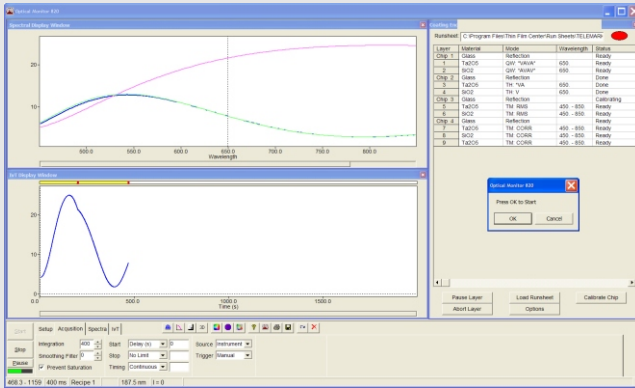


Model 820 In-Situ Spectroscopic Optical Monitor

Full Spectrum, Real-time Analysis and Control of Reflectance and Transmittance During Thin-Film Deposition



Features

- Full Spectrum Analysis
- Multiple Endpoint Techniques
- Real-time Chamber Characterization
- Optical Constants (n& k)

Full Spectrum Analysis - Spectrometer monitors from 380-930nm to analyze the true reflectance or transmittance of the test chips being monitored.

Multiple Endpoint Techniques - The Model 820 can be configured to endpoint each layer with Pre-Quarter wave, Post-Quarter wave or Simulation Template Match. The Essential Macleod thin film design and optimization software is integrated into the Model 820 software to enable template matching.

Real-time Chamber Characterization - Because the Model 820 monitors the full spectrum during the deposition process, the system can identify shifts in spectrum due to various changes in material composition and chamber parameters. The spectrum data can then be used to calculate new N&K values which can update the design of the product being produced.

The Model 820 can also characterize the optical constants of the films related to process steps, such as venting, spectral shifts due to temperature, and/or gas flow rates.

Offline Stage (optional) - measurement of transmittance, reflectance or Color for QC of Filters, Prisms, or Beam Splitters.

Plasma Diagnostics/Endpoint - The Model 820 software also includes the capability for control and analysis of plasma processes.

Functional Description

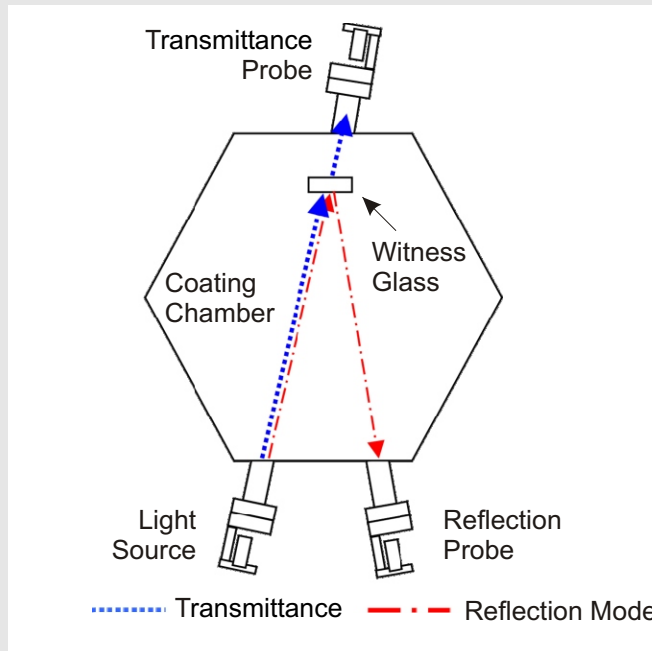


Figure 1

The Model 820 is a multi-wavelength spectrophotometer, comprised of a low voltage halogen light source, silicon photodiode array detector, embedded computer and software with sophisticated algorithms. State of the art fiber optic components deliver high signal to noise ratio and long-term stability. The photodiode array allows the entire range of individual wavelengths in the spectrum to be detected simultaneously. A curve fitting approach to layer termination further assists in detecting and controlling small signals in a process environment when dispensing materials like SiO_2 on glass substrates.

Transmittance Mode

The light is illuminated from the bottom (or Top) of the chamber by the light source probe. The light will transmit through the test chip and into the transmission probe on the top (or bottom) of the chamber. The light is collected in the probe and focused into a fiber where it is transferred to the spectrometer for analysis. See Figure 1 for illustration.

Reflectance Mode

The light is illuminated from the bottom of the chamber by the light source probe. The light will reflect from the test chip and back down to the bottom of chamber to the reflection probe. The light is collected in the probe and focused into a fiber where it is transferred to the spectrometer for analysis. See Figure 1 for illustration.

Endpoint Techniques

The optical monitor is capable of using several techniques for controlling the thickness of each layer. The techniques are described below.

Quarter Wave

The quarter wave technique is the most common technique used in the deposition industry. It consists of monitoring a single wavelength vs time during the coating process. During this time, the single wavelength intensity signal will change due to the constructive and destructive wavelength interference, based on the refractive index of the film being deposited. From the wavelength and refractive index of the material, the film thickness can be calculated.

Wavelength /(Refractive Index)

An illustration of multiple quarter wave reflectance is shown in Figure 3.

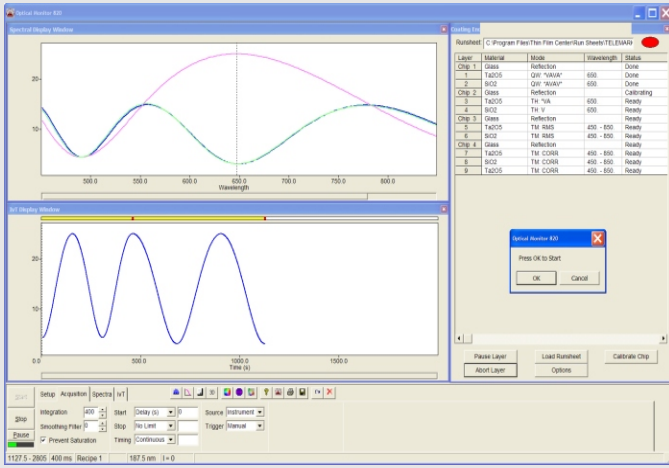
Template Match

In the Template Match technique the raw collected spectrum is compared to a predicted simulation from a simulation software like Essential Macleod. The algorithm uses a Merit Function to identify the match. A single file of templates are used to control all layers. See figure 4 for illustration.

Full Spectrum

Figure 2

Figure 2 shows the full spectrum of Six-quarter waves of Ta₂O₅. The spectrum can be used to recalculate N&K (Refractive Index) of deposited material or actual film thickness



Quarter Wave

Figure 3

Figure 3 shows multiple and non-quarter waves during the deposition of Ta₂O₅. Pre-Quarter wave or Post-Quarter waves are used for layer termination.

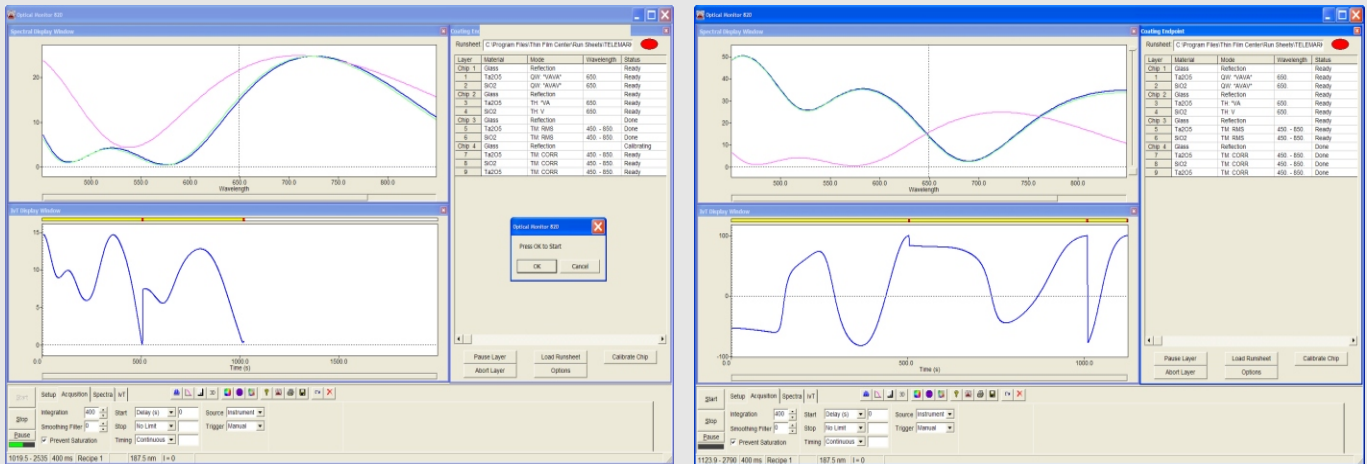
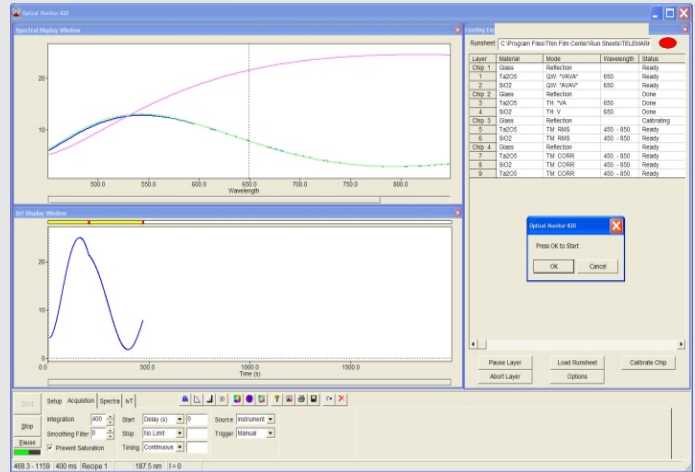


Figure 4

Figure 4 shows the template matching technique. The screens above displays the raw collected value (Blue line) and the template used for matching (Green line). The screen on the left shows the "Root Mean Square" algorithm fit of the data vs. time. When the two spectral displays (bottom left) match, the system will terminate the layer deposition. A simulation package, such as Essential Macleod must be used to generate the templates for matching.

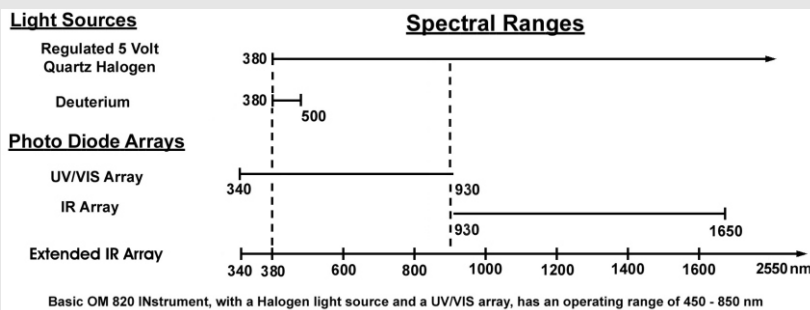
Multi-layer User Interface

Layer	Material	Mode	Wavelength	Status
Chip 1	Glass	Reflection		
1	LAZ HFO2	QW: *VA*	650	Ready
2	Si O2	QW: *AV*	650	Ready
Chip 2	Glass	Reflection		
3	LAZ HFO2	QW: *VA	650	Ready
4	Si O2	QW: V	650	Ready
Chip 3	Glass	Reflection		
5	LAZ HFO2	TM: RMS	450 - 850	Ready
6	Si O2	TM: RMS	450 - 850	Ready
Chip 4	Glass	Reflection		
7	LAZ HFO2	TM: CORR	450 - 850	Ready
8	Si O2	TM: CORR	450 - 850	Ready
9	LAZ HFO2	TM: CORR	450 - 850	Ready

Witness Glass Changer



Collection Probe
And Optical Fiber



Specifications

Spectrometer Type:	Ebert
Detector:	512 element silicon photodiode array
Photosensitive area:	50 micron pixel pitch x 2.5 mm pixel height
Quantum efficiency:	75% @ 600 nm
Sensitivity:	2200 photons/count @ 600 nm
Response:	4.5×10^{-4} coulombs/joule/cm ²
Dark Current:	2 pico-amps
Saturation Charge:	22 pico-coulombs
Precision/Stability:	Less than or equal to 0.2% of full scale/hour
Color Calculations:	CIE L*a*b, CIE l*u*v, XYZ
Minimum Signal Acquisition Time:	50 msec

Fiber Optics

Light Source Viewport:	2.75" CFF is standard; specials available on request
Light Detector Cable:	Fused silica with SMA (1/4-36) connectors and 3mm ferrule
Maximum Cable Temperature:	108 Deg. C
Maximum Working Distance:	6 meters

Chassis Physical Data

Size (Width x Height x Depth)	19" x 1.75" x 26" (483mm x 44.45mm x 660mm) 19" x 5.75" x 18" (483 mm x 146.05 mm x 457mm)
Weight:	40 pounds (18.25 kg)

Computer Specifications

Processor:	Quad Core Pentium Xeon
Memory:	1024 MB DDR2
Hard Drive:	80 GB Sata
Operating System:	Windows XP. Professional
Communications Ports:	3 USB 2.0 ports; 1 Serial Port, 2 TTL inputs, 2 TTL outputs (8 TTL I/O OPTIONAL)
Display:	19" Flat Panel, active-matrix LCD