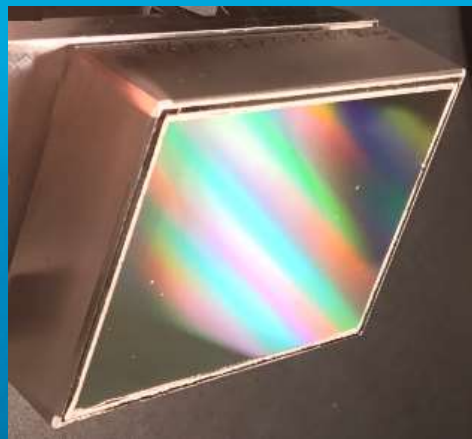


Unique Scattering Measurements Using the Agilent Universal Measurement Accessory (UMA)

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Rapid, Automated, Quality Control of Diffraction Grating Efficiency



Agenda

The Problem : How can we can we determine Grating Efficiency faster and with greater control ?

Solution : Cary 7000 UMS(Universal Measurement System) or Cary 5000 with UMA(Universal Measurement Accessary)

Results : 300, 1200, 1800, 3600 lines per mm Gratings

Conclusions

Cost Control, Quality Control

The goal to produce high quality diffraction gratings, can rapidly, and cost effectively, be assisted by timely and specific feedback throughout the production process.

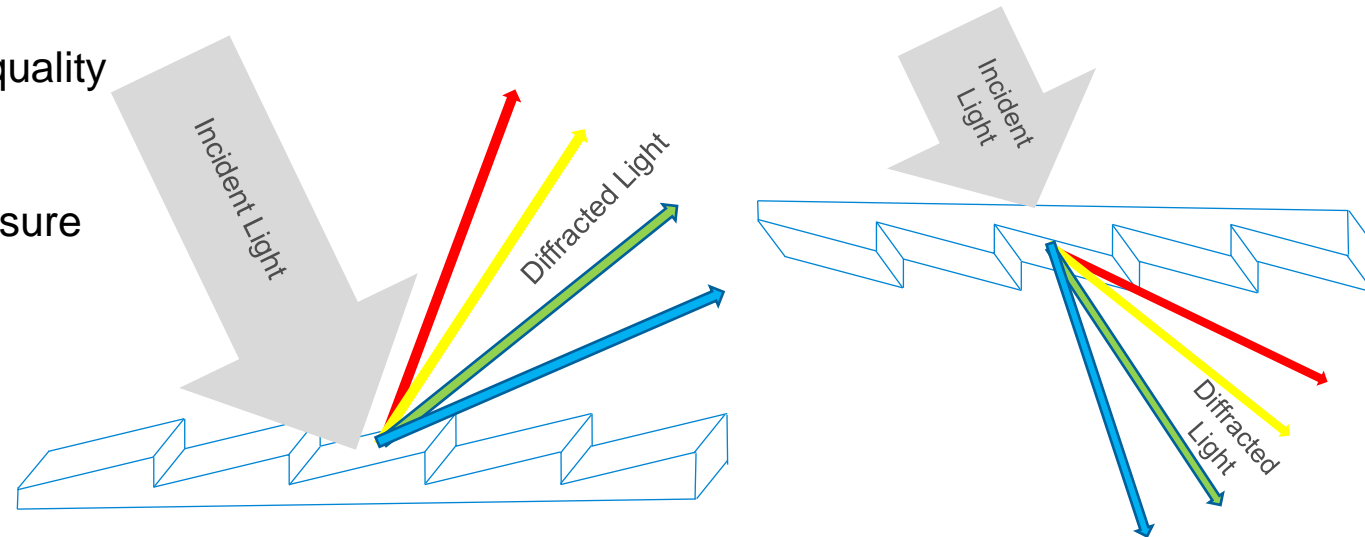
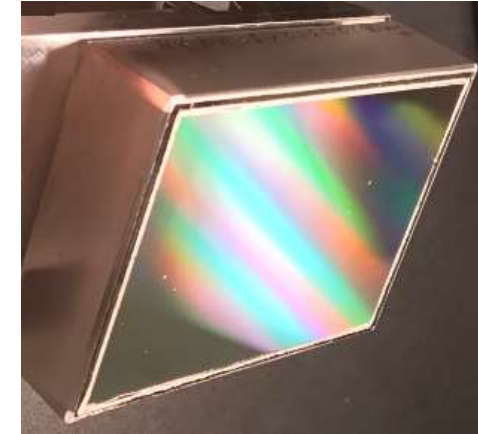
❑ High quality automated spectrophotometric characterization tools can be used to help;

- test the optic against it's design intent throughout coating stages
- steer end product batches toward consistent quality
- monitor and control the production process

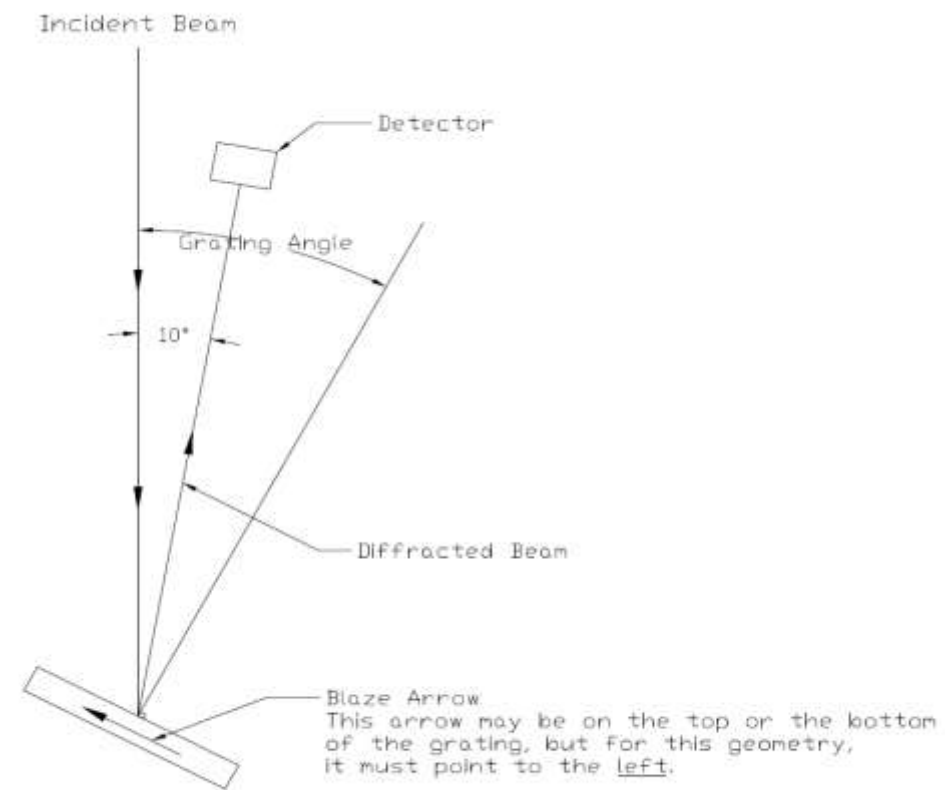
❑ Multi-angle spectrophotometric measurements can ensure

- yields are maximize
- waste is reduced
- product quality is better controlled
- time is saved – down time reduced

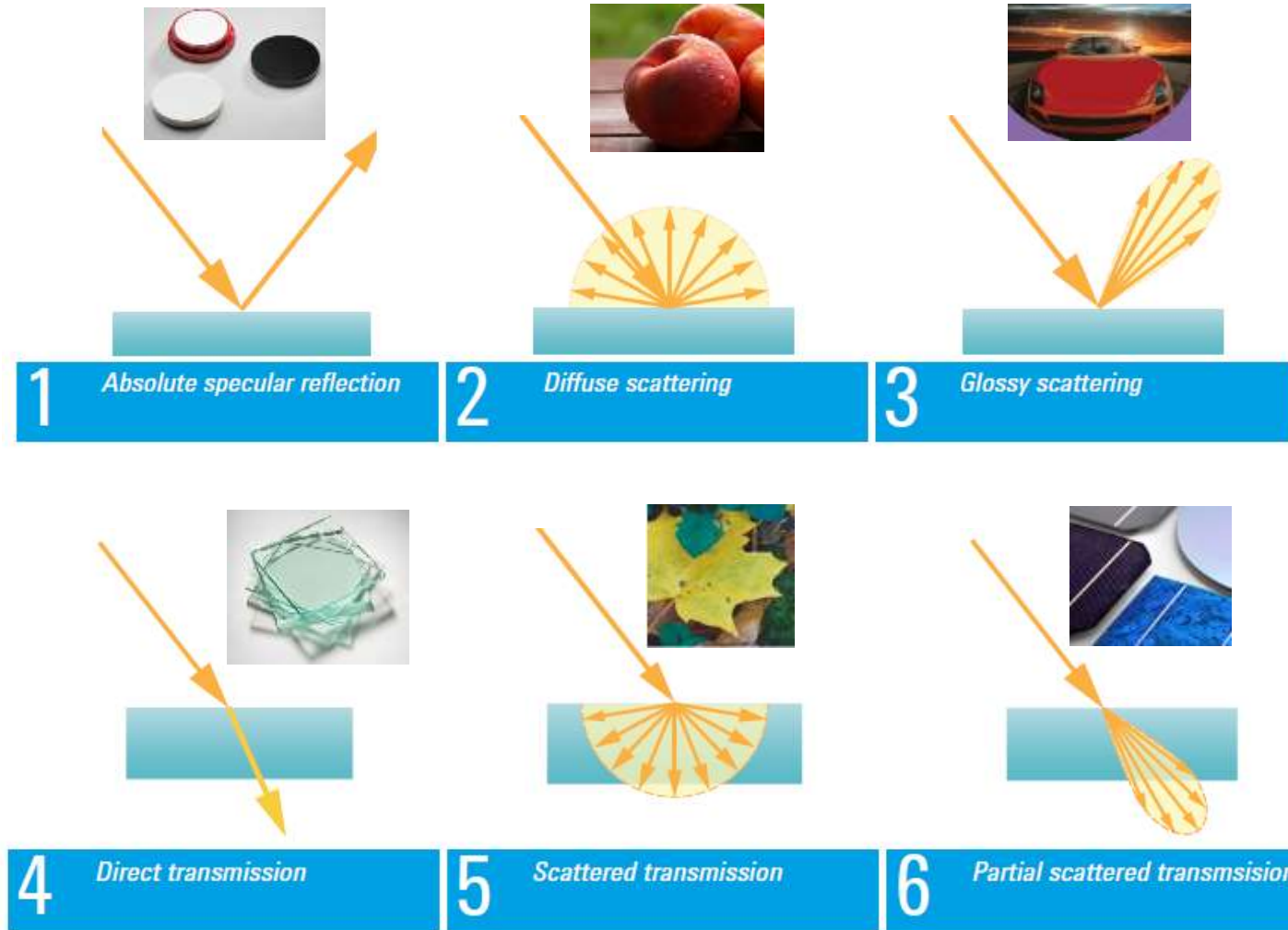
Diffraction Gratings



Orientation of Sample



Cary UMS Measurement Modes



6
Modes
1
System

Perform all these
measurements
on the Cary
7000 UMS



Technical Aspects of UMA

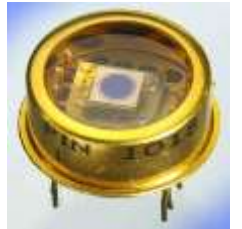
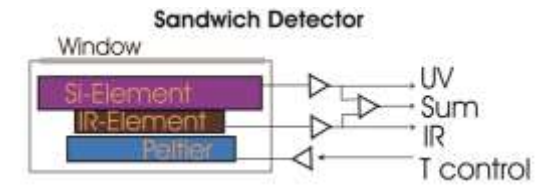
Automated Wired grid polarizer



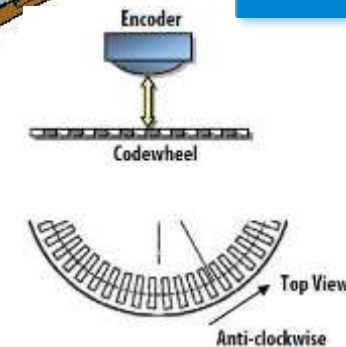
Horizontal/vertical apertures



Silicon/InGaAs Sandwich Detector

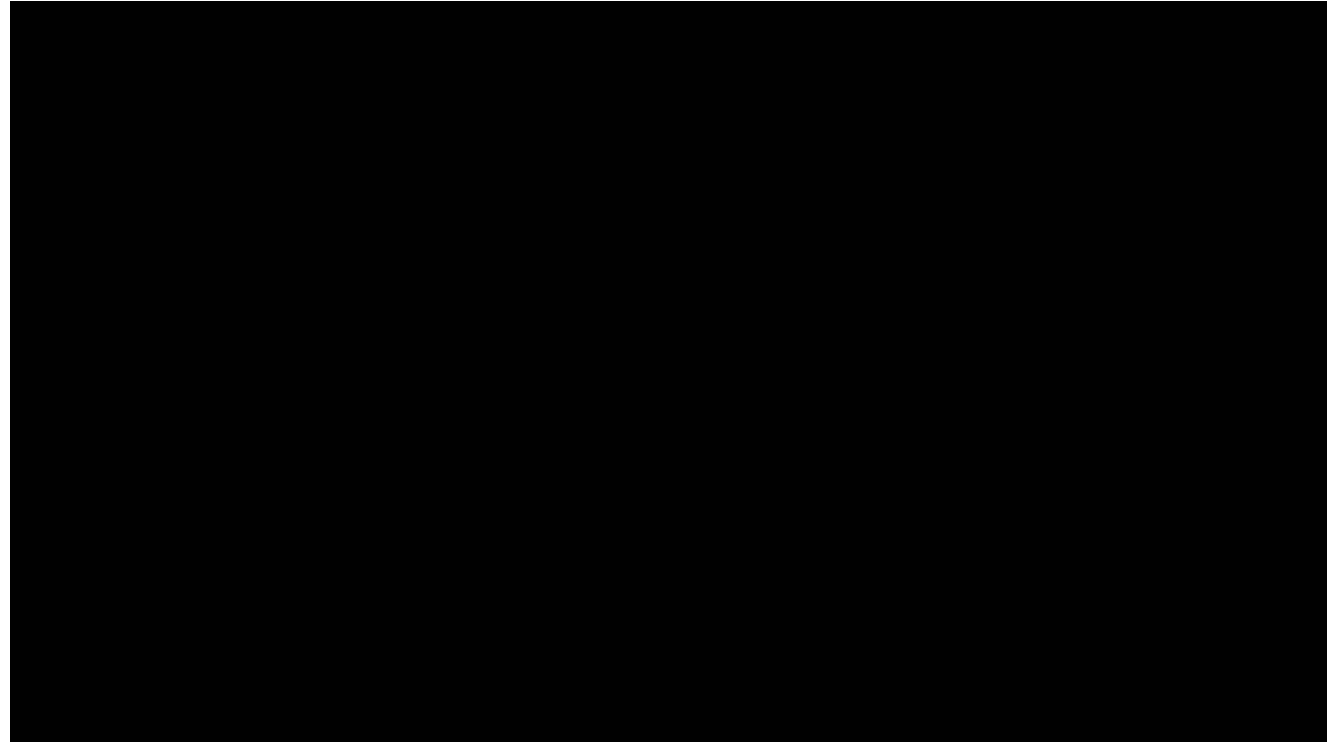


Optical Encoder



UMS Measurement Modes

- Automated Control of sample angle, detector position and polarization
- Sample sits at center of rotatable stage (360° rotation)
- Detector can move in arc around sample



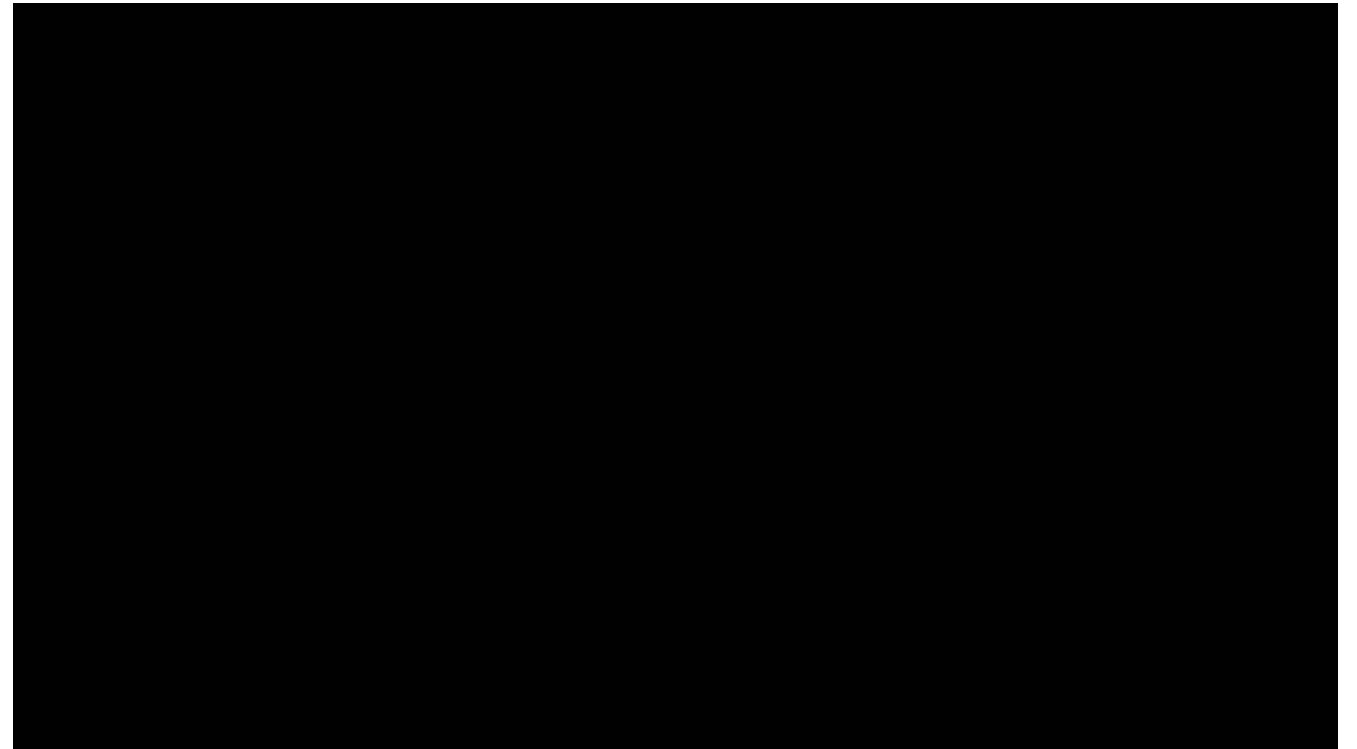
UMS Measurement Modes

Baseline

- One baseline is needed for all %R and %T measurements, at all angles for a given polarization

Absolute Reflection & Transmission

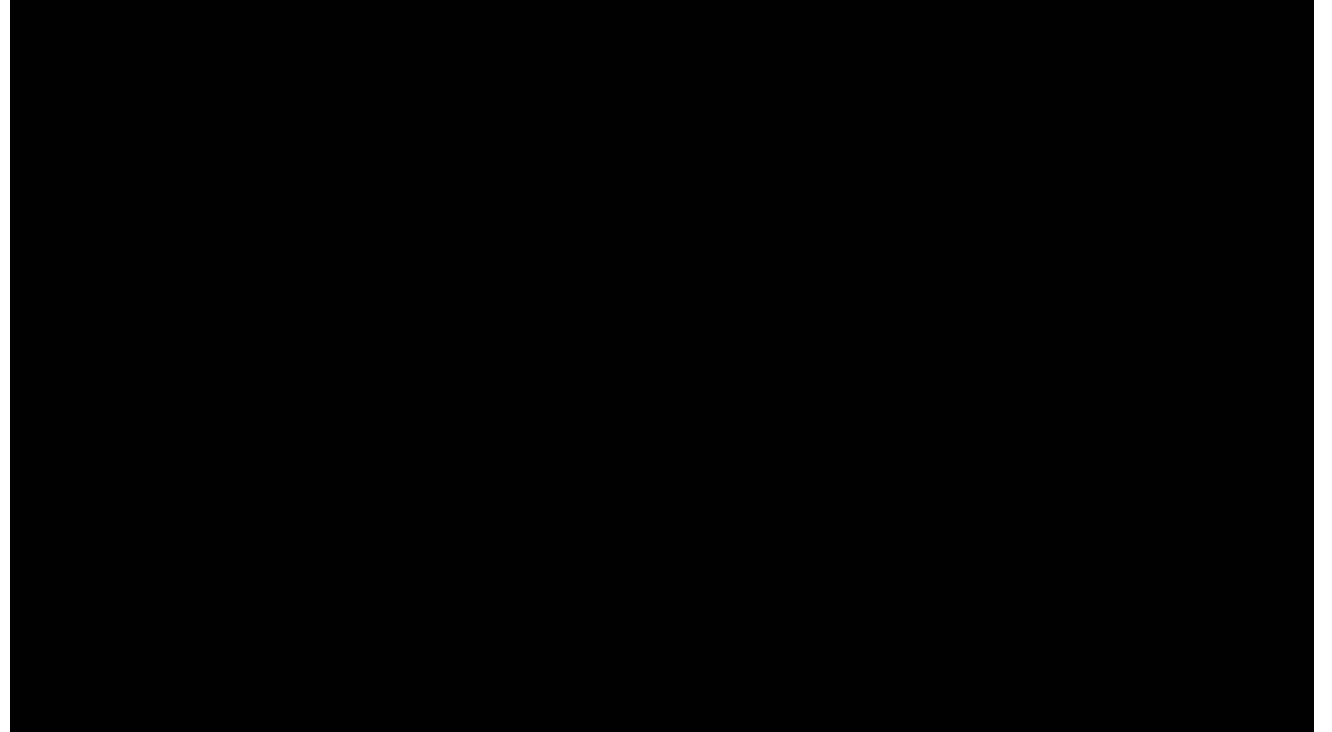
- Only difference between baseline and measurement is the sample itself.



UMS Measurement Modes

Absolute Reflection and Transmission

- Without moving the sample the detector can be rotated to collect %R and %T
- Consistency & accuracy because incident light position, angle and shape is fixed for both %R and %T

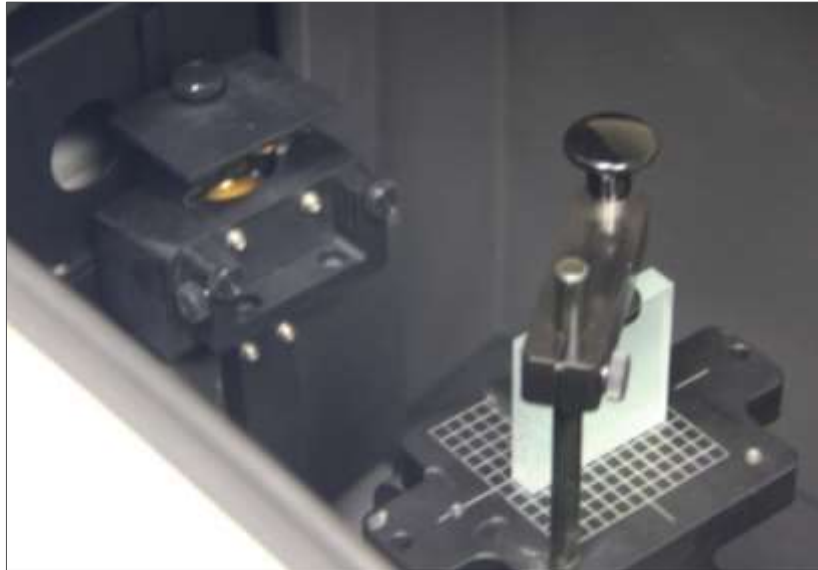


Grating Efficiency Measurement Mounting of Sample

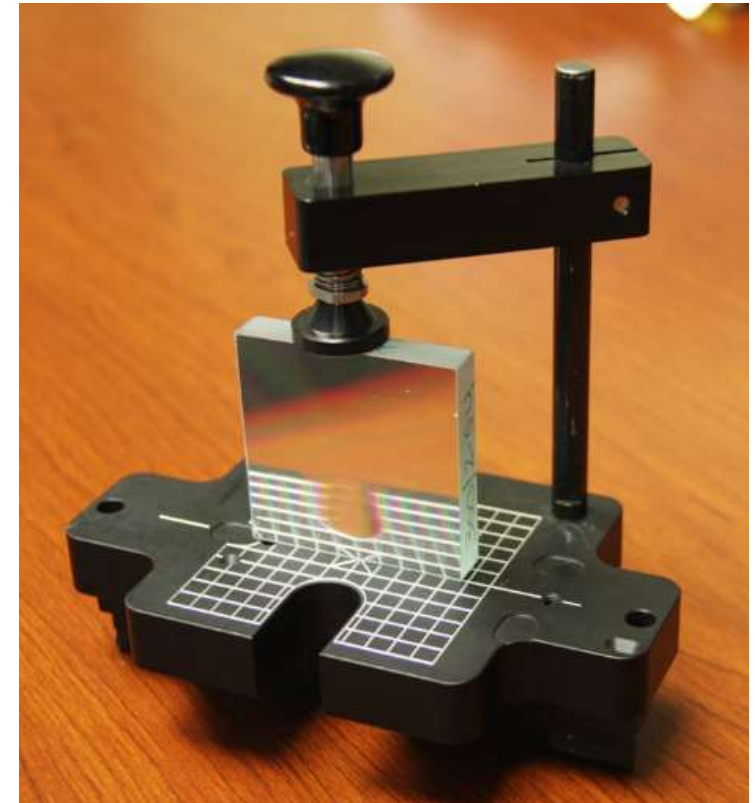
Right : 300 lines per mm grating mounted on Cube Beam Splitter Sample Holder.

Below : Sample Holder placed onto the sample stage in the UMA. Detector held at 10°.

Grating mounted
inside the Cary
7000 Universal
Measurement
Spectrophotometer



Grating mounted in Edward Mount



Grating Efficiency Measurement

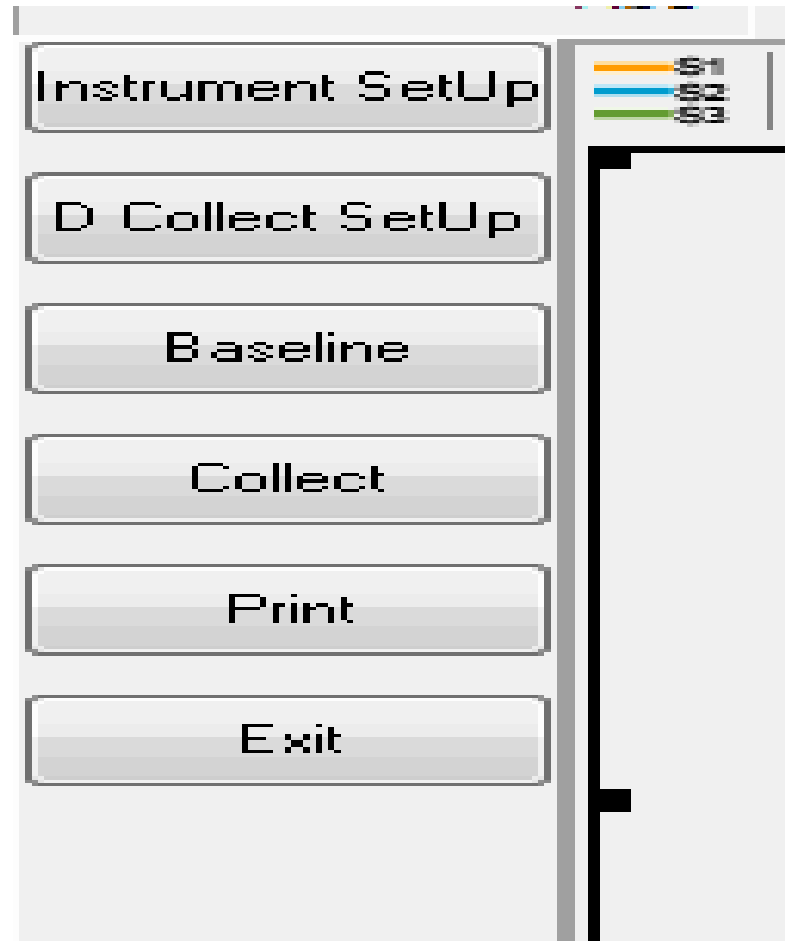
Basic Instrument Parameters used to Collect the Data for the Diffraction Gratings

Wavelength and Angle of Incidence were Read from a Text File (number of data points was determined by the grating measured)

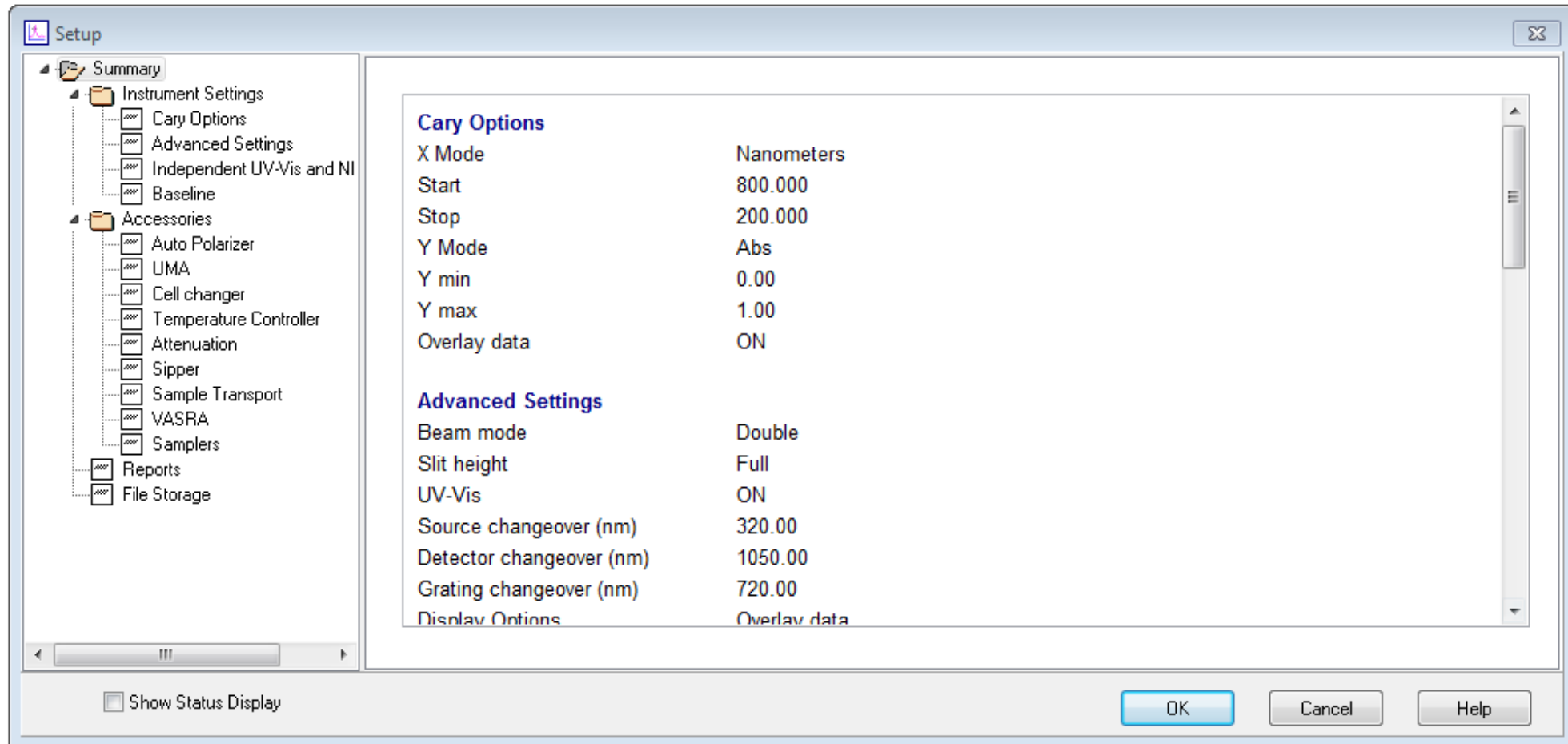
Two Different Data Intervals were used to Demonstrate how to Improve Data Collection Time

Parameter	Value
Angle of incidence	Wavelength-dependent
Detector angle	10°
Wavelength range	250 – 2500 nm
Data interval	10 and 1 nm, respectively
Spectral bandwidth*	2 nm
Signal averaging time	0.5 sec
Polarization	s-and p-polarization
Incident beam aperture	3°x1° (vertical x horizontal)
Baseline correction	On

Initial Screen with Options



After Instrument SetUp Button Pressed



After D Collect SetUp Button Pressed

Data Collection Parameter Entry

Parameters

Detector Angle degrees

☒ Average Polarization

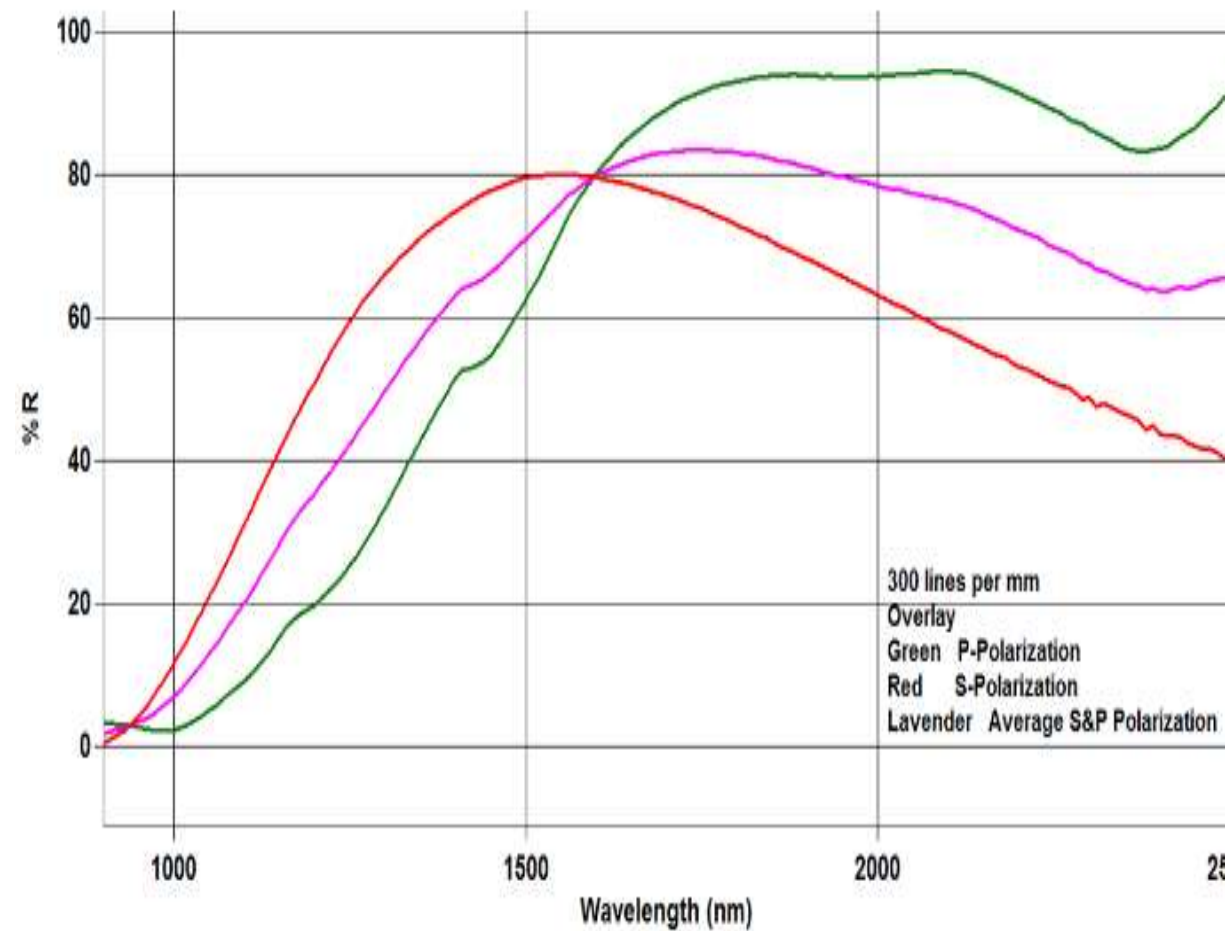
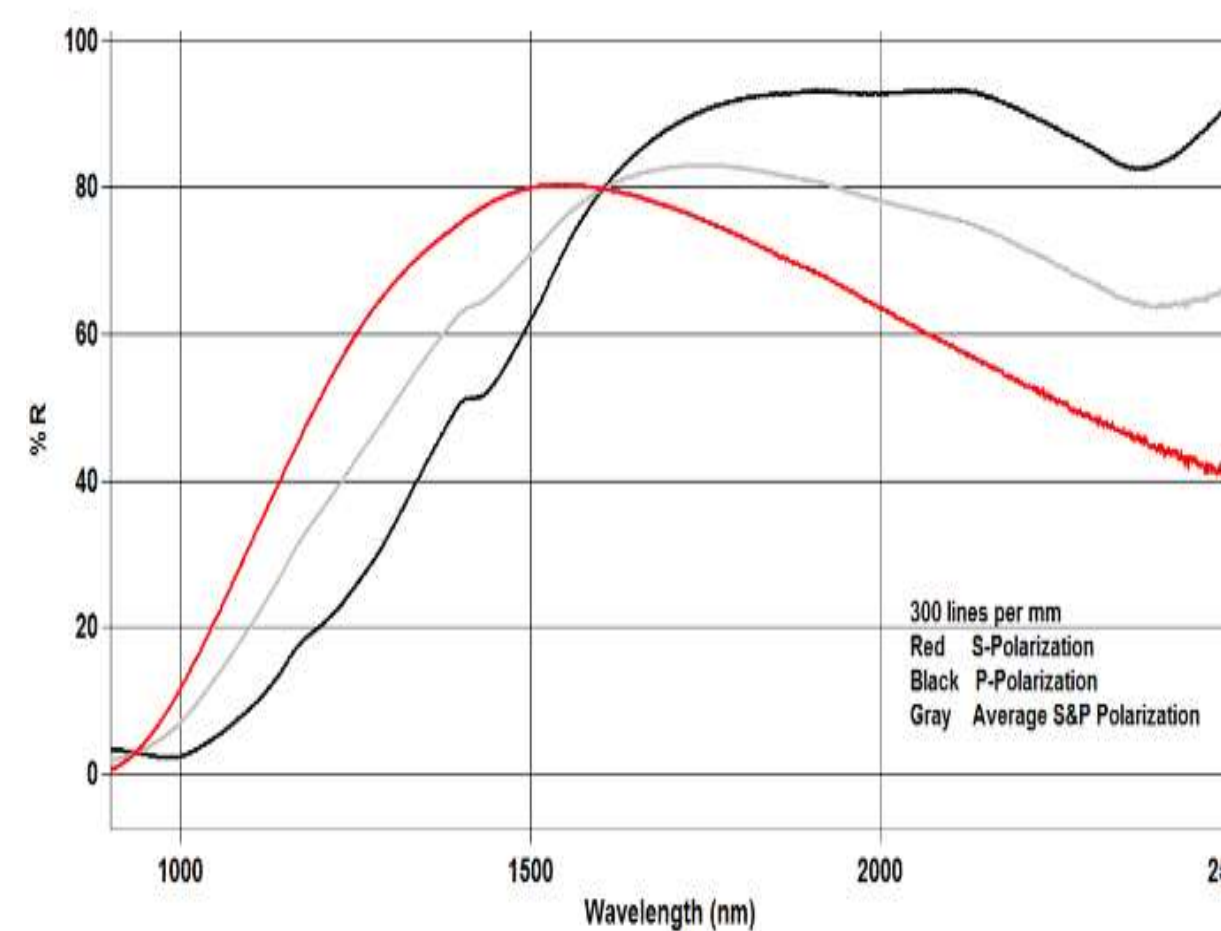
☐ S-Polarization

☐ P-Polarization

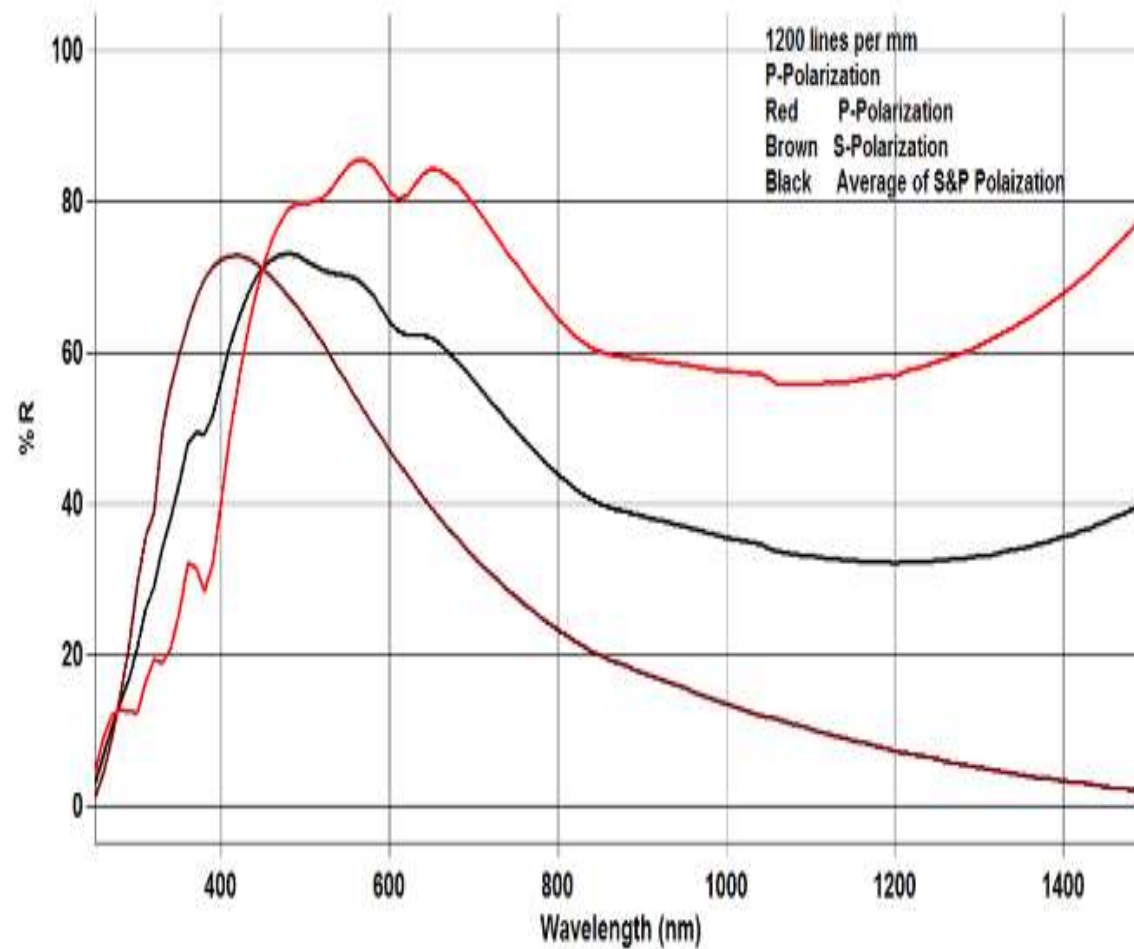
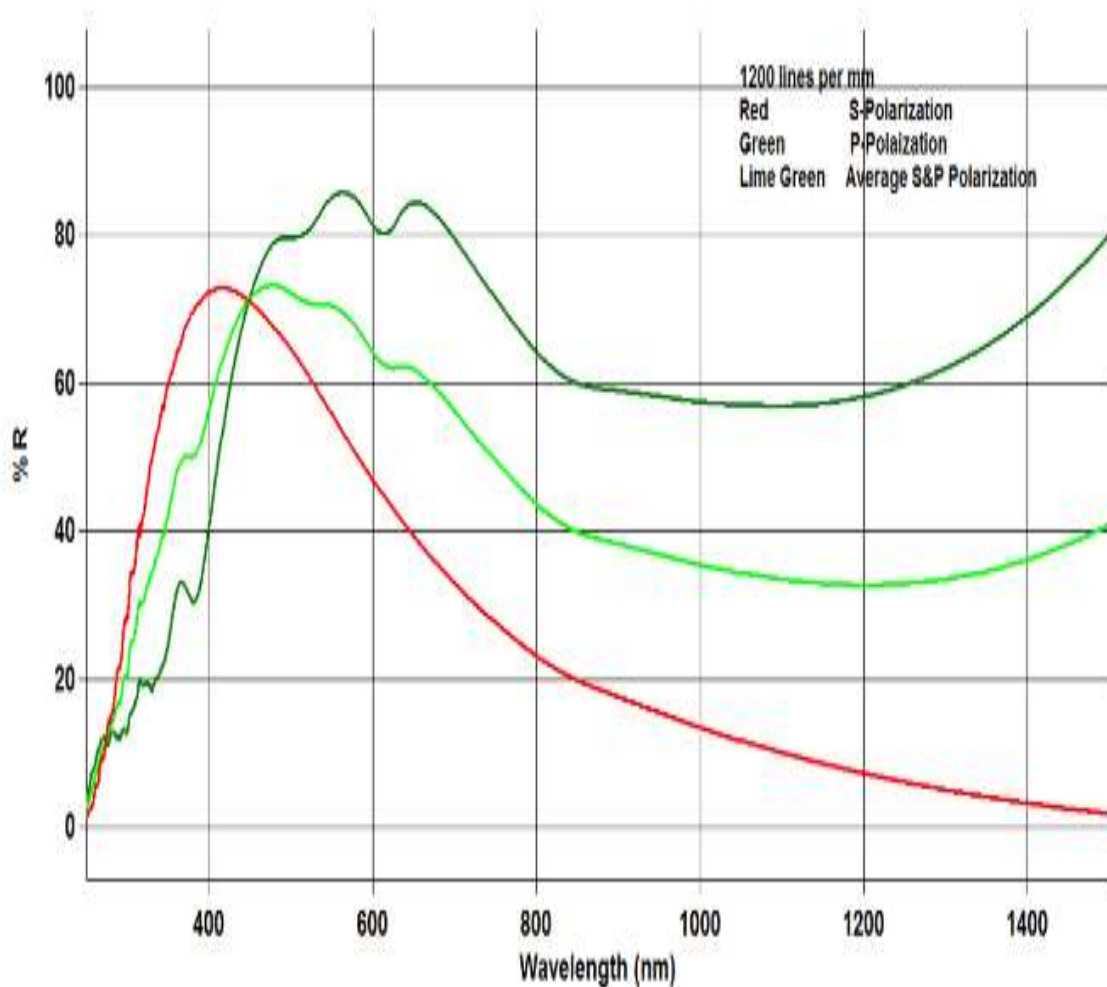
Grating File Path and Name

OK Cancel

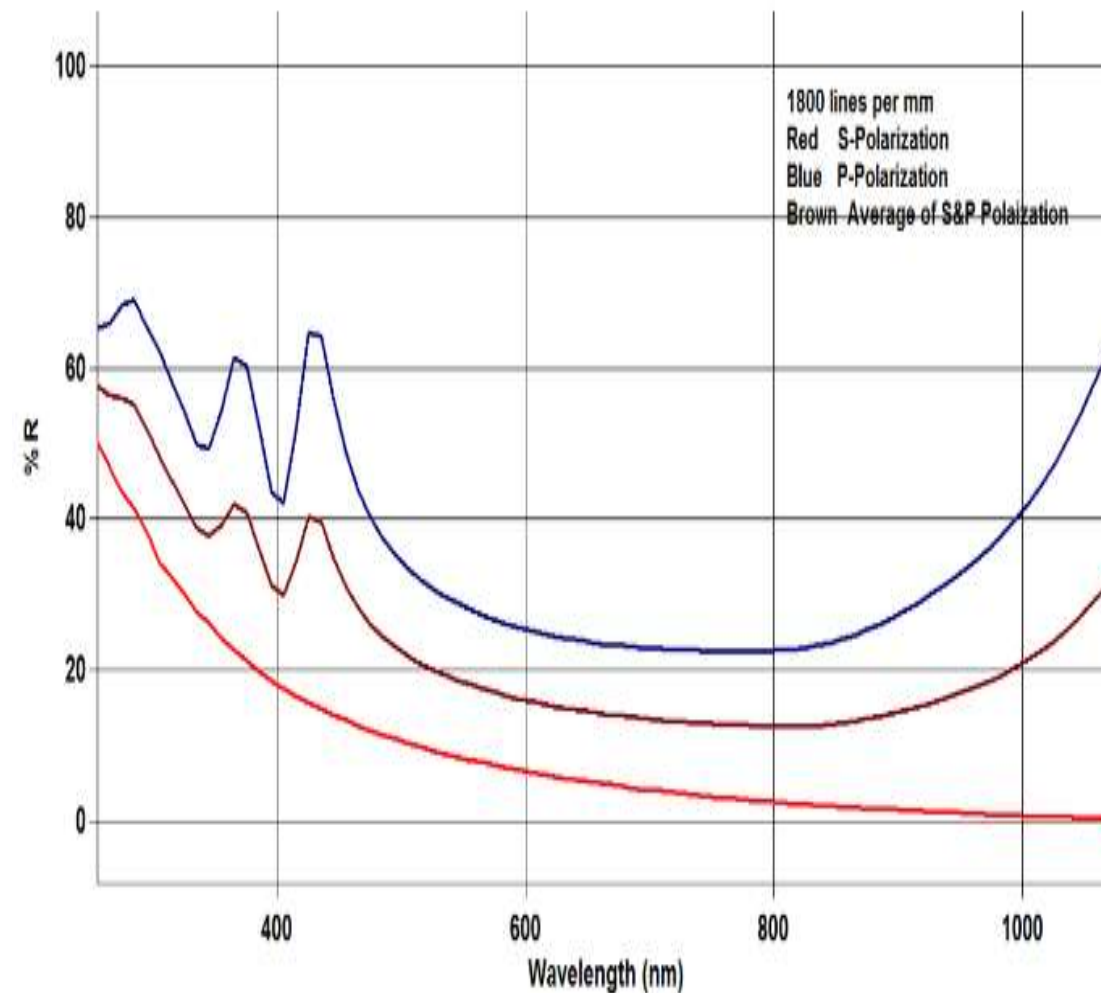
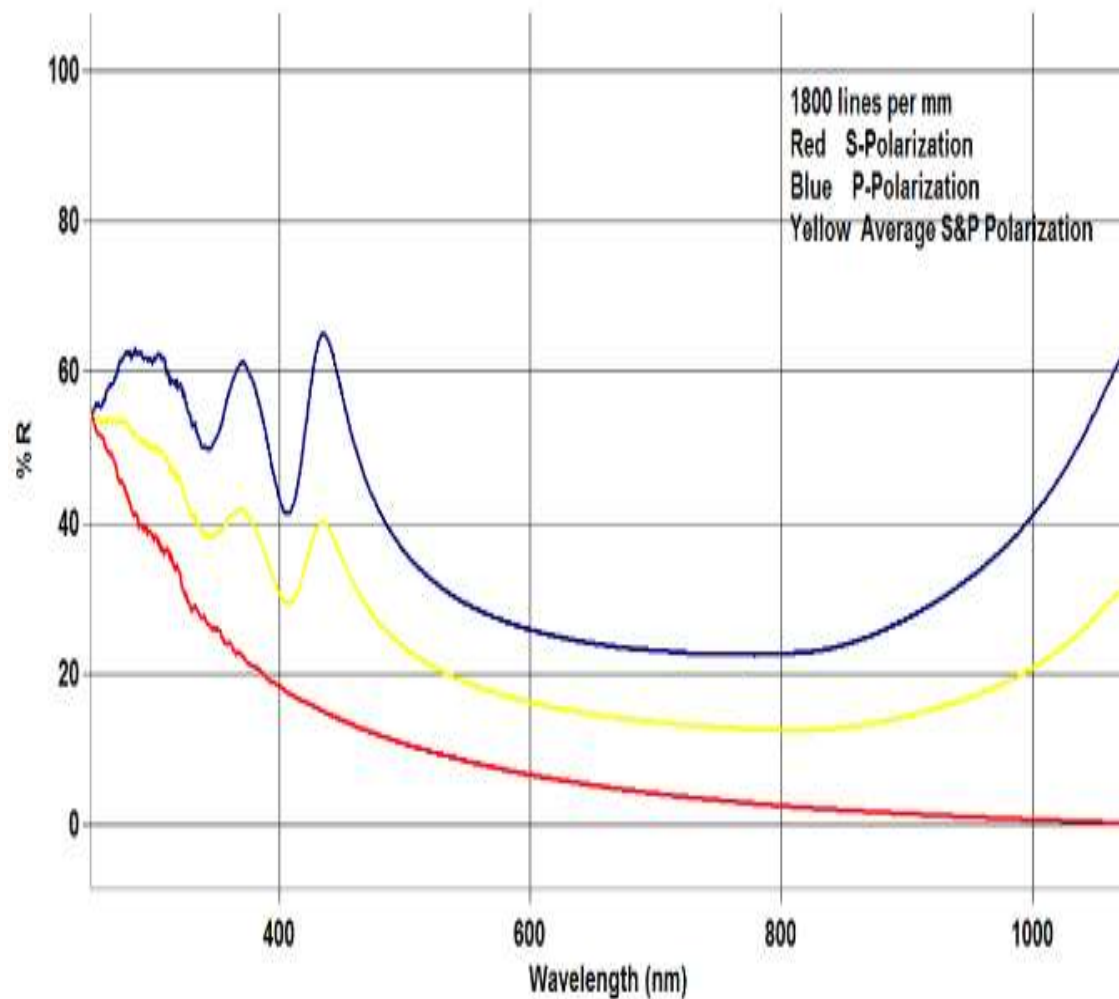
Spectral Results for 300 Lines per mm Gratings



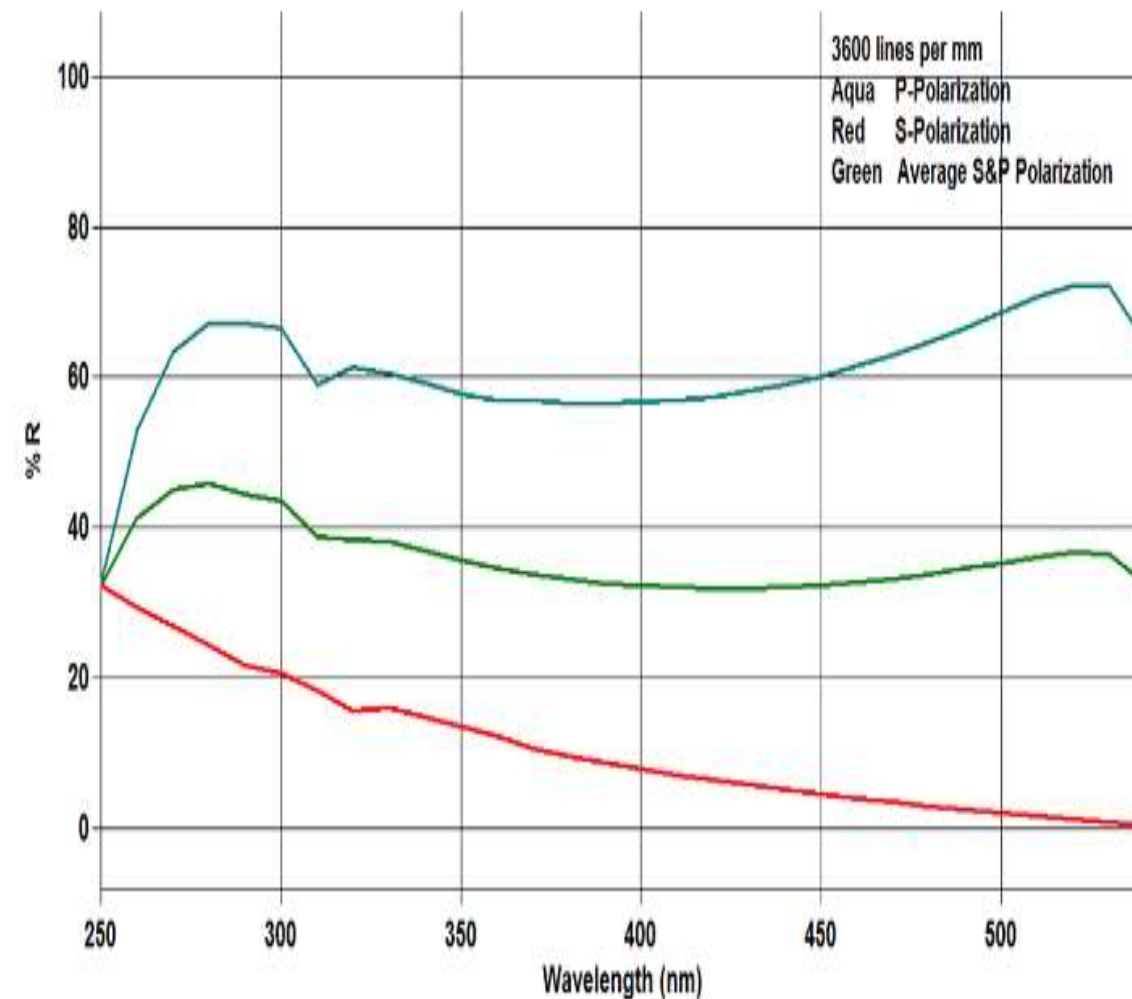
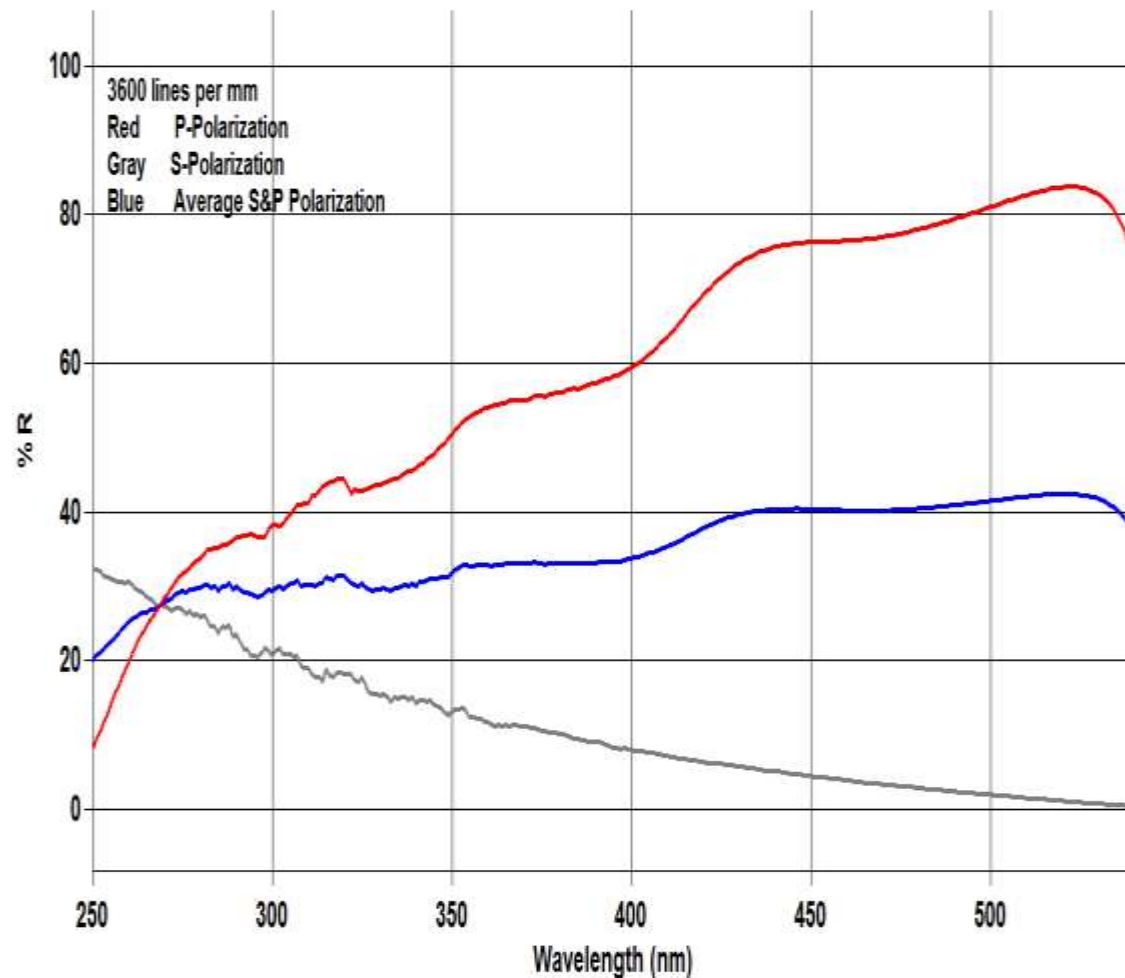
Spectral Results for 1200 Lines per mm Gratings



Spectral Results for 1800 Lines per mm Gratings

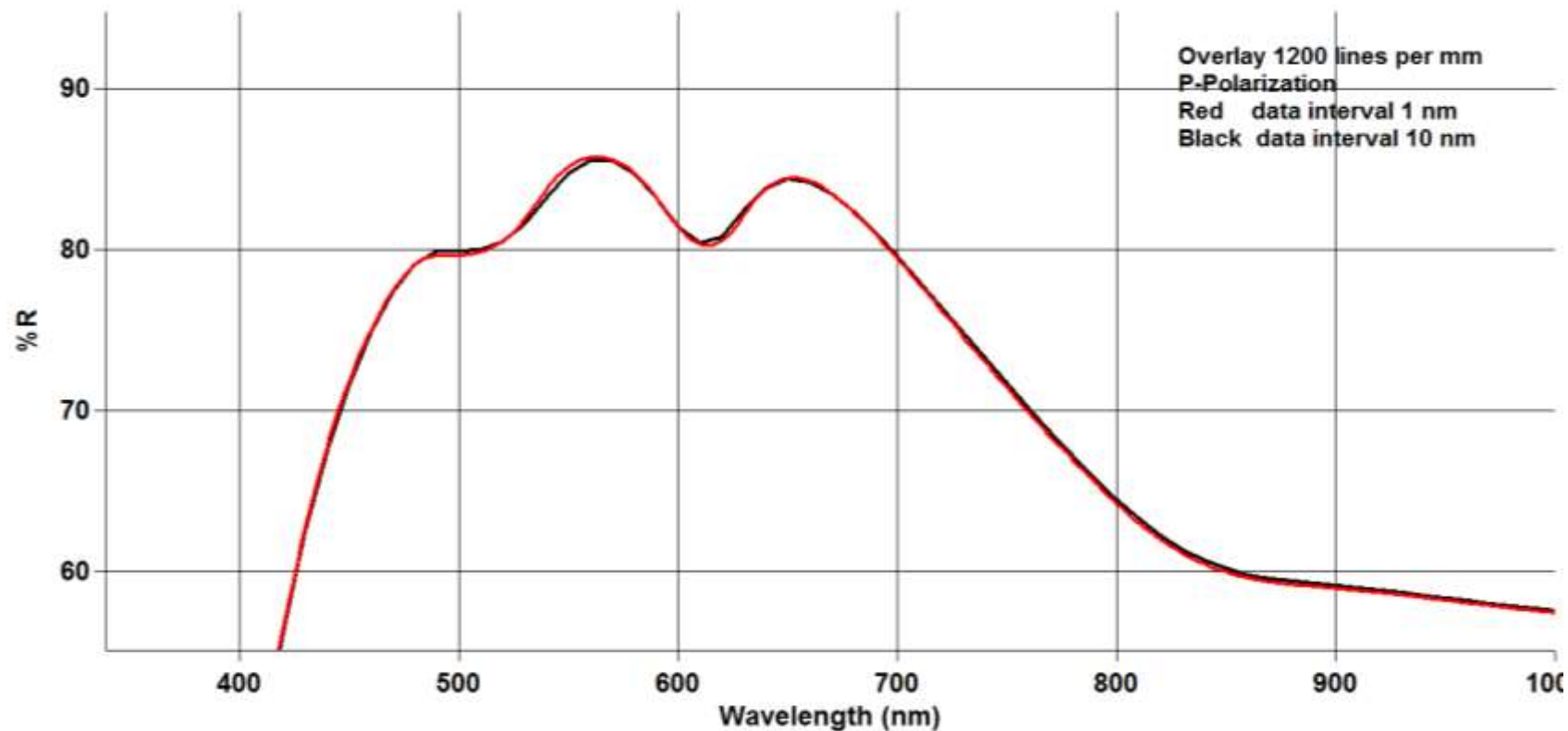


Spectral Results for 3600 Lines per mm Gratings



Overlay of Spectral Results for 1200 lines per mm Grating

Data Interval of 1 nm and 10 nm

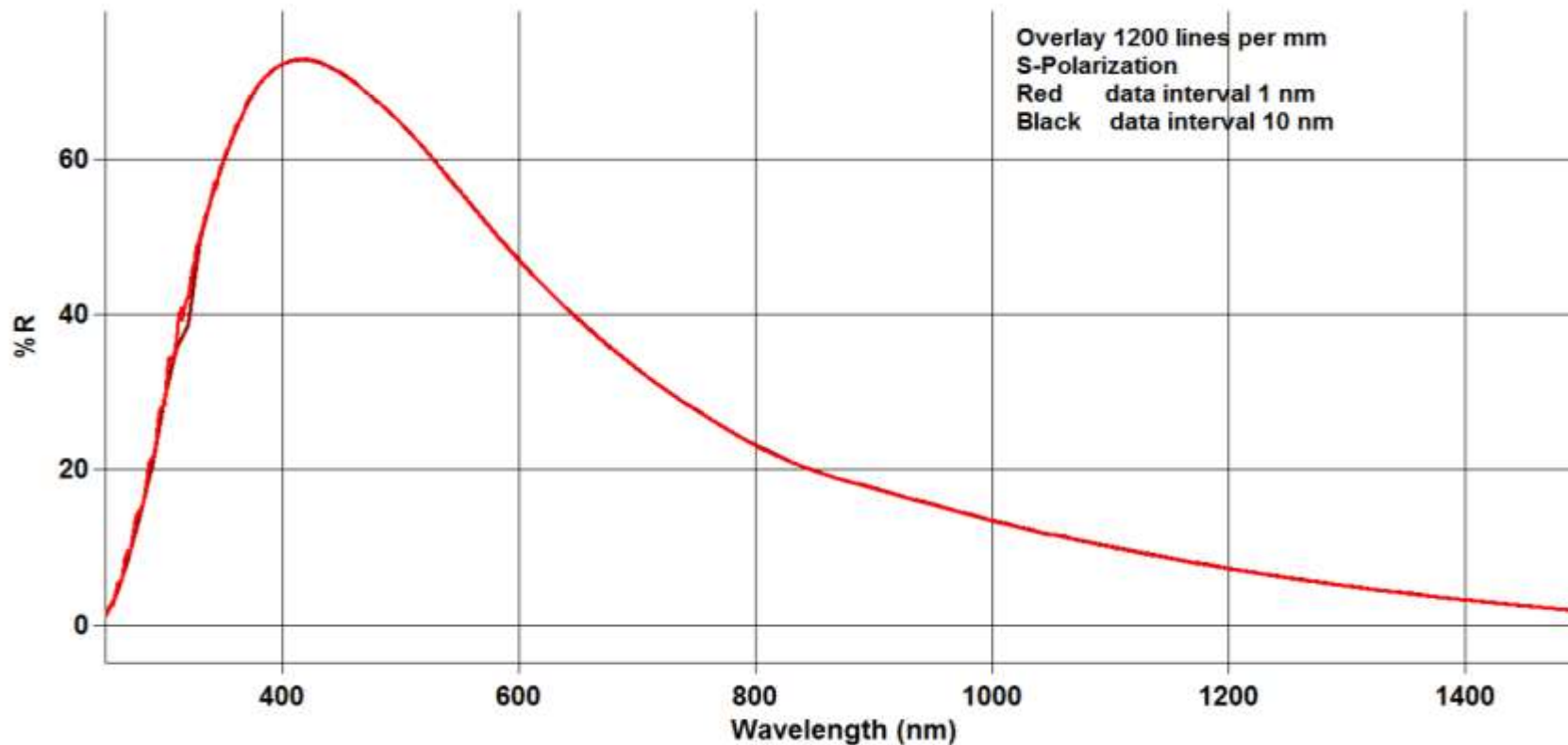


Overlay of P-Polarization Data Interval of 1 nm and 10 nm

Red data interval = 1 nm Black data interval = 10 nm

Overlay of Spectral Results for 1200 lines per mm Grating

Data Interval of 1 nm and 10 nm



Overlay of S-Polarization Data Interval of 1 nm and 10 nm

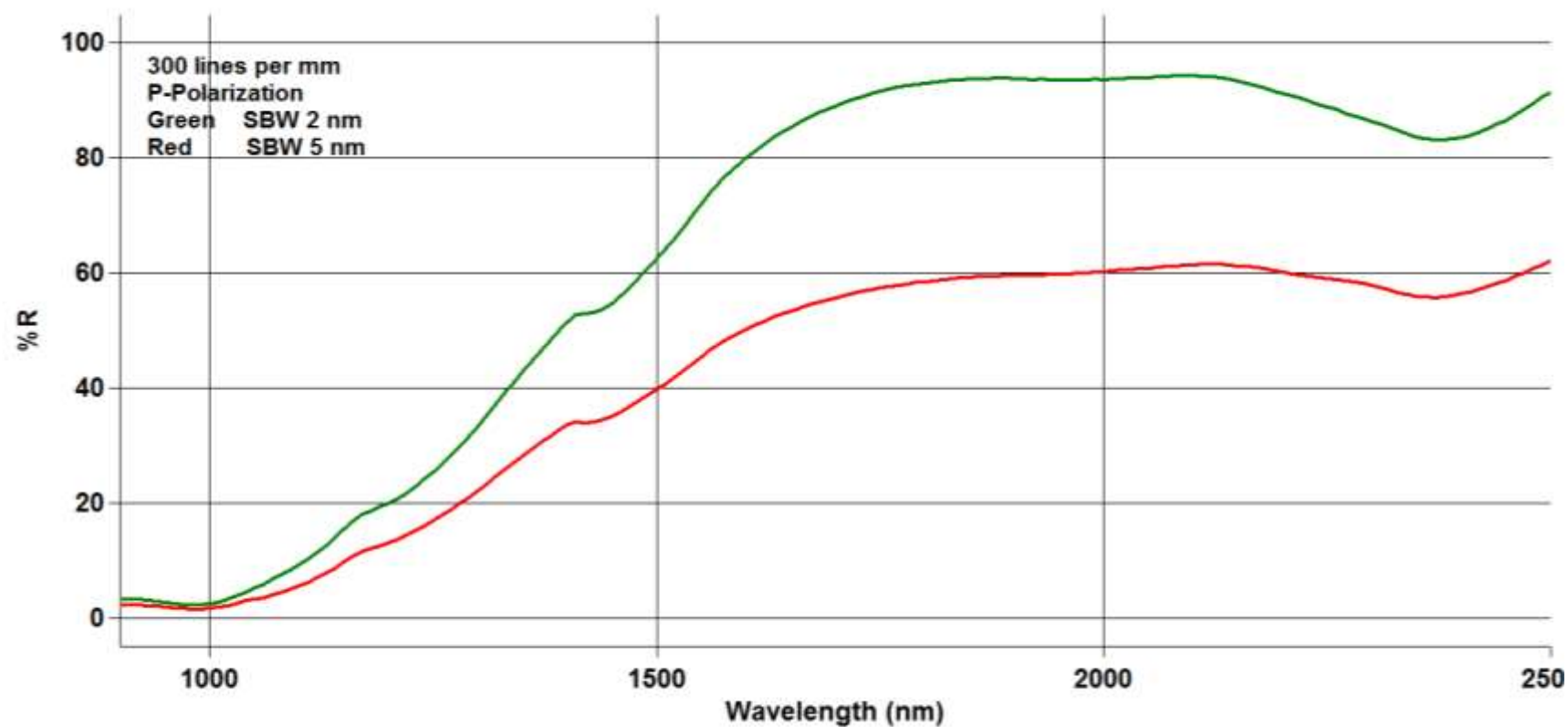
Red data interval = 1 nm Black data interval = 10 nm



Comparison of SBW of 2 nm and 5 nm

Sample 300 lines per mm

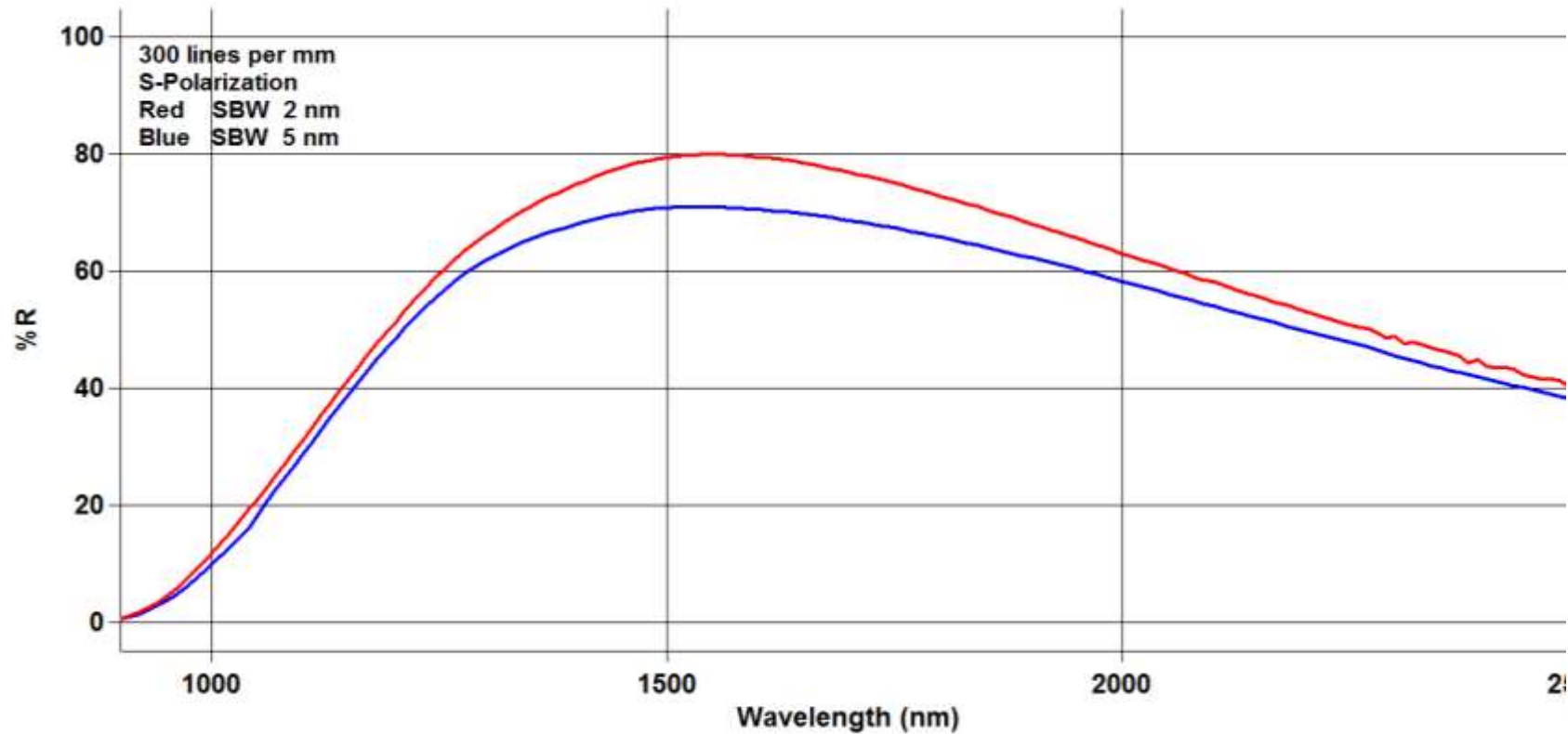
300 lines per mm Grating



Overlay of P-Polarization of SBW 2 nm and SBW 5 nm

Green SBW= 2 nm Red SBW= 5 nm

300 lines per mm Grating



Overlay of S-Polarization of SBW 2 nm and SBW 5 nm

Red SBW= 2 nm Blue SBW= 5 nm

Summary and Conclusions

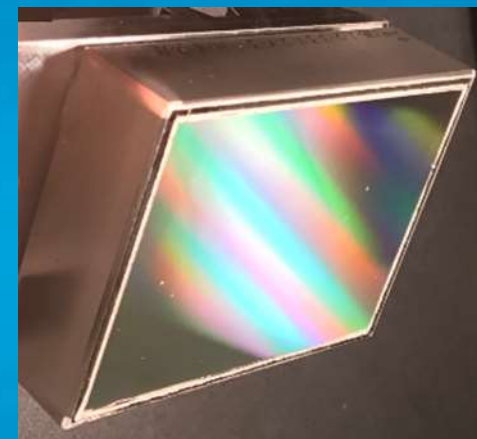
Grating Lines per mm	Data interval = 1 nm		Data interval = 10 nm	
	Total Elapsed Time	Number of Data Points	Total Elapsed Time	Number of Data Points
300	5 hrs 29 min 15 sec	1601	34 min 38 sec	161
1200	4 hrs 21 min 30 sec	1251	28 min 57 sec	126
1800	2 hrs 52 min 50 sec	826	18 min 34 sec	83
3600	1 hr 41 sec	290	7 min 57 sec	29



- The Cary 7000 UMS was demonstrated as a fast and accurate analytic tool for the characterization of diffraction gratings.
- The UMA gives the user the flexibility to characterize gratings either at a given angle of incidence (the sample stage rotates), as shown here, or at a given reflection/transmission angle (the detector moves) depending on the supposed application.
- The complete collect is fully automatic with minimal user interaction and the use of an ADL code increases the measure capabilities of the Cary 7000 UMS.



**Thank You
Questions ?**



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