applications of spectroscopic ellipsometry.

RC2 on Vertical Base

Why an RC2?

Dual Rotating Compensators

Synchronous rotation of two compensators provides high accuracy, high speed, and complete Mueller-matrix measurements.

Achromatic Compensator Design*

New achromatic compensator design with optimized performance over a wide spectral range.
*patent pending

Wide Spectral Range

Collect over **a thousand** wavelengths across the ultraviolet, visible, and near infrared spectrum.

High Speed

Synchronous operation of both compensators for accurate spectral data in less than a second.

Advanced "dual" light source

Dual light source for extended spectral range with computer control of beam intensity. Automatically optimize signal on any sample (low or high reflection).

Anisotropy Applications

Generalized Ellipsometry

Traditional ellipsometry measurements are ideal for standard thin film characterization. However, more advanced measurements are required for anisotropic materials.

Generalized Ellipsometry collects six values compared to the standard two (Ψ, Δ). This additional information completely characterizes the cross-polarization of anisotropic samples.

Jones matrix for anisotropic sample:

$$\begin{bmatrix} r_{pp} & r_{sp} \\ r_{ps} & r_{ss} \end{bmatrix}$$

Generalized Ellipsometry measures:

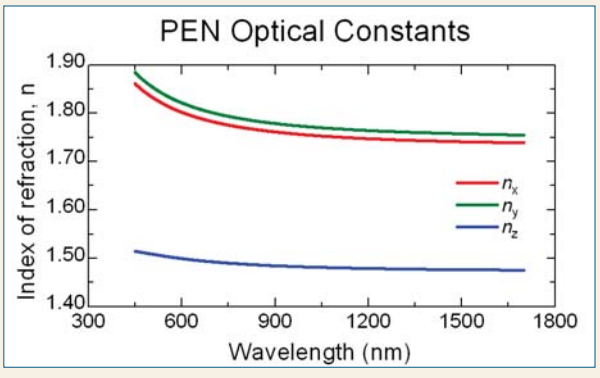
$$\rho = \tan(\Psi)e^{i\Delta} = \frac{r_{pp}}{r_{ss}}$$

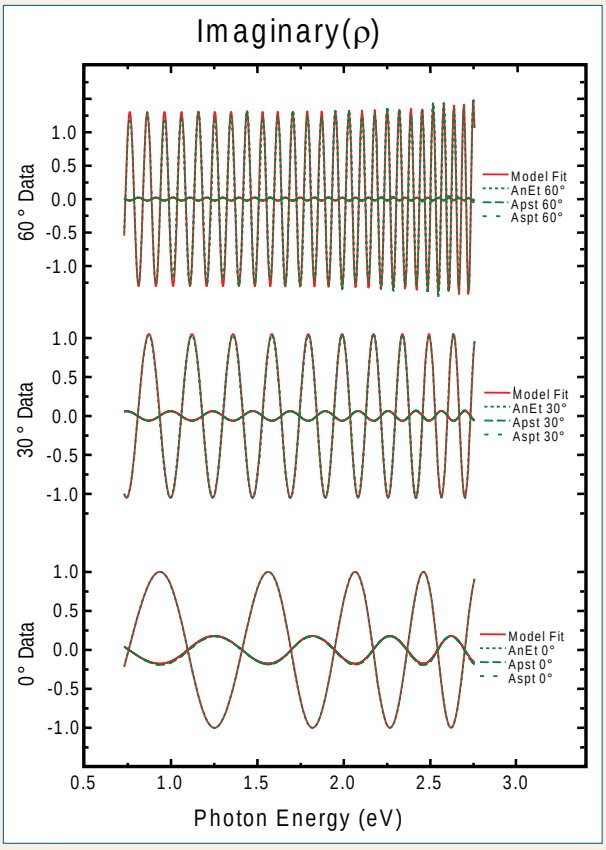
$$\rho_{ps} = \tan(\Psi_{ps})e^{i\Delta_{ps}} = \frac{r_{ps}}{r_{pp}}$$

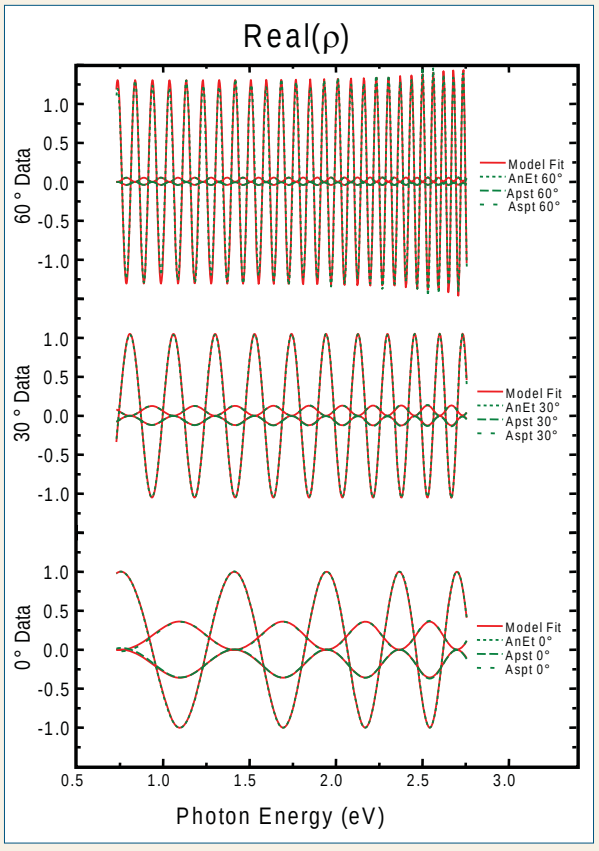
$$\rho_{sp} = \tan(\Psi_{sp})e^{i\Delta_{sp}} = \frac{r_{sp}}{r_{ss}}$$

Anisotropic PEN (Polyethylene Naphthalate)

Generalized Ellipsometry measurements of the transmitted beam provide high sensitivity to the birefringence in anisotropic PEN films.







Variable Angle Generalized Ellipsometry was used to fully characterize the biaxial indices ($n_x \neq n_y \neq n_z$) of the PEN substrate.

Complete Mueller-matrix

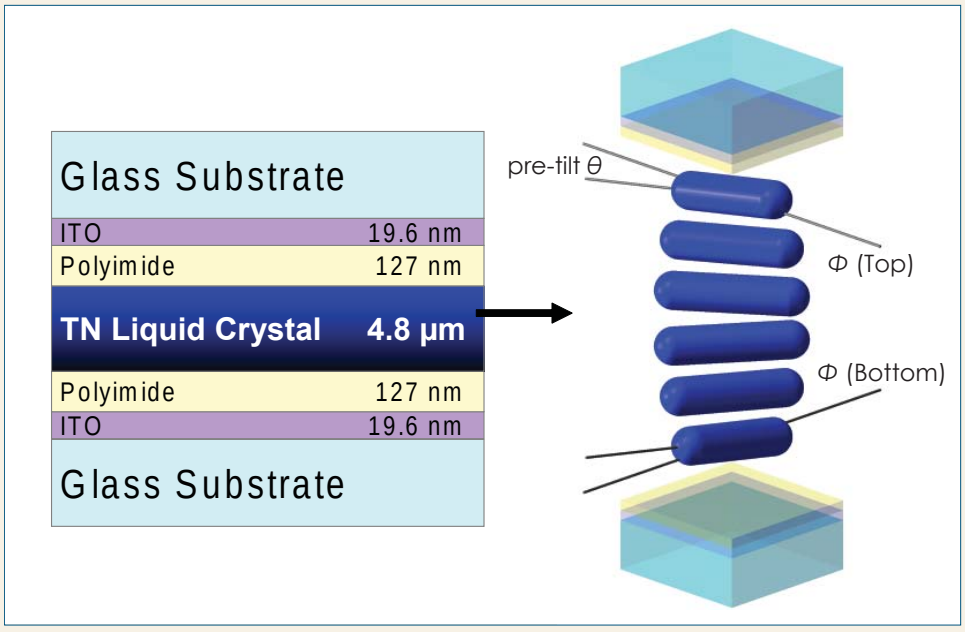
The RC2® can characterize the full Mueller-matrix of a sample. This advanced data type insures appropriate characterization of complex samples that are both anisotropic and depolarizing.

Mueller matrix for anisotropic, depolarizing sample:

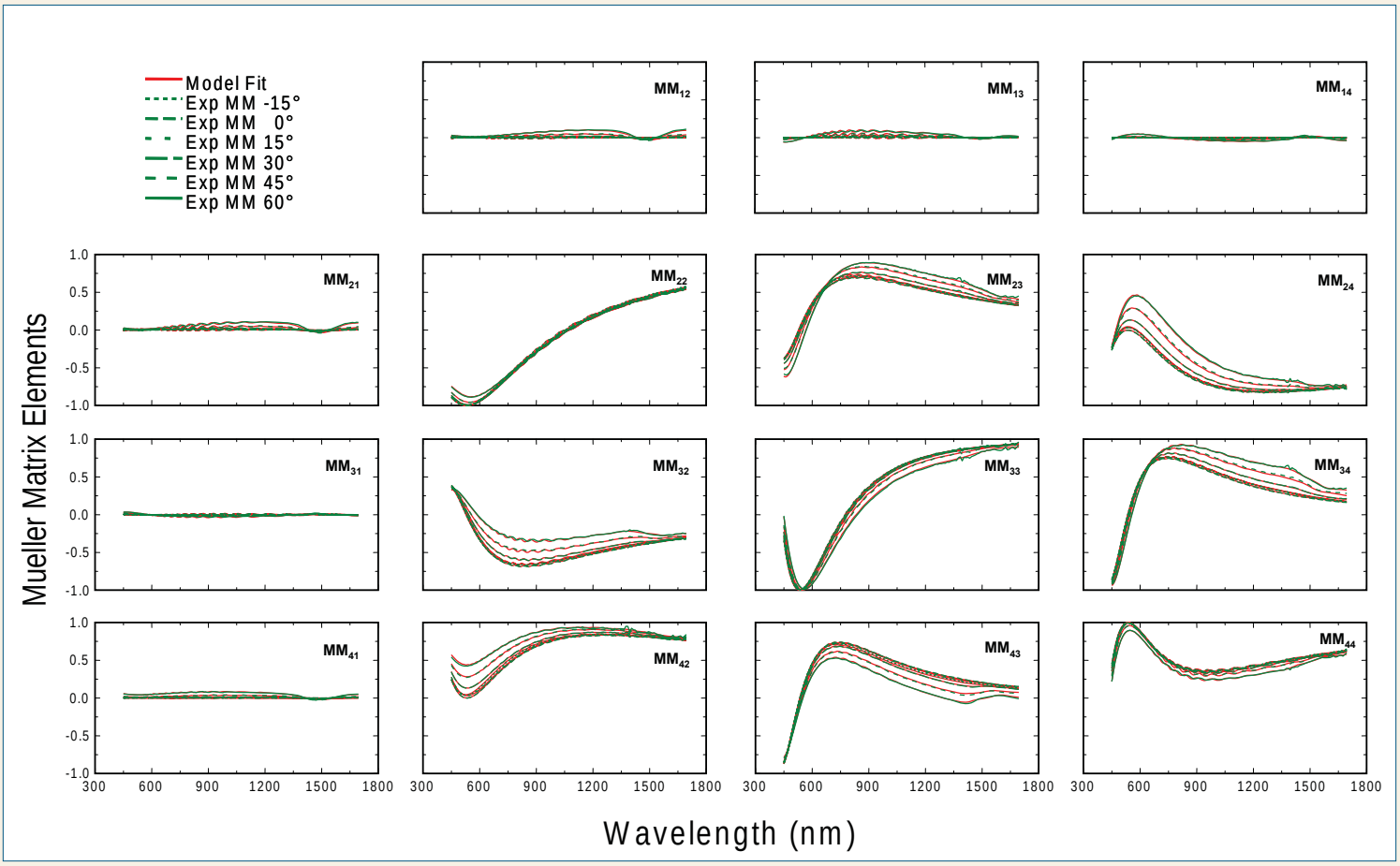
$$\begin{bmatrix} m_{11} & m_{12} & m_{13} & m_{14} \\ m_{21} & m_{22} & m_{23} & m_{24} \\ m_{31} & m_{32} & m_{33} & m_{34} \\ m_{41} & m_{42} & m_{43} & m_{44} \end{bmatrix}$$

Liquid Crystal

Twisted nematic liquid crystal films introduce the complexity of an anisotropic film with a smoothly varying optical axis. With the thick liquid crystal layer sandwiched between glass substrates, the Mueller-matrix measurements insure the best measurement.



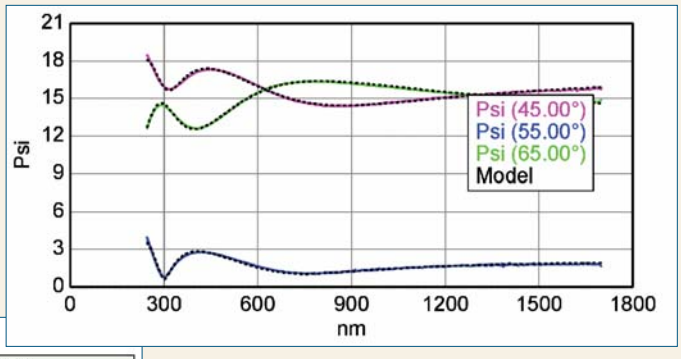
The complete Mueller-matrix was measured for a twisted liquid crystal. This enabled characterization of the optical axis twist and pre-tilt, and liquid crystal anisotropic refractive index.



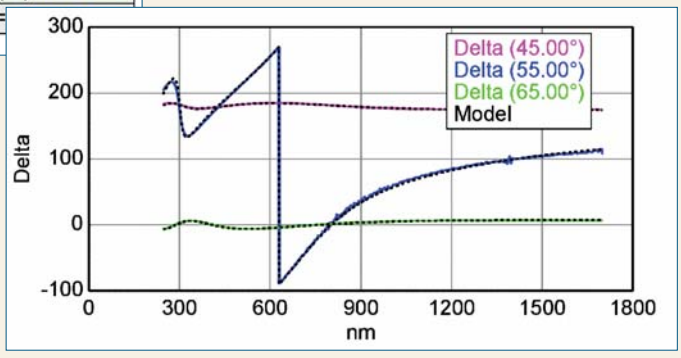
Thin Films

SiO_2 on Glass

Adjustable light output optimizes measurements for low-reflection coatings such as index matched films on glass.

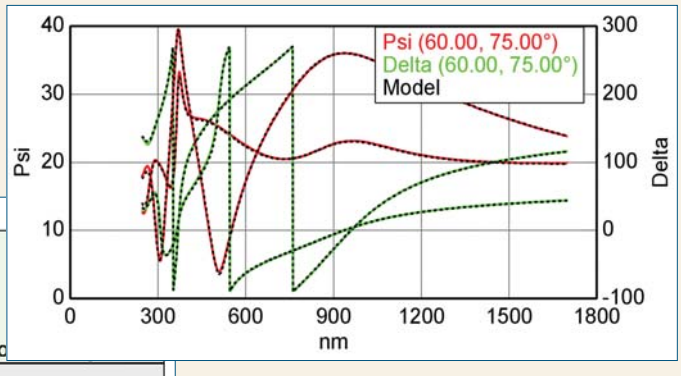


Roughness = -1.07 nm (fit)
+ Layer # 1 = Cauchy Thickness # 1 = 175.31 nm (fit)
+ Substrate = 7059_Cauchy Substrate Thickness =

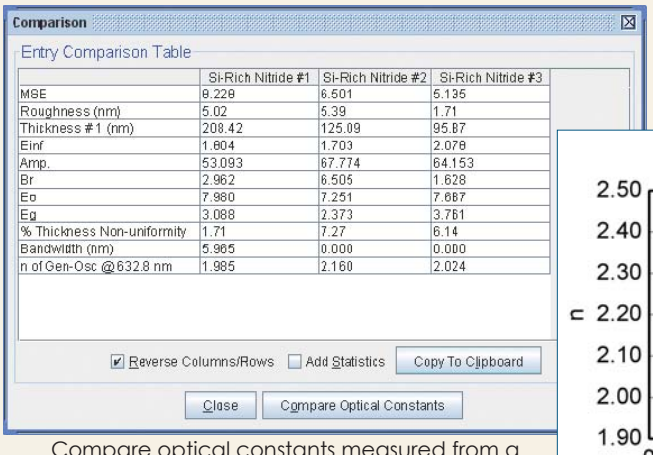


Si-rich Nitride

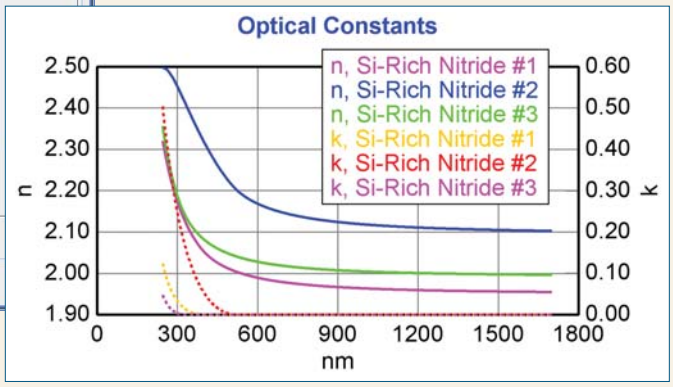
Get quick results for any thin film - whether a dielectric, organic, semiconductor, metal...and more.



Roughness = 5.39 nm (fit)
- Layer # 1 = Gen-Osc Thickness # 1 = 125.09 nm (fit)
  Add Oscillator
  Einf = 1.703 (fit)
  1: Type = Tauc-Lorentz Amp. = 67.774 (fit)
  Br = 6.505 (fit) Eo = 7.251 (fit) Eg = 2.373 (fit) Co
Substrate = SI_JAW



	Si-Rich Nitride #1	Si-Rich Nitride #2	Si-Rich Nitride #3
MSE	9.229	6.501	5.135
Roughness (nm)	5.02	5.39	1.71
Thickness #1 (nm)	208.42	125.09	95.87
Einf	1.604	1.703	2.078
Amp.	53.093	67.774	64.153
Br	2.962	6.505	1.628
Eo	7.980	7.251	7.687
Eg	3.088	2.373	3.761
% Thickness Non-uniformity	1.71	7.27	6.14
Bandwidth (nm)	5.965	0.000	0.000
n of Gen-Osc @632.8 nm	1.985	2.160	2.024



Compare optical constants measured from a series of silicon-rich nitrides to study changes with process conditions.

ADVANCED

SPECIFICATIONS:

Wavelength Range:

370 to 1000nm
370 to 1700nm
245 to 1000nm
245 to 1700nm*
*over 1000 wavelengths

In-Situ:

Compact design is perfect for in-situ applications where optics mount directly to a process chamber.

Angle Range:

Attach to any base: fixed angle, manual angle, automated angle.

System Overview:

Synchronous Dual Rotating Compensator Ellipsometer

Data Acquisition Rate:

CCD Detection for simultaneous measurement of all wavelengths in less than a second